Energía del Pacífico

Environmental Impact Study
Project: LNG to Power
TOME I

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Glossary

Acronym	Description
AAC	Civil Aviation Authority
ADESCO	Association of Community Development
AIP	Project Influence Area
AMP	Port Maritime Authority
ANDA	National Association of Aqueducts and Sewers- ANDA
AP	Project Area
BM	World Bank
CAMARASAL	Chamber of Commerce and Industry of El Salvador
CAS	Chemical Specialty Service
CCNIS	National Coordinating Council Salvadoran Indigenous
CEL	Hydroelectric Commission for the Lempa River
CEM	Electro Magnetic Fields
CENDEPESCA	Directorate General for Fisheries and Aquaculture Development
CENTA	National Center of Agricultural and Forestry Technology
CEPA	Autonomous Port Executive Commission
CN	National Censuses
CNE	National Energy Council
CNR	National Center of Records
CNSP	National Council of Public Security
COMURES	Corporation of Municipalities of the Republic of El Salvador
CONACYT	National Commission on Science and Technology
CONAMYPE	National Commission of the Micro and Small Business
CONCULTURA	National Council for Culture and Art
CORSATUR	Salvadoran Tourism Corporation
COV	Volatile Organic Compounds
CRETIB	Corrosive, Reactive, Explosive, Toxic, Flammable, Bioinfectious
CSSP	Higher Council of Public Health.

Acronym	Description
CSV	Chamber Valuators of El Salvador
dB(A)	Sound pressure levels measured in decibels on the scale A
DBO	Biochemical Oxygen Demand
DGDR	Directorate-General for Rural Development
DGFCR	General Direction of Forest Management Basins and Irrigations
DGOA	Direction of the Environmental Observatory
DGPC	Directorate-General for Civil Protection, Disaster Prevention and Mitigation
DIGESTYC	General Directorate of Statistics and Censuses
DQO	Chemical Oxygen Demand
DRHM	Regulatory Direction of Hydrocarbons and Mines
US-EPA	Environmental Protection Agency
EDP	Energy of the Pacific
EPP	Personal Protective Equipment
EsIA	Environmental Impact Study
FISDL	Social Investment Fund for Local Development
FOEX	Export Promotion Fund
FONAES	Environmental Fund of El Salvador
FONAVIPO	National Fund for Popular Housing
FSU	Floating Storage Unit
FSRU	Floating Storage and Regasification Unit
FSV	Social Fund for Housing
GEI	Greenhouse Gas
GNL	Liquefied natural gas
IDH	Human Development Index
IFC	International Finance Corporation
ISDEM	alvadoran Institute of Municipal Development
ISS	Salvadoran Institute of Social Security
ISTA	Salvadoran Institute for Agricultural Transformation
ISTU	Salvadoran Institute of Tourism
Kg	Kilograms
LDE	Electrical Distribution Line
LFI	Lower Flammable Limit
LMA	Maximum Limit Acceptable
LMP	Maximum Allowable Limit
LMT	Medium Voltage Line
LNGC	Liquefied Natural Gas Freighter
MAG	Ministry of Agriculture and Livestock

Acronym	Description
MARN	Ministry of Environment and Natural Resources
MIDE	Ministry of Defense
MIGOB	Ministry of Government
MINEC	Ministry of Economy
MINED	Ministry of Education
MINSAL	inistry of Public Health and Social Assistance
MOP	Ministry of Public Works
MTPS	Ministry of Labor and Social Welfare
MW	Mega Watt
MW/h	Mega Watt / hour
NMP	Most Probable Number
NOx	Nitrogen oxides
NO2	Nitrogen dioxide
NSO	Salvadoran Obligatory Standard
OMS	World Health Organization
PA	Acajutla Port
PH	Hydrogen Potential
PMA	Environmental Management Program
PM	Particulate Material
PM10	Articulate material less than 10 microns
PM2.5	Particulate material less than 2.5 microns
PNC	National Civil Police
PNUD	United Nations Development Program
PS	Performance Standard
PTS	Suspended Total Particles
RNPN	National Registry of Natural Persons
SC	Superintendence of Competition
SECULTURA	Secretary of Culture
SIGET	General Superintendence of Electricity and Communications
SNET	National Service of Territorial Studies
TDR	Terms of Reference
TDS	Total Solids
UFC	Colony Forming Unit
UTM	Universal Transverse Mercator

Energía del Pacífico

Environmental Impact Study

Project: LNG to Power

Chapter 1: Title and Authors

ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

DILLON CONSULTING

1 Title y Authors

ENVIRONMENTAL IMPACT ASSESSMENT
PROYECT "LNG TO POWER",
ACAJUTLA, SONSONATE, EL SALVADOR

1.1 Project Owner

ENERGÍA DEL PACÍFICO S.A. DE C.V.

_____
Ing. Alejandro Alle
Legal representative

1.2 Authors

ECO INGENIEROS: RPJSEA 001 y DILLON CONSULTING LIMITED

Table 1.1 presents the authors of the environmental impact assessment registered in MARN, while Table 1.2 contains all the other contributing authors.

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Energía del Pacífico

Environmental Impact Study
Project: LNG to Power
Chapter 2: Executive Summary

ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

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2.0 Executive Summary

2.1 Project Overview

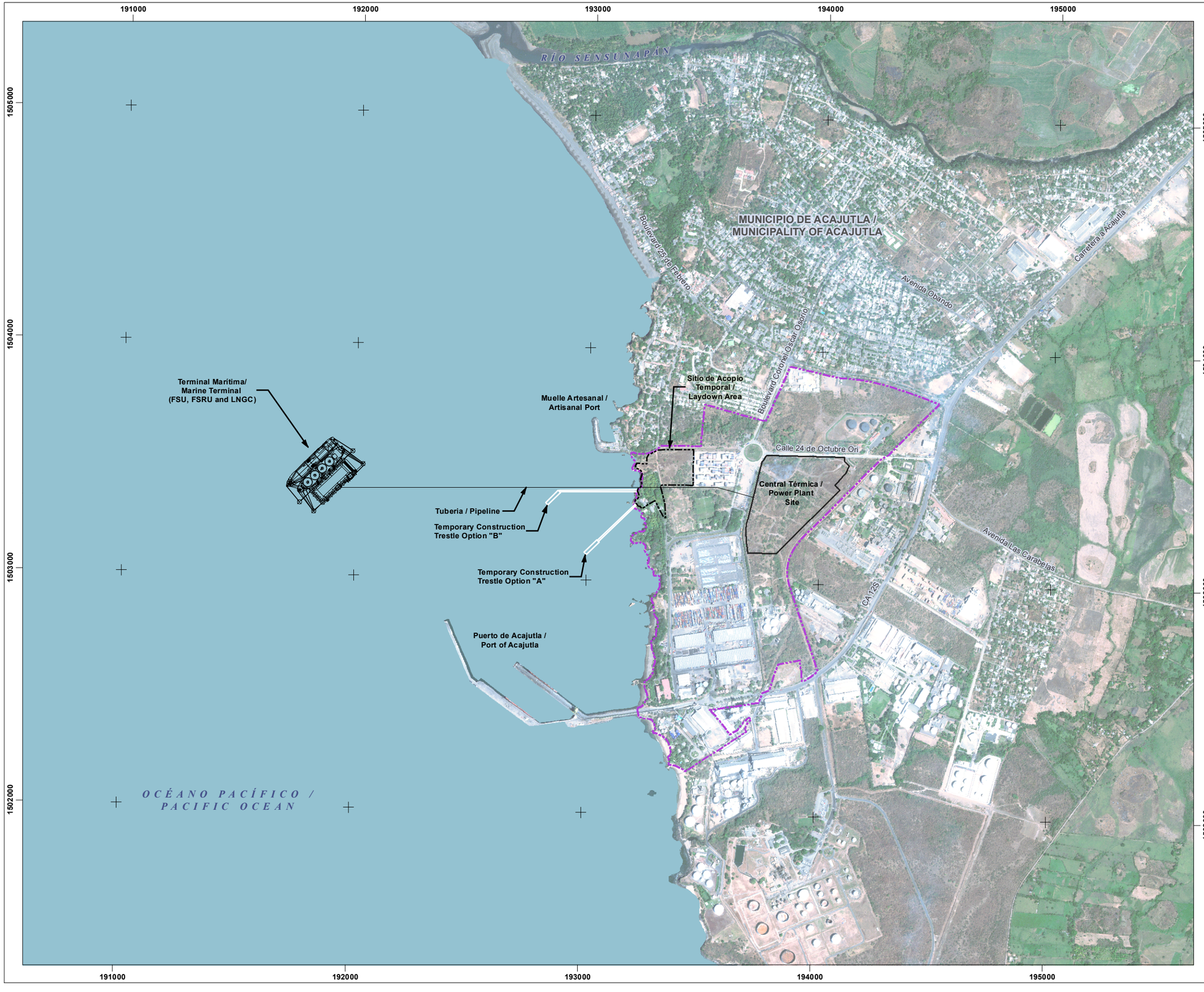
In December 2012 the Distribuidora de Electricidad del Sur, S.A. de C.V. (DELSUR), representing distribution companies in El Salvador, launched a tender for the supply for 20 years up to 355 MW of electricity to a central power plant operating with natural gas, coal and renewable energy.

In response to the tender from DELSUR, the shareholders of Energía del Pacífico S.A. de C.V. (EDP) proposed the "LNG to Power" project that consists of a new power plant to operate on natural gas, which will be installed in the port of Acajutla. In November 2013 the EDP proposal was announced as the winner of the tender option. The LNG TO POWER PROJECT will be located in the industrial area of Acajutla Port. The Figure 2.1 shows the project location.

The key project features, which are shown in Figure 2.1, are:

- Liquid Natural Gas (LNG) TERMINAL for LNG reception, storage, regasification and handling that consists of:
    - An LNG Floating Storage Unit (FSU) that will be semi-permanently moored at the off-shore marine terminal/enclosure;
    - A permanent off-shore marine terminal/enclosure that will be created through the use of cofferdam cells or casissons;
    - A Floating Storage Regasification Unit (FSRU) barge that is to be located within the off-shore marine terminal/enclosure;
- A pipeline to transport the natural gas (NG) from the FSRU to the power plant;
- A tempory construction trestle (about 300 m long) that would extend from the shoreline of the construction laydown area to provide off-shore access during construction. Note that two possible temporary trestle locations are shown in Figure 2.1. Only one location is to be constructed;
- A Combined cycle 378 MW power generation plant consisting of;
    - 19 natural gas-fired reciprocating engines housed within a single power house,
    - A steam turbine that will use steam generated from the waste heat of the engines to generate additional electrical power,

The property to be occupied by the power plant and LNG terminal is located inside land for industrial use from the "Port of Acajutla". During construction one area for laydown for temporary storage, next to the project site will also be used, as shown in Figure 2.1.



Energía del Pacífico

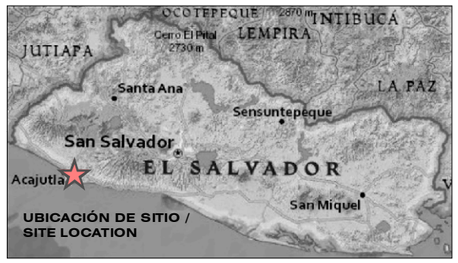
ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

UBICACION DEL PROYECTO / PROJECT LOCATION

FIGURA 2.1 / FIGURE 2.1

- SITIO DEL PROYECTO / PROJECT SITE
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA
- TERRENO PROPIEDA DE CEPA / CEPA PROPERTY



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FUENTE / REFERENCE
VISIÓN DEL MUNDO 2 IMÁGENES DE ALTA RESOLUCIÓN /
WORLDVIEW 2 HIGH RESOLUTION IMAGERY (2014-02-12)

MAPA CREADO POR / MAP CREATED BY: PFM/SFG
MAPA REVISADO POR / MAP CHECKED BY: MW
PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONE 16 WGS84

ARCHIVO / FILE:
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PROYECTO / PROJECT: 163489
ESTADO / STATUS: FINAL / FINAL
FECHA / DATE: 12/5/2016

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ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

2.1.1 Involvement of International Financial Institutions

At the timing of writing, EDP is in the process of confirming the international lender for the project.

2.1.2 EIA Process and Regulatory Framework

This EIA Report contains the results of the EIA process that was completed for the project. The process involved describing the existing social and natural environmental conditions in the Project's area of influence, and assessing the effects that the Project might have on those conditions. The assessment considered project activities covering the complete project life-cycle, including construction, operations, and decommissioning phases. The assessment considered mitigation and management measures to prevent, minimize or compensate for potential negative effects, and optimize benefits. The report also contains monitoring and management plans to be implemented for the Project through construction, operation and decommissioning phases.

This EIA has been prepared to address the relevant legal and regulatory requirements of El Salvador Ministry of Environment and Natural Resources (MARN), IFC's environmental and social Performance Standards including the WBG Environmental Health and Safety Guidelines.

The nomenclature for EIA documentation varies between institutions and agencies and includes "Environmental Impact Statement", "Environmental and Social Impact Assessment", and "Social and Environmental Assessment". For the purposes of this project the term Environmental Impact Assessment, or EIA, is considered to be synonymous with the different terms used by the various environmental agencies and financial institutions that might be engaged in the Project.

2.2 Organization of the EIA Report

The contents of this EIA report has been designed to address the EIA terms of reference (TOR) for the Project issued by MARN on May 28, 2014 (Appendix 2A) and IFC Performance Standards.

Following this introductory chapter, the EIA Report is laid out as follows:

- **Chapter 3- Purpose and Need of the Project:** describes the need for and purpose of the LNG to Power Project;
- **Chapter 4- Description of the Project and its Alternatives:** describes the project location, access, scope, technical regulations for design, construction and operations activities, project features and processes, testing protocols, and project closure and/or abandonment;

- **Chapter 5- Description of the Environmental Conditions:** Physical, Biological and Socio-Economic and Site Area of Influence – describes the area of influence of the Project and the existing social and natural environment conditions in the study area;
- **Chapter 6- Legal and Regulatory Framework:** describes the El Salvador laws and WBG guidelines, regulations and standards applicable to the Project. This chapter includes summary tables indicating the concordance of the Project with the local El Salvador and international WBG requirements;
- **Chapter 7- Identification, Prioritization, Prediction and Quantification of the Potential Environmental Impacts and Risk Situations:** describes the assessment of effects of the Project on the environment, identifies the mitigation proposed and the potential net (or residual) effects resulting from the Project once the proposed mitigation are implemented. This chapter includes the cumulative effects assessment;
- **Chapter 8- Public Consultation and Disclosure (Stakeholder Engagement Plan):** describes the consultation process used for the EIA, the stakeholders engaged, the consultation activities undertaken, summaries of what was heard during the consultation activities, and indication of the concerns and opportunities identified during consultation;
- **Chapter 9- Risk Study and Contingency Plan:** describes the study of the potential natural and technological risks associated with the Project, the magnitude of the risks and the contingency plans to be in place to manage risk; and
- **Chapter 10- Environmental and Social Management Program:** describes the impact management plans and procedures to be implemented during construction, operation and decommissioning phases of the Project, including identification of responsibilities and costs for environmental mitigation and monitoring measures; and;

A breakdown of the contents of each of chapter is provided in the Table of Contents at the beginning of this report.

2.3 Project Alternatives and Project Description

During Project planning the following alternatives ways of carrying out the Project and design optimization studies were undertaken:

- Project site selection
- LNG regasification and storage system,
- Power plant cooling system,
- Power plant water supply system,
- Site layout,
- Construction trestle design and location.

- Marine terminal design
- Natural gas pipeline – including marine to shore transition

Details related to analysis for each of the items above is provided in Chapter 4.1. The description of the Project provided below is based on the preferred design that has been identified as a result of the alternatives analysis and optimization work.

LNG Delivery

Fuel for the Project will be delivered as Liquefied Natural Gas (LNG) using LNG tankers (otherwise known as a Liquid Natural Gas Carrier (LNGC). It is expected that up to approximately 32 ships per year (under the scenario of NG being sold to other users) would bring LNG to the FSU. The operation of the power plant would require only about 8 LNG deliveries per year. The LNG would be stored on the FSU and the FSRU.

Regasification

LNG would be transferred from the FSU to the FSRU barge within the marine enclosure. The FSRU would then regasify the LNG to NG. The regasification facility will run on an on-demand basis to supply natural gas to the power plant. For the regasification process heat is required to vaporize the LNG and it will be provided from sea water. The regasification facility will consist of vaporizers using shell and tube heat exchangers. An NG-pipeline will connect the FSRU and the on-shore power plant.

Figure 2.2 provides an illustration of the off-shore facility including the LNGC, FSU, FSRU and marine terminal enclosure.

Power Plant

The NG from the regasification facility will be used as the fuel for a new, high-efficiency, combined-cycle power plant. The power plant will consist of a power-house containing 19 reciprocating engine generator sets, each of which is capable of generating about 18.3 MW of power. The efficiency of the plant will be enhanced by using heat from the engines' exhaust to generate steam and an additional 30.0 MW of power in a steam turbine. The peak capacity of the plant when running in combined cycle is 378 MW.

Emissions from the power plant stacks will be lower than emissions from oil or coal fired power plants. Power Plant cooling will be a combination of closed-loop air cooled radiators for engine cooling and another closed-loop air cooled radiators for the steam cycle. Due to the close-loop nature of the

system, the Project will have minimal water consumption. Groundwater will be used as the source of water for the Project.

An illustration of the power house, cooling equipment, exhaust stacks, and other related equipment can be seen in Figure 2.3.

Associated Facilities

The separate but closely related 230 kV Transmission Line Project will be built to interconnect the Project with the national electrical grid. The Transmission Line Project will be subject to a separate Environmental Impact Assessment.

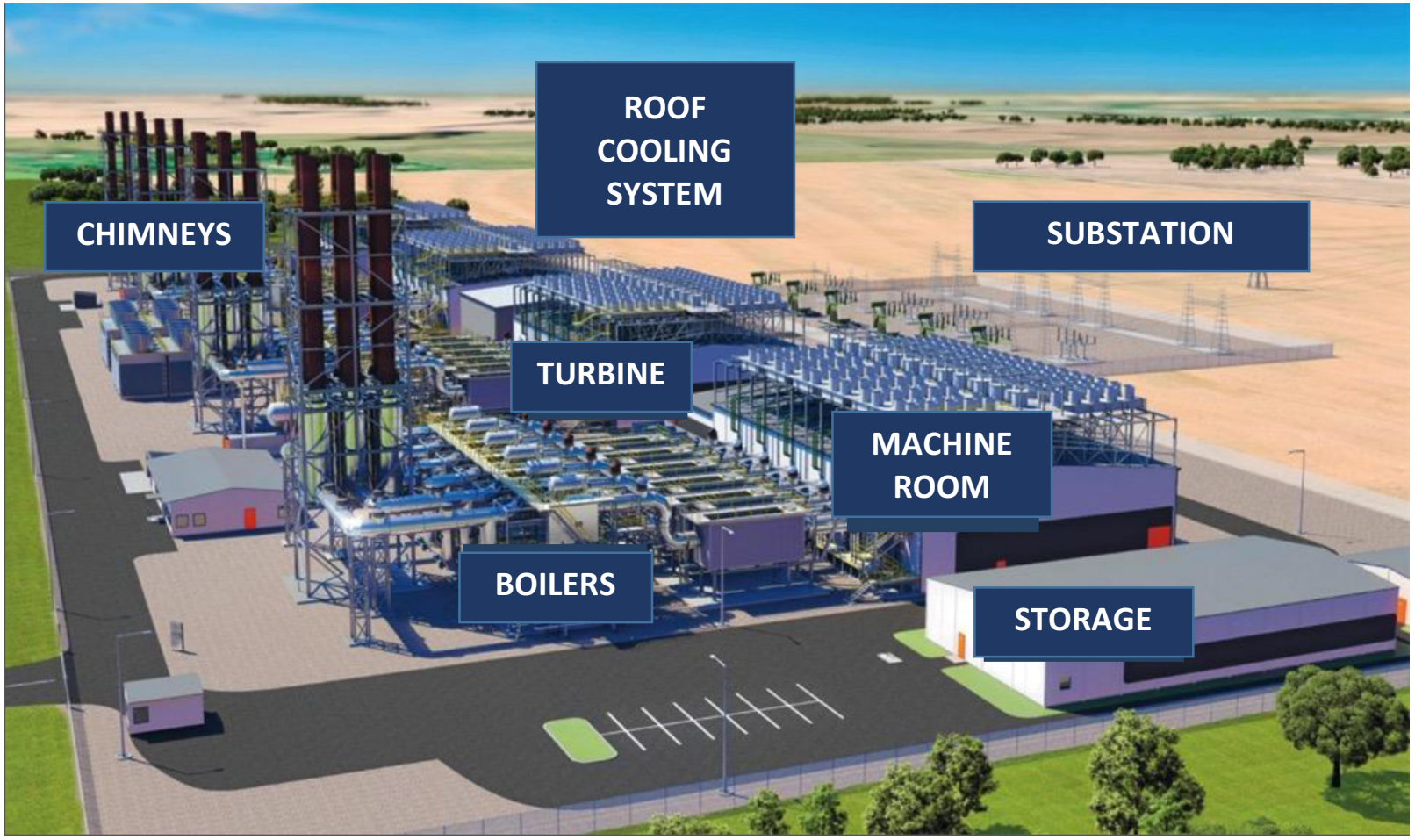
Construction and Operation Schedule and Work Force

Construction is expected to begin in 2016 and take approximately 3 years. With the appropriate maintenance and repairs, the plant will be able to operate for several decades. It is expected that there will be approximately 100 permanent employees required for operations. The number of employees needed for construction will vary according to the construction activities - at the peak of activities the number of workers is expected to be about 1,500 persons.

Figure 2.2 – LNGC, FSU, FSU, FSRU and Marine Enclosure Illustration

Source: Wärtsila

Figure 2.3 – Power Plant Illustration



Source: Wärtsila

2.4 Environment in the Area of Influence

2.4.1 Project Area of Influence

Table 2.1 summarizes the area of influence for the Project according to the project area of influence definition provided in IFC's Performance Standards. Effects on the Project site, as well as indirect effects, cumulative impacts, and the effects of unplanned but predictable developments are addressed in this EIA report. Effects associated with associated facilities are addressed in a separate EIA Report being prepared for the closely related LNG to Power 230 kV Transmission Line Project.

Table 2.1 – Area of Influence for LNG to Power Project
A(i) Project Activities and Facilities
1. Land and sea areas permanently occupied by FSU, FSRU, marine enclosure, pipeline, and power plant site
2. Land area temporarily occupied for Lay-down area
3. Sea area temporarily occupied for the construction trestle
4. Off-shore dredge sediment disposal location
5. Off-site facilities and infrastructure that will be utilized by the project (quarries providing fill, disposal areas for waste soils, waste disposal facilities, access roads)
A(ii) Unplanned but Predictable Developments caused by the project
1. No significant unplanned but predictable developments are foreseen
A(iii) Indirect Project Impacts on Biodiversity or on Ecosystem Services
1. Potential effect of trestle, FSRU/FSU terminal, and marine activities on local fisheries resources and activities (fin-fish and shell-fish)
B. Associated Facilities
1. LNG to Power Transmission Line Project area of influence set out in a separate EIA.
C. Cumulative Impacts
1. Cumulative effects on air quality and noise considering existing power plant and other local sources of air and noise emissions
2. Incremental effects on land, water, marine conditions considering previous, planned, and reasonably defined industrial development of the port and port area lands

2.4.2 Existing Conditions

The project is located within the property of the current Port of Acajutla in an industrial area affected by the activities of the port. It is located in the municipality of Acajutla, Department of Sonsonate.

2.4.2.1 Physical Environment

The climate of the municipality of Acajutla within which the project is located, is characterized as warm as it is located on the western coastal plain of the department of Sonsonate, with temperatures

between 27 ° to 40 ° C, relative humidity between 67% and 70% and average rainfall between 1.400 to 1.700 mm per year.

The area has relatively high levels of air pollutants, primarily particulate matter, according to measurements taken. Noise measurements were also performed, finding high levels of noise, compared with World Bank guidelines.

The Project is located in the geomorphological unit known as Coastal Plain, characterized by land slopes between 0% and 7%. The land where the project is located, are formed by volcanic rocks belonging to the Tertiary period, mainly tuffs and pyroclastics. The natural foundation of clusters that make up this, make it one of the most stable material for compaction, to which is added the large thickness of the horizon, only noticeable from the coastline, which sometimes reaches 30 m without being able to define its depth below sea level. According to all analyzes performed during geotechnical studies, land is suitable to withstand the expected loads and meet the structural demands of the project. Due to the geology of the area, the soils have low permeability; however groundwater can still be located on the project site through the development of deep wells.

Soils in the area are class IV, with low or moderate fertility, and regosols and halomorphic soils. In the land where the project will be developed there are no rivers or other water bodies that pass through it, the soil drains into a channel of the port; this gutter drain the project property and also drains industries in the area.

The wells drilled in the area are aquifers located in materials of “Balsamo” Formation. The depth of the water found in the nearest wells drilled is between 24 and 30 meters. Acajutla aquifer has good yields and it is anticipated that will be able to supply water for the project with the drilling of a deep well. In analyzes performed in wells in the area, saline intrusion has not been detected, presenting good water quality.

The marine environment in the vicinity of the marine terminal is subject to higher turbidity levels during periods of heavy outflow of area rivers including the Rio Sensunapan, Rio Barranca, and El Sunza, particularly during the rainy season. Water samples in the area indicated that sediment levels can be around 180mg/l up to 300 mg/l.

Marine sediment samples in the larger area were collected and analyzed for chemical concentrations. A total of 29 sediment samples were collected and analyzed. Based on this analysis, it was determined that the concentrations of all sediment target analytes were much lower than their respective criteria.

These results suggest that adverse biological effects would not be expected in the project area as a result of the sediment metal and metalloid concentrations.

2.4.2.2 Biological Environment Terrestrial

Tree species on the site represent a transition from dry to hot / humid tropical forest, with species such as morro (*Crescentia alata*), zarzo blanco (*Acacia colinsii*), zarzo (*Machaeriumbiovulatum*), zarzo Espino (*polyphylla Acacia*), pie de venado (*Bauhiniaungulata*), casco de venado (B*auhiniaaculeata*), among others. Altogether a total of 96 species of flora, of which 37 are arboreal type and 56 shrubby and herbaceous type were recorded. In the route of the pipeline are CEPA gardens with mangoes and coconuts.

Two species of trees categorized as “Threatened” by MARN were identified in the power plant site: *Sterculia apetala* and *Maclura tinctoria* commonly known as "castaño" and "palo de mora" respectively. In addition *Dalbergia chontalensis,* was identified on the property, a shrub which is categorized as an “Endangered” species.

In the pipeline Right of Way, the shrub species Avellana (*Caesalpinia bonduc)* was identified, also a threatened species. In the construction laydown area, there were two species of trees identified as “Threatened” by MARN including: Conacaste Blanco (*Albizia niopoides)* and Guachipilin (*Dyphysa Americana*) and one shrub species *Dalbergia chontalensis Standl. & L.O. Williams*.

With regard to wildlife, a total of 16 species of herpetofauna (1 amphibians and 15 reptiles) were observed within the project area, of which five are categorized as "threatened" by the MARN; Garrobo (*Ctenosauria similis*), Iguana verde (*Iguana iguana*), falso coral (*Lampropeltis triangulum*), Víbora castellana (*Porthidium ophryomegas*) and Bejuquilla de cabeza verde (*Leptodrymus pulcherrimus*), and one categorized as "least concern" by the IUCN (common name: common toad).

Fifty-three (53) species of birds and a total of 7 active nests were identified; one of the birds identified in the project area are considered threatened according to the list of MARN: Catalnica (*Brotogeris jugularis*). All bird species identified were classified as "least concern" by the IUCN. Of the birds that nest in place, all are considered resident species and typically build their nests in the same place a year or similar sites. The most common bird species observed on site was the brown pelican (resident). Most of the identified avifauna are considered generalists and are tolerant to anthropogenic influences. Mammals identified within the project area are characterized as domestic fauna (ie, cat, mouse and rat) and 8 species of wild animals (eg, rabbit, skunks, squirrels, opossums and raccoons). All mammals

observed within the project area are considered Least Concern or Data Deficient with IUCN and are not considered threatened or endangered by the MARN.

With regard to marine wildlife, habitat within the proposed area is mainly composed of silt, sand, rock and some coral reefs south of the pier near the pier existing CEPA. This habitat provides an ideal combination of micro-habitat for a wide variety of marine life including sessile: coral benthic invertebrates, eggs, larvae and juvenile fish (ECO, 2014). Marine life (such as adult fish, mammals and sea turtles) will be minimally affected because the habitat is not considered critical to their life history requirements, these animals moves throughout the area. Turtle nesting habitats are not affected.

In the area of the temporary construction trestle, the existing substrate is dominated by rock coverage there are also areas of mixed substrate, one sub area had a higher percentage of aquatic grasses observed, while the other had a higher percentage of green algae. On the beach anemones and zoantharians observed in the crevices of the rock. In shallow rocks and higher altitudes more evidence of algae were found, observed at depths of 5-7 meters. The bedrock in this sector is not presented continuously in the seabed, there are small promontories surrounded by sandy areas. However, the octocoral group presence in this environment makes this enviroment different compared to the shore bedrock. The animals in this sector are subject to constant degradation impacted by fishing gear like lobster nets.

A variety of 34 species of fish that are part of 20 families were identified, the majority of them of marine habitats associated with rocky reefs. The high diversity of species found in the study area, demonstrates the ecological importance of that this ecosystem has, as rocky reefs serve as breeding sites and spawning, breeding and care of many species of mollusc fish and crustaceans with ecological and economic importance, consistent with local fishermen who claim that most recorded species are used for trade and consumption.

The two groups of mammals that can inhabit or circular in tropical areas, such as El Salvador, are cetaceans and pinnipeds; it is important to mention that during periods of dry season between the second week of December each year and January, humpback whales (*Megaptera novaeangliae*) in the category of Threatened (MARN 2009) are sighted and specifically in the port of Acajutla sea lions (*Zalophus californienensis*) been accidentally captured. Regarding oysters, oyster banks were found in rocky areas but with reduced sizes.

2.4.2.3 Socioeconomic and Cultural Environment

The project site is located within the Port of Acajutla property, with industry intended use, in the city of Acajutla. The land is surrounded by industrial plants, warehouses, storage, and land for industrial use, and within land owned by CEPA. The current use of the land is vacant, there is no need to relocate

people. The laydown area and pipeline Right of Way are largely undeveloped with the exception of where they overlap with the Malecon Waterfront Park that is located on CEPA lands and was developed by CEPA in 2015. The pipeline will also pass next to a CEPA recreational area (sports field), with restricted access.

Acajutla, where the project is located, is one of 16 municipalities in the Department of Sonsonate. Acajutla is 19 kilometers away from the head of the Department of Sonsonate and 84 kilometers from the capital city of San Salvador. For 2007, the city recorded a total of 52.359 inhabitants, 51.8% of them / as are located in rural areas and 48.2% in urban areas. The Human Development Index of Acajutla in 2009 was 0.717, a result that placed it in 58th position nationally (HDI 0.735). The adult literacy rate (15+) recorded in 2007 was 77.9%, which means that more than one fifth of the adult population (22.1%) could not read or write.

The predominant economic activity is trade, followed by services and industry, although services are those that produce more jobs. Installation of construction camps are not foreseen considering the easy access from the capital city and surrounding areas. In the marine terminal area there are fishing activities that could be affected, including increased travel to fishing areas, and areas for fishing lobster, oysters and fish were identified; although the latter are within the restricted area of the Port.

Access to the project is a primary road that leads to San Salvador, access to the project can be done without affecting residential areas. The city has basic services, which include waste collection and electricity. Within the project site, there is no existing wastewater management and disposal system or potable water supply.

With regards to the the landscape and views, the prevailing views are very similar to the project facilities, including the view of the current dock.

2.5 Stakeholder Engagement

Stakeholders were engaged throughout the EIA process. Engagement activities completed included:

- Opening and maintaining a public information center in Acajutla;
- Establishing a project web-page;
- Targeted stakeholder meetings and focus group workshops, including with local fishers; and,
- The holding of two public meetings to present the draft results of the EIA.

Key concerns and comments that arose from the engagement activities are:

- Interest in employment opportunities and economic benefits;
- Concern for impact to artisanal fishing activities;
- Concern for nuisance dust during the construction phase;
- Concern for noise, including low-frequency induced sound/vibration; and,
- Concern for effects on local air quality.

Details of the stakeholder engagement program and findings are provided in Chapter 8 of the EIA Report.

2.6 Risk Study and Contingency Plan

A quantitative risk assessment (QRA) for the project has been completed, evaluating items such as process risk, navigation, location, earthquakes, heavy rains and anthropic threats in project location, which could trigger events such as fires and explosions, within the project and affect the facilities themselves and surrounding area. The QRA concluded that based on the risk acceptance criteria, the public and the environment are not exposed to unacceptable risk. Preventive measures to minimize the risks, included in the environmental management plan, have been identified.

A concept level Contingency Plan has been prepared that outlines the content of a future more detailed Contingency Plan that is to be developed as part of project detailed design. This concept level plan specifically outlines risk events that are to be considered in the detailed Contingency Plan.

2.7 Impacts and Environmental Measures

The EIA undertook a comprehensive process to identify and analyse potentially significant effects, considering proven and effective management measures that are available to mitigate negative effects, and presents a comprehensive impact management and monitoring framework. The following summarizes the potential key impacts of the project that were identified through this EIA.

Construction Impacts

- Air quality and noise disruption effects from operation of construction equipment;
- Increase in construction vehicles on local roadways and public safety risk from general construction activities;
- Removal of vegetation and habitat within the construction laydown area, pipeline corridor and power house site;
- Potential for increased sediment loadings from construction site run-off;
- Potential for spills of hazardous materials including fuel and lubricants;
- Project lighting effects on wildlife/marine species;
- Temporary increase in sediment levels in the marine environment from sediment dredging and disposal;
- Removal of aquatic habitat and disturbance of nearby habitat;
- Potential groundwater draw down from use;
- Potential local social impacts from job-seeker in-flux;
- Boater and fisher access restriction around off-shore project components; and
- Economic benefits to the local community through employment and service contract opportunities.

Operation Impacts

- Air and noise emissions from the project will be within applicable criteria;
- Project lighting effects on wildlife/marine species;
- Boater and fisher access restriction around off-shore project components;
- Cold and warm water discharge in the marine environment - discharge will not exceed a delta of 5 degrees Celsius;
- Project lighting effects on wildlife/marine species;
- Potential groundwater draw down from use;
- Creation of new marine habitat opportunities; and
- Economic benefits to the local community through employment and service contract opportunities.

Table 2.2 provides an overview of the identified impacts, both positive and negative; proposed mitigation measures for each impact and presents the environmental management program for the construction phase, with a cost of $941,764.88. Table 2.3 presents the monitoring program for the construction and Table 2.4 the implementation schedule for environmental measures.

Likewise, Tables 2.5, 2.6 and 2.7 present the Environmental Management Program, monitoring and implementation schedule for the operation phase, respectively. The cost of environmental management program in the operation stage is $ 234,307.80.

Table 2.2 – Environmental Management Program, Construction Phase

Execution Phase	Project Activity	Description of Generated Environmental Impact	Environmental Measure (Prevention, Attenuation, Compensation)	Description of Proposed Measure	Location of the Environmental Measure	Responsible for its execution	Calculated Amount of Environmental Measure	Time of execution	Expected result
Site Preparation, Construction and Closing	• Operation of stationary generators • Operation of the mobile motorized equipment • Cutting and logging • Excavation work • General construction activities • Construction related to traffic	• Exposure of workers and the public to the emission of air pollutants • GHG emissions	**Attenuation** ***1.* Reduction of air emissions**	Develop a Maintenance Plan that considers: • Maintenance program, • Control / monitoring system • Location of stationary generators 50 m from the northern boundary of the site • Anti-shutdown protocol • Use of buses to transport workers from outside Acajutla to the site from the main cities	Project site area and transport and haul routes	EDP	$2,000.00	During construction	No significant impact on air quality and the reduction of emissions of greenhouse gases from the transport of workers
Site Preparation, Construction and Closing	• Clearance • Excavation works • General construction activities • Traffic related to construction	• Migration of dust emissions to off-site receptors	**Prevention** **2. Dust management plan**	Dust Management Plan including: • Irrigation of water in internal streets of the project during dry season • Site exit control (wheel washing, surface hardening) • Stabilize storage areas • Speed limits on internal roads • Truck covers	Project site, temporary storage site, main transport routes and material haulage	EDP	$54,012.00	During construction	Prevent short-term dust increase in the vicinity of the site
Site Preparation, Construction and Closing	• Construction of piles (on land) • Earthworks • Construction, use of equipment • Concrete plant	• Disturbing noises for surrounding communities and residents	**Attenuation** **3. Noise management during construction**	Develop a Noise Management Plan that considers: • Type, number and location of the piles; • Use of low noise techniques for piles, if feasible (ex: vibratory piles, pressure piles) • Schedules for excavation of piles and operation of the concrete plant. • Schedule for use of primary routes and for hauling of materials	Project Site, Temporary Collection Site, and route of construction materials	EDP	$1,000.00	Duration of construction activities, in particular pile driving.	Short-term annoying noises at a project site radius during daylight hours.
Site Preparation, Construction and Closing	• Cut and logging • Earthworks • Construction activities in general (on land)	• Loss of fertile soil/soil layers • Possible effects on flora and marine fauna for sediments entering the marine waters as a result of erosion of materials on land • Offsite flooding as a result of peak events for running surface waters	**Attenuation** **4. Soil and rainwater management during construction**	Apply the provisions for the management of earthworks and rainwater in "Instruction for quality and installation, earthworks, Power Plants" from Wärtilä, including: • Trenching and storage of organic soil separated from the subsoil • Use of berms and fencing to control erosion and sediment runoff • fences to prevent entry of machinery in sensitive areas. • Protect or stabilize exposed material (re-vegetation, geo-membranes, concrete, etc.) • Protect corners of ditches and curves with rocks or breakwater - installation of energy dissipation devices in outputs and download locations • settling ponds / or other system to remove the sediments of water before discharge and ponds to control • Ponds To control the discharge of rain water.	General Project Site, Laydown area, and shoreline areas that could be susceptible to erosion	EDP	$75,800.00	Before and during the duration of construction activities, including activities in the vicinity of the coast	Use of organic soil from the site's trace, removed for off-site use. Release of marine sediment for a short period, without significant effects on marine flora and fauna. There are no changes in the event of maximum flood

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Site Preparation, Construction and Closing	Storage, handling, use and disposal of hazardous raw materials and hazardous wastes (on the project site and temporary storage area)	Accidental release of hazardous materials at the site with potential for: • pollution of the environment at the site (soil, surface and groundwater) • exposure of workers to toxic or irritant materials	**Prevention** **5. Handling and Storage of Hazardous Materials**	Use of the Best Practices of the International Industry for the handling, storage, use of hazardous materials, including: • Training to personal and protective equipment available • Overfilling and spill protection • Labeling and Inventory Control • Use of secondary containment • Incompatible materials stored in separate places • Spill response and cleaning of material • Fire extinguishers available	Laydown area and Construction Site	EDP	$12,200.00	During construction	Low risk of significant contamination of soil, ground or surface water as a result of construction
Site Preparation, Construction and Closing	Storage, handling, use and disposal of hazardous raw materials (onshore and offshore)	• Pollution of the environment through the inadequate disposal of human waste	**Prevention** **6. Sewage waste water treatment**	• Portable toilets with integrated tanks will be provided for workers • Material collected will be transported by truck for off-site treatment and disposal at an authorized facility	Construction Site and Laydown area.	EDP	$47,180.00	During construction	There is no contamination of human waste at the project site. Discharge of effluents to the off-site waste treatment plant.
Site Preparation, Construction and Closing	Storage, handling, use and disposal of raw materials, and hazardous waste (offshore)	• Pollution of marine waters or sediments by the accidental release of hazardous materials during construction activities • Possible contamination of the human food chain	**Prevention** ***7.* Hazardous materials in construction of Maritime Terminal**	In addition to the general procedures for the storage and handling of hazardous materials defined in other sections, the following practices shall be used: • Storage of hazardous materials, including fuels and lubricants, in confined areas. • Spill equipment will be available for immediate deployment in case of a spill (absorbent booms, floating oil containment barriers, skimmers) • Workers will be trained in the prevention of marine spills and to provide response and cleaning during construction activities	Temporary trestle, pipeline, and Maritime Terminal area	EDP	$11,520.00	Duration during construction of temporary dock, sea terminal, and pipeline	No significant environmental pollution as a result of sea spills is anticipated
Site Preparation, Construction and Closing	• drilling of wells (onshore)	• Unsealed holes can allow the migration of contaminating material into groundwater	**Prevention** **8. Closing of perforations in soil**	Capping or sealing open holes with bentonite clay or other suitable material	Area where drilling may be required (powerhouse)	EDP	$1,000.00	Geotechnical exploration	There are no new pathways created for the migration of material to groundwater
Site Preparation, Construction and Closing	Cleaning of pipelines	• Contamination of the environment by the release of water from hydrostatic test and pipelines cleaning	**Prevention** **9. Discharge of test water**	• The water used for pressure test will be test to confirm the absence of contamination. Water free from contamination will be released to a local drain. If it is contaminated above the applicable criteria, the water will be treated before discharge. • Water for cleaning will be collected for proper disposal as needed.	Site for the discharge of water after the tests.	EDP	$3,000.00	Upon completion of hydrostatic testing of ships and pipelines	No significant contamination of wash effluent release / hydrostatic tests
Site Preparation, Construction and Closing	Cut and logging	• Elimination of vegetation resulting in the displacement of fauna to inadequate areas, which could cause mortality	**Attenuation** **10. Relocation of fauna**	• Wildlife Relocation Program: before commencing works, relocate wildlife (ex: snakes) to an appropriate habitat with the support of an NGO • Keeping cage and training for construction workers from respecting and protecting wildlife during construction	The project site and Laydown Area	EDP	$6,200.00	Immediately prior to cleaning, and during logging activity	To reduce the mortality of fauna of great size. Reduce the migration of fauna in nearby areas not suitable

Table 2.2 – Environmental Management Program, Construction Phase

Execution Phase	Project Activity	Description of Generated Environmental Impact	Environmental Measure (Prevention, Attenuation, Compensation)	Description of Proposed Measure	Location of the Environmental Measure	Responsible for its execution	Calculated Amount of Environmental Measure	Time of execution	Expected result
Site Preparation, Construction and Closing	Cut and logging	• Loss of habitat and increased habitat fragmentation	**Compensation** **11. Reforestation and support to FIAES**	Restoration of habitat, planting of 20,782 trees: • Plantation of 1,781 trees in the project property • Planting of 18,114 in properties of the municipality of Acajutla •The payment of $ 11,889.93 to FIAES for use in projects for improvement and protection of the environment in El Salvador	• Project site • Properties of the municipality of Acajutla	EDP	$123,102.98	At the end of construction	The tree planting program will not result in the loss of tree numbers. Restoration works carried out as part of the FIAES program will compensate for the loss of habitat in the area
Site Preparation, Construction and Closing	• Cut and logging • Construction general activities	• Disturbance of shoreline and beach areas from storage of material, and passage of heavy equipment	**Prevention** **12. Barrier in beach area**	Install fences at the top of the cliff and along the road to the temporary trestle, to demarcate areas off-limits and no disturbance.	Pipeline corridor and Laydown Area.	EDP	$710.00	Prior to the start of cutting and logging and , and during the duration of construction	Affection to the cliff and the beach by the construction of the temporary dock and the access road to it.
Site Preparation, Construction and Closing	Storage, handling, use and disposal of hazardous raw materials, and common and / or hazardous waste	• inadequate storage and disposal of food waste attractive for wildlife	**Prevention** **13. Prevention of interaction with fauna**	• Food waste will be stored in wildlife-proof containers that are emptied and cleaned regularly • All waste will be disposed outside the properly	Project Site, Laydown Area, maritime terminal, pipeline bondage, and temporary trestle.	EDP	$2,400.00	Duration of construction activities	There are no important attractants for wildlife related to the storage and handling of food and waste
Site Preparation, Construction and Closing	Driving of piles (offshore)	Noise in the water from the pile driving can: • be detrimental to oyster divers (and recreational divers) • Have lethal and non-lethal effects on marine mammals, turtles and other marine wildlife	**Attenuation** **14. Noise reduction during pilotage in sea**	Develop a management plan for piloting, consistent with the Joint Nature Conservation Committee (JNCC) protocol to minimize the risk of injury to marine mammals and turtles due to pile-driving noise, including the following considerations • Identify and communicate a safety zone for fishermen and divers • If feasible, consider using low noise techniques to drill. • Search for divers, turtles and marine mammals in the mitigation zone (500 m radius of piles), before drilling • Delay activities, if divers, sea turtles or mammals were detected within the mitigation zone • Soft start of drilling rig and restart protocol after recess • Record keeping and reporting	In an area of 500m outside the activities of piloting, temporary trestle, and facilities of the maritime terminal	EDP	$5,100.00	Plan prior to the commencement of drilling and its implementation during the drilling activities of piles	Non-significant mortality and minimal disruption to marine mammals or other wildlife species. Interruption to oyster catchers s and possibly other divers
Site Preparation, Construction and Closing	Site Preparation, Construction and Closing General construction activities (offshore)	• Artificial lighting necessary for construction can affect the behaviour of marine fauna, including turtles	**Attenuation** **15. Lighting Plan for Maritime Terminal and Temporary Trestle**	Apply Lighting Management Plan: • Reduce lighting in non-essential areas, particularly during critical periods of life-cycle (ex: nesting of turtles) • Use of guards to direct lights to areas requiring lighting • Avoid direct light in water • Low light mounting where possible • Use of long wavelength lights (ex: amber) that make light less intense for nocturnal animals.	Maritime Terminal and temporary dock	EDP	$1,000.00	Duration of offshore construction activities	Reduce lighting that can disturb marine fauna behavior

Table 2.2 – Environmental Management Program, Construction Phase

Execution Phase	Project Activity	Description of Generated Environmental Impact	Environmental Measure (Prevention, Attenuation, Compensation)	Description of Proposed Measure	Location of the Environmental Measure	Responsible for its execution	Calculated Amount of Environmental Measure	Time of execution	Expected result
Site Preparation, Construction and Closing	Dredging of marine sediment	• Dredging will increase the amount of suspended sediment in the water column, as well as turbidity	**Prevention** **16. Measures to Reduce Turbidity and Oyster Biomonitoring**	Stop or temporarily reduce dredging activities if excess turbidity limits are detected during monitoring. At the same time to perform biomonitoring of oysters.	Points M1 and M23 as well as oyster zone	EDP	$6,960.00	Establish prior to the start of dredging activities and maintain while dredging activities continue, daily	Temporal and localized with less impact to aquatic flora and fauna
Site Preparation, Construction and Closing	• Cutting and logging • Earthworks • General construction activities	•Risk of safety to the public by general construction activities, including the use of heavy machinery •Construction activities can cause disruption and inconvenience to local residents or businesses (complaints)	**Prevention** **17. Environmental and Social Management Plan**	Establish a community liaison program to be served by two relationship officers, whose responsibilities include: • Maintain the presence of an off-site community liaison office • Implement a communication plan that includes meetings, materials, interviews, including information / educational material for the municipality, schools and community. • Make the community aware of the existence of the Complaint Mechanism. To register and to solve the complaints that are presented by the stakeholders	Around communities, schools, municipality	EDP	$84,150.00	Establish before the start of construction and maintenance during construction	Broad knowledge of the project and the risks of the general public Low risk of unauthorized entry or public safety risk Respond to all valid complaints and complaints filed in the office
Site Preparation, Construction and Closing	General Construction Activities - offshore	• Safety risk for the public (seafarers and fishermen) operating in the vicinity of the temporary trestle, pipeline, and ships necessary for the construction of the facilities	**Prevention** **18. Open sea safety**	Coordination with CEPA and the Port Maritime Authority (AMP), to develop a safety plan, including considerations for: • Formalize the 300m exclusion zone around the project site, with the MPA in agreement with CEPA. This exclusion zone applies to all ships including commercial port traffic. • An additional security zone with a radius of at least 500m, applicable for non-CEPA controlled vessels. • Mark the limit of the security perimeter. • Security Patrols / Reinforcement • Communication with / and education of local fishermen and other active navigators in the area	Project site in the sea	EDP	$5,500.00	Before the start of construction and during offshore construction activities	Low risk of significant safety incidents for navigators and fishermen
Site Preparation, Construction and Closing	Traffic related to construction	Project traffic on public roads can: • Create risk for public safety (collisions and accidents) • Cause traffic jams	**Prevention** **19. Traffic Plan**	Traffic Management Plan includes: • The use of collective transport for workers (buses) to reduce vehicle movements • Specification of designated haul routes • No heavy vehicles on local roads • Drivers will receive training on the Traffic Management Plan. • Inform closures or blockages and plan it in hours of little activity • appropriate traffic controller signals • Consultation with the municipality, local communities, and local schools on the traffic plan and traffic hazards	Project site, transport routes roads	EDP	$1,820.00	Duration of construction	There is no significant increase in the risk to the public safety of traffic related to the project less congestion of the main access road to the site

Table 2.2 – Environmental Management Program, Construction Phase

Execution Phase	Project Activity	Description of Generated Environmental Impact	Environmental Measure (Prevention, Attenuation, Compensation)	Description of Proposed Measure	Location of the Environmental Measure	Responsible for its execution	Calculated Amount of Environmental Measure	Time of execution	Expected result
Site Preparation, Construction and Closing	Management of the construction workforce	•The influx of job seekers and the growing demand for social services and the possible disruption of peace and community security • Security and safety hazard, by the group of people who seek employment in the facilities	**Prevention/ attenuation** **20. Employment of local workers**	• Hire a local hiring officer to support EDP and contractors with the identification of qualified and unskilled local workers • Expand the off-site office in Acajutla for use by EDP and contractors as a local contracting center • Publish that the contracting will focus on local staff and that there will be no contracting at the doors of the facilities	• The entrance of the site • commercial area Acajutla • Project Office	EDP	$25,500.00	Before and during construction	Net profit expected from the local economy through the hiring and use of local service providers An influx of job seekers is expected, but with minimal changes to the local population base, demand for local services, peace and safety
Site Preparation, Construction and Closing	General construction activities	• Security problems due to the development of food stalls and informal merchants, near the entrance of the facilities.	**Prevention** **21. Prevention of informal stores near the site**	In addition to providing on-site cafeteria facilities, provide: • Communication to workers to discourage informal food • Signs prohibiting informal sales on the property's outdoor fence • Coordinate with the municipality to remove informal stores	Entrance to site	EDP	$ 700.00	Duration of construction	Reduce the incentive for informal traders to be located near entry to facilities
Site Preparation, Construction and Closing	• Cutting and logging • Earthworks • Pile driving • General Construction Activities - on land • Hydrostatic test	• Construction activities may pose a danger to the safety of CEPA workers and the public in the use of CEPA sports fields.	**Prevention / attenation** **22. Pipeline Safety Barrier**	Provide a security barrier to ensure public safety.	• Temporary Laydown Area • Piping route	EDP	$8,822.00	During construction and testing activities in pipeline corridor	Prevention of access by CEPA and public workers to active construction areas
Site Preparation, Construction and Closing	• General offshore construction activity • Physical presence of the temporary pier and maritime terminal	Construction activities and, finally, the presence of the temporary trestle, and the maritime terminal, will produce: • Restrict fishing areas for "oyster-catcher" and "tuberos" fishermen, • Forcing fishermen leaving the artisan pier to travel longer distances when traveling to / from the south	**Compensation** **23. Compensation for fishermen**	To compensate members of fishermen's cooperatives affected by longer distances of travel: • Installation of a new winch at the artisanal dock • Installation of 15 "Fish Aggregator Devices" (FAD) To compensate the fishermen "Oyster catchers" • Installing artificial reefs To compensate 57 fishermen known as "tuberos" and "Oyster-catchers", allow to choose among: • Participate in the construction of a boat, completing with safety training (product handling), and reception of basic fishing equipment, or, • Receive training in an alternative line of work with the objective of leaving the fishing industry.	• FAD- Northwest Artisanal dock • Artificial Reefs- North of the Artisanal dock • Winche- Artisanal dock • Equipment and Training - To be defined (Artisanal dock)	EDP	$55,650.90	Complete installation of FAD, Reefs and winches, and start the training of oyster-catchers and tuberos, before the start of construction	The cost and longer navigation time for cooperatives will be compensated for improvements in the winch of the artisan pier, and the installation of the FADs. The livelihoods of local oysters will be enhanced by the development of the artificial reef. The livelihoods of the local pipelines will be compensated by equipment / training Improving the safety of fishermen
Site Preparation, Construction and Closing	Operations stage Wastewater Management	• Sewage generation	**Prevention** **24. Construction of wastewater treatment systems**	Installation of waste water treatment plant in the Thermal Power Plant and the Maritime Terminal (FSRU / FSU)	Power Plant: South-west of the property (See figure of location of environmental measures) Maritime Terminal: FSU and FSRU	EDP	$126,262.00	Installation during the construction phase	All process water and treated wastewater must comply with applicable standards
Site Preparation, Construction and Closing	Operations stage Increased surface runoff	• Generation of drainage of surface waters potentially contaminated by oils and grease	**Prevention** **25. Oily Water Treatment System**	Installation of a waste water treatment system to treat potentially contaminated water with oils from surface drainage	West of the property (See figure of location of environmental measures)	EDP	$16,480.00	Installation during the construction stage	All treated water must comply with applicable standards

Table 2.2 – Environmental Management Program, Construction Phase

Execution Phase	Project Activity	Description of Generated Environmental Impact	Environmental Measure (Prevention, Attenuation, Compensation)	Description of Proposed Measure	Location of the Environmental Measure	Responsible for its execution	Calculated Amount of Environmental Measure	Time of execution	Expected result
Site Preparation, Construction and Closing	Physical presence of the facilities	• Off-site flooding as a result of increased flow of surface water	**Prevetion** **26. Sedimentation / rainwater control pond**	Construction of two sedimentation ponds, one for the substation and one for the rest of the property. The final stormwater management system will consider LID Low Impact Development techniques such as: • Reduction of impermeable areas, permeable paving, ditches and bio-retention, and with landscaping vegetation. • Send the rest of the surface water flow of the permanent stormwater management system.	Sedimentation ponds will be located south of the Project Site	EDP	$15,000.00	Before starting operations	It was not expected to have a significant change in flood potential downstream of the site, by an increase in the maximum flow.
Site Preparation, Construction and Closing	Operation stage - general operating activities	• Operations stage Firefighting equipment	**Prevention** **27. Fire protection system**	• Installation of fire extinguishing equipment: fire extinguishers, hydrants, hoses, valves, mobile foam units, etc. • Provide training in fire extinguishing and drills	General facilities including Thermal Power Station and Marine Terminal	EDP	$119,295.00	Installation and training to be completed before the start of operations	International Good Practices of the Firefighting Industry
Site Preparation, Construction and Closing	Operation stage - general operating activities	• Accidental release or leakage of natural gas	**Prevention** **28. Leak Detection System**	Leak detection equipment at the Thermal Power Plant (fixed), pipelines and CEPA Port, as well as portable gas meters for detecting leaks in the visual inspections of the facilities	NG, FSU, FSRU pipeline	EDP	$16,000.00	Buying meters before starting operations	Periodic inspections will help identify leaks
Site Preparation, Construction and Closing	Operation stage – Well Operation	• Groundwater use	**Prevention** **29. Well flow monitoring equipment and monitoring wells**	Installation of flow control equipment, and measure levels and parameters in monitoring wells.	Wells	EDP	$3,100.00	Installation before begining operations	The extraction of water must not exceed the limit established in the permit
Site Preparation, Construction and Closing	General construction activities - offshore	• Risk to the public and workers	**Prevention** **30. Disease Vectors Minimization**	Minimize / remove areas with water stagnation, and provide training to employees to minimize vector sites	Thermal Power Plant and Temporary Collecting Site	EDP	$2,400.00	During construction activities	Elimination of mosquito breeding habitats
Site Preparation, Construction and Closing	General construction activities - offshore	• Removal and disturbance of marine habitat	**Prevention** **31. Minimize the impact on marine habitat**	•Wherever possible, operate equipment on land or at sea (from a barge or temporary dock), in a manner that minimizes potential disturbances to the coastline and seabed; • Avoid running aground barges used during construction work •A Qualified Environmental Monitor will monitor the work to determine the need for mitigation and confirm that the measures implemented are working as expected. • Inspection of endangered species at the location of the temporary dock, prior to construction to avoid areas with significant marine habitats.	Offshore construction sites	EDP	$1,000.00	During construction activities	Minimized disturbance to marine habitats
Site Preparation, Construction and Closing	LNG delivery, LNG storage, management and regasification	• Risk to the public and nearby industrial activities due to a catastrophic event (major LNG / NG spills, large fires, explosion)	**Prevention** **32. Detailed risk assessment and contingency plan**	Perform a detailed risk assessment as part of the final detailed design work. • Development of a Major Threat Risk Management Plan and Contingency Plan. • Training and drills	FSRU/FSU	EDP	$100,000.00	Prior to begin activities	Risks to public safety within Standards and Good International Practices for the Industry
Site Preparation, Construction and Closing	Seabed dredging for marine terminal installation	• Generation of sediments in the water and accumulation of sediments in the seabed	**Prevention** **33. Measures for disposal site for dredged material**	Reduce dredge speed and turbidity Measures in water	Dredging material final disposal site	EDP	$6,900.00	During dredging	Minimize disturbance of the seabed
						TOTAL	**$941,764.88**		

Table 2.3 – Monitoring Program, Construction Stage

Stage of Execution	Environmental Measure	Parameters to Consider	Place or Monitoring Point	Frequency of Monitoring	Method to Use	Responsible for Monitoring	Interpretation of results	Feedback	Reference in Impact Description Text
Site Preparation, Construction and Closing	**Attenuation** **1. Reduction of Gas Emissions**	Maintenance record	Project construction office	Monthly	Review the record	EDP	Verify that maintenance is performed in accordance with the plan	Improve maintenance according to program	Page 10-4
Site Preparation, Construction and Closing	**Prevention** **2. Dust Management Plan**	Excess of dust emissions	All active construction areas where there is uncovered land	Daily / Weekly	Weekly visual check for excessive dust emissions by site environmental monitoring Weekly inspection of dust mitigation measures	EDP	Confirm that dust controls are effective to prevent significant off-site migration of dust by air or vehicles	If excessive dust migration is carried out, the activity that causes it should be stopped and appropriate control measures applied at the site or until the weather changes (rain or wind reduction)	Page 10-5
Site Preparation, Construction and Closing	**Attenuation** **3. Noise management during construction**	Disturbing noise	Nearby residential areas	Non-applicable	Complaints from interested parties	EDP	All noise complaints should be investigated to identify the root cause	Introduce control measures to deal with noise nuisance complaints and follow up communication with the complainant	Page 10-7
Site Preparation, Construction and Closing	**Attenuation** **4. Ground and rainwater management under construction**	Physical soil conditions	Areas subject to earthworks and excavations	Weekly	Weekly inspection of exposed soils and drainage channels for excess erosion and sedimentation	EDP	Confirm that sediment controls are effective to avoid significant erosion / sedimentation	If there is excessive erosion introduce additional stabilization measures for control	Page 10-8
		Flood	Sites for discharge of rain water and channel of CEPA in point of discharge	Weekly during the rainy season - monthly during the dry season	Visual inspection of the stormwater management system to verify capacity and integrity, and any evidence or risk of flooding and erosion	EDP	Check for erosion, signs of flooding, damage to gutter	Take corrective actions by improving the pipeline infrastructure or retention pond	Page 10-8
Site Preparation, Construction and Closing	**Attenuation** **5. Management and Storage of Hazardous Materials**	Adequate handling: storage in fenced area, MSDS available, establishment secondary containment.	Hazardous Materials Storage Site	Monthly	Inspection of the site and photographic record	EDP	All hazardous materials must be stored according to their characteristics	Correct storage of materials and reinforcement of training to the person in charge of the area	Page 10-11
Site Preparation, Construction and Closing	**Prevention** **6. Domestic wastewater treatment**	Presence and use of portable toilets	In front of work place	Monthly	Visual inspection, rental registration, cleaning record	EDP	Compare number of toilets with registration of workers, there must be one per 25 workers. Toilets must be in good condition and cleaned periodically	Hire more portable toilets and request their cleaning and maintenance	Page 10-15
Site Preparation, Construction and Closing	**Prevention** **7. Hazardous materials in construction of Maritime Terminal and temporary dock**	Training and accident records, spill equipment and biodegradable oil	In construction site	Every six months	Staff interviews, purchase and photo record	Holder	Prevent damage to personnel, infrastructure and the environment	Update of training topics and purchase of equipment needed	Page 10-17
Site Preparation, Construction and Closing	**Prevention** **8. Closing of perforations in soil**	Presence of open holes in the property	Tank construction site and powerhouse	Finishing construction of foundations	Inspection of the site and photographic record	EDP	Check that all open holes in the ground are closed	Close the open holes in the soil	page 10-18
Site Preparation, Construction and Closing	**Prevention** **9. Test water discharge**	Sampling water test water	Before discharge point	Before discharge, at the end of construction	Sampling with local equipment: suspended sediment, oil and fats	EDP	Check that the parameters are according to the regulations	Treat the water before it is discharged	Page 10-19

Table 2.3 – Monitoring Program, Construction Stage

Stage of Execution	Environmental Measure	Parameters to Consider	Place or Monitoring Point	Frequency of Monitoring	Method to Use	Responsible for Monitoring	Interpretation of results	Feedback	Reference in Impact Description Text
Site Preparation, Construction and Closing	**Attenuation 10. Relocation of fauna**	Presence of fauna on site	Project property, spread areas, and piping corridor	Once, before starting the eviction of the property	Inspection of the site and photographic record	EDP	Verify that there is no established fauna present on the site	Apply the relocation program	Page 10-19
Site Preparation, Construction and Closing	**Compensation 11. Reforestation and Support (FIAES)**	Number of species planted, record of payments to FONAES	Green areas in the Project site	Weekly	Inspection of the site and photographic record	EDP	Verify planting establishment	Care and maintenance or replanting of damaged species	Page 10-21
Site Preparation, Construction and Closing	**Prevention 12. Barrier in beach area**	Presence of fence	Coastal area on the ground for the pipeline	Monthly	Inspection of the site and photographic record	EDP	The fence must be installed	Install the fence if it is not installed correctly or is damaged	page 10-29
Site Preparation, Construction and Closing	**Prevention 13.Prevention of interaction with fauna**	Deposits for solid waste	In front of work place and inside the facilities	Weekly	Visual inspection	EDP	Verify the installation of containers and their proper use	Ensure eviction and proper disposal	Page 10-30
Site Preparation, Construction and Closing	**Attenuation 14. Noise reduction during sea piloting**	Recording Observations	Area of 500m pilot noise around the dock and safety zone in CEPA Port (fig.10.18)	Weekly during piloting activities	Daily records of observations including species, location, time, status of piles	EDP	Implement management measures that apply when marine mammals are present	Reinforce monitoring and proposed measures	Page 10-32
		Pile driving	Rocky seabed.	Monthly during construction	Inspection of the site and photographic record	EDP	The area of work must be cleared of fauna	removal of fauna that has not been removed prior to the activities	Page 10-32
Site Preparation, Construction and Closing	**Attenuation 15.Lighting Plan of Maritime Terminal and Temporary dock**	Lighting on the jetty	Jetty	Monthly during construction	Inspection of the site and photographic record	EDP	Lighting should not be directed to sea water	Correct the direction of lightning	Page 10-35
Site Preparation, Construction and Closing	**Prevention 16.Measures to Reduce Turbidity and Oyster Biomonitoring**	Turbidity in water and metals in oysters	Construction dock area outside the curtains and oyster banks	turbidity, Weekly and biomonitoring in oysters every two months	Work material and analysis in laboratory	EDP	Turbidity must meet 75NTU average 30 days and 100NTU average 7 days; Metals in oysters should not be above the baseline (first Measure before works)	Improve measures for sedimentation control	Page 10-36
Site Preparation, Construction and Closing	**Prevention 17.Environmental and Social Management Plan**	Verify the information of the population about the project and conflicts that arise	Record of meetings and complaints	MOnthly	Review complaints and their resolution	EDP	Verify that project information and conflict resolution have been provided	Improve the media and the attention to complaints	page 10-38
Site Preparation, Construction and Closing	**Prevention 18. Safety in the open sea**	Incidents and accidents	Near dock construction	Monthly	Review accident statistics and the cause of accidents	EDP	Review the cause of accidents	Install measures to prevent accidents and improve coordination	Page 10-40
Site Preparation, Construction and Closing	**Prevention 19. Traffic plan**	Claims from population	Communications office	Monthly	Check for any community complaints or traffic-related accidents.	EDP	Review the cause of the complaint or accident	Improve training for personnel in charge of transporting materials or equipment	Page 10-41
Site Preparation, Construction and Closing	**Prevention/ attenuation 20. Local workers employment**	Number of people from the community hired for the project	Communications office	Monthly	Review of Statistics of the people hired for the project	EDP	Compare current hiring with the target of 100% unskilled local area workers	Improve the mechanism for hiring staff to incorporate more people from Acajutla	Page 10-42
Site Preparation, Construction and Closing	**Prevention 21. Prevention of informal stores around the site**	Informal stores around the project site	Within the perimeter of the area of the project	Monthly	Site inspection and photographic record	EDP	Stores should not be installed	Improve measures with workers	Page 10-43

Table 2.3 – Monitoring Program, Construction Stage

Stage of Execution	Environmental Measure	Parameters to Consider	Place or Monitoring Point	Frequency of Monitoring	Method to Use	Responsible for Monitoring	Interpretation of results	Feedback	Reference in Impact Description Text
Site Preparation, Construction and Closing	**Prevention / attenuation** **22. Pipe safety barrier**	Presence of barrier	Coast in the corridor for the pipe	Monthly	Site inspection and photographic record	EDP	The barrier must be installed	Install the barrier, if it is not installed correctly or missing parts	Page 10-44
Site Preparation, Construction and Closing	**Compensation** **23. Compensation to fishermen**	Installation of winch, in the artisanal dock, artificial reefs and FDAs	Artisanal dock	6 months and 1 year after completion of installation	Site inspection and photographic record Interview to verify the effectiveness of the FAD	EDP	The winch must be installed. FAD and reefs must be installed	Install equipment	Page 10-44
Site Preparation, Construction and Closing	**Prevention** **24. Construction of wastewater treatment systems**	Compensation program for independent fishermen	NA	Before starting the program to establish the baseline, then 6 months, 1 year and 2 years after completion of the compensation program	Interview each independent fisherman on the status of his livelihood	EDP	Compare the baseline values	Provide corrective assistance for all fishermen whose livelihoods worsen as a result of the project	Page 10-46
Site Preparation, Construction and Closing		Water quality Analysis: BOD5, COD, pH, Oils and Fats Sedimentable solids Total Suspended Solids, Total Coliforms (CT)	Treatment plant effluent outlet point	Quarterly (4 times a year)	Individual samples subjected to laboratory NSO standards.	EDP	NSO 13.49.01:09, BOD5, 60 mg/L COD 60 mg/l, pH, fat and oils 20 mg/L, solid sedimentary 1 mg/L total suspended solids, 60 mg/L, Temperature 20-35°C, chlorides (report, there is no standard), flow (point "a" or "b")	If the monitoring detects contamination related to the project, corrective measures must be taken to avoid further contamination	Page 10-4
Site Preparation, Construction and Closing	**Prevention** **25. Water-oil separator**	Sampling of water quality: oil and fats and hydrocarbons	Before discharge in CEPA channel	Quarterly (4 times a year)	Individual samples for laboratory analysis	EDP	Comparison of the applicable surface water quality criteria: fats and Oils 20 mg / L, there should be no presence of hydrocarbons	If the monitoring detects contamination related to the project, corrective measures must be taken to avoid further contamination	Page 10-52
Site Preparation, Construction and Closing	**Prevention** **26. Sedimentary tank / rain damper**	Flood	Characteristics of surface water management	Weekly during the rainy season - monthly during the dry season	Visual inspection of the storm water management system to verify capacity and integrity, and any evidence or risk of flooding and erosion	EDP	Comparison with system design specifications	If inspections indicate a risk of flooding or erosion take corrective actions	Page 10-55
Site Preparation, Construction and Closing	**Prevention** **27. Fire protection system**	Installation of all equipment and operation test	Tank yards, cargo rack and bottling plant	Biannual	Equipment operations report	EDP	The equipment must operate according to the specifications thereof	Replacement of defective equipment	Page 10-57
Site Preparation, Construction and Closing	**Prevention** **28. Leak detection system**	Installation of all equipment and operation test	Tank yards, cargo rack and bottling plant	Biannual	Equipment operations report	EDP	The equipment must operate according to the specifications thereof	Replacement of defective equipment	Page 10-58
Site Preparation, Construction and Closing	**Prevention** **29. Well flow monitoring equipment and well monitoring**	Flow rate of extraction and piezometric levels and parameters which are indicative of saline intrusion	Monitoring wells groundwater up and down the gradient of the well and the well project	Quarterly (4 times a year)	Individual samples submitted for laboratory analysis	EDP	Comparison to baseline conditions	If monitoring detects contamination related to the project, corrective measures must be taken to avoid further contamination and to seek for the necessary corrective measures	Page 10-59
Site Preparation, Construction and Closing	**Prevention** **30. Disease vector minimization**	The presence of mosquito larvae	Areas of deposition areas of stagnant water (for example, a storm water pond) site in general	2 times a week (can be reduced in the dry season)	Visual inspection	EDP	Presence of breeding habitat, presence of larvae in water	Eliminate reproduction habitat whenever possible. Otherwise, if larvae persist, treat with larvicide	Page 10-64

Table 2.3 – Monitoring Program, Construction Stage									
Stage of Execution	**Environmental Measure**	**Parameters to Consider**	**Place or Monitoring Point**	**Frequency of Monitoring**	**Method to Use**	**Responsible for Monitoring**	**Interpretation of results**	**Feedback**	**Reference in Impact Description Text**
Site Preparation, Construction and Closing	**Prevention** **31. Minimize affectation to marine habitat**	Establishment of plan	Maritime Terminal and Temporary Dock	During construction at sea	Inspection	EDP	Verify affectation of marine habitat	Establish procedures or improvements to theses or reinforce established procedures that apply correctly thereof	Page 10-64
Site Preparation, Construction and Closing	**Prevention** **32. Detailed risk assessment and contingency plan**	Establishment of plan	Central Power Plant Site in general	1 time prior to the start of operations stage	Verify that the plan has been established, coordinate with authorities, and train employees	EDP	This plan should contain all the aspects established in Chapter 9	Complete or justify what is needed	Page 10-67
Site Preparation, Construction and Closing	**Prevention** **33. Measures for disposal site of dredging material**	Turbidity	Dredging material disposal site, initial sampling points	Daily during the 18 days of dredging	Using turbidimeter equipment on site	EDP	Turbidity must meet 75NTU average 30 days and 100NTU average 7 days	Reduce discharge speed until reaching the set parameter	Page 10-68

Table 2.4 – Execution Schedule of the Environmental Management Program, Construction Stage

Execution stage	Environmental measure	2017												MONTHS / COST YEAR 1	2018												MONTHS / COST YEAR 2	2019												2020				MONTHS / COST YEAR 3 (2019+2020)	Calculated Amount of Environmental Measure
		J	F	M	A	M	J	J	A	S	O	N	D		J	F	M	A	M	J	J	A	S	O	N	D		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A		
Construction	**Attenuation**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	
	1. Reduction of Gas Emissions													$ 444.44													$ 666.67																$ 888.89	**$ 2,000.00**
Site Preparation, Construction, Closing	**Prevention**										1	1		2	1	1	1	1							1	1	6	1	1	1	1						1	1	1	1	1	1	1	10	
	2. Dust Management Plan													$ 6,001.33													$ 18,004.00																$ 30,006.67	**$ 54,012.00**
Site Preparation, Construction, Closing	**Attenuation**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	
	3. Noise management during construction													$ 222.22													$ 333.33																$ 444.44	**$ 1,000.00**
Site Preparation, Construction, Closing	**Attenuation**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1													4	
	4. Soil and rainwater management under construction													$ 25,266.67													$ 37,900.00																$ 12,633.33	**$ 75,800.00**
Site Preparation, Construction, Closing	**Prevention**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	
	5. Handling and Storage of Hazardous Materials													$ 2,711.11													$ 4,066.67																$ 5,422.22	**$ 12,200.00**
Site Preparation, Construction, Closing	**Prevention**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	
	6. Domestic wastewater treatment													$ 10,484.44													$ 15,726.67																$ 20,968.89	**$ 47,180.00**
Site Preparation, Construction, Closing	**Prevention**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1								9	
	7. Hazardous materials in construction of Maritime Terminal and temporary dock													$ 3,177.93													$ 4,766.90																$ 3,575.17	**$ 11,520.00**
Construction, Closing	**Prevention**													0											1	1	1	3																0	
	8. Closing of perforations in soil													$ -													$ 1,000.00																$ -	**$ 1,000.00**
Site Preparation, Construction, Closing	**Prevention**													0													0													1	1	1	3	
	9. Test water discharge													$ -													$ -																$ 3,000.00	**$ 3,000.00**
Site Preparation, Construction, Closing	**Attenuation**					1	1	1						3				1	1	1							3																0	
	10. Relocation of fauna													$ 3,100.00													$ 3,100.00																$ -	**$ 6,200.00**
Site Preparation, Construction, Closing	**Compensation**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	
	11. Reforestation and Support to (FIAES)													$ 27,356.22													$ 41,034.33																$ 54,712.44	**$ 123,102.98**
Site Preparation, Construction, Closing	**Prevention**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1								9	
	12. Barrier in beach area													$ 195.86													$ 293.79																$ 220.34	**$ 710.00**
Site Preparation, Construction, Closing	**Prevention**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	
	13. Prevention of interaction with fauna													$ 533.33													$ 800.00																$ 1,066.67	**$ 2,400.00**
Site Preparation, Construction, Closing	**Attenuation**					1	1	1	1	1	1			6													0																0	
	14. Noise reduction during sea piloting													$ 5,100.00													$ -																$ -	**$ 5,100.00**
Site Preparation, Construction, Closing	**Attenuation**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1								9	
	15. Lighting Plan for Maritime Terminal and Temporary dock													$ 275.86													$ 413.79																$ 310.34	**$ 1,000.00**
Site Preparation, Construction, Closing	**Prevention**							1	1					2													0																0	
	16. Measures to Reduce Turbidity and Oyster Biomonitoring													$ 6,960.00													$ -																$ -	**$ 6,960.00**
Site Preparation, Construction, Closing	**Prevention**				1	1	1	1	1	1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	
	17. Environmental and Social													$ 20,468.92													$ 27,291.89																$ 36,389.19	**$ 84,150.00**

Table 2.4 – Execution Schedule of the Environmental Management Program, Construction Stage

Execution stage	Environmental measure	2017												MONTHS / COST YEAR 1	2018												MONTHS / COST YEAR 2	2019												2020				MONTHS / COST YEAR 3 (2019+2020)	Calculated Amount of Environmental Measure
		J	F	M	A	M	J	J	A	S	O	N	D		J	F	M	A	M	J	J	A	S	O	N	D		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A		
	Management Plan																																												
Site Preparation, Construction, Closing	**Prevention** **18. Safety in the open sea**					1	1	1	1	1	1	1	1	8 $ 1,517.24	1	1	1	1	1	1	1	1	1	1	1	1	12 $ 2,275.86	1	1	1	1	1	1	1	1	1							9 $ 1,706.90	**$ 5,500.00**
Site Preparation, Construction, Closing	**Prevention** **19. Traffic Plan**					1	1	1	1	1	1	1	1	8 $ 404.44	1	1	1	1	1	1	1	1	1	1	1	1	12 $ 606.67	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16 $ 808.89	**$ 1,820.00**
Site Preparation, Construction, Closing	**Prevention / attenuation** **20. Employment of Local Workers**					1	1	1	1	1	1	1	1	8 $ 5,666.67	1	1	1	1	1	1	1	1	1	1	1	1	12 $ 8,500.00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16 $ 11,333.33	**$ 25,500.00**
Preparación de Sitio, Construcción, Cierre	**Prevention** **21. Prevention of informal stores around the site**					1	1	1	1	1	1	1	1	8 $ 155.56	1	1	1	1	1	1	1	1	1	1	1	1	12 $ 233.33	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16 $ 311.11	**$ 700.00**
Site Preparation, Construction, Closing	**Prevention / attenuation** **22. Pipe Safety Barrier**													0 $ -	1	1	1	1	1	1							6 $ 8,822.00																	0 $ -	**$ 8,822.00**
Site Preparation,	**Compensation** **23. Compensation to Fishermen**		1	1	1	1	1	1						6 $ 55,650.90													0 $ -																	0 $ -	**$ 55,650.90**
Construction, Closing	**Preventive** **24. Construction of sewage treatment systems**													0 $ -													0 $ -								1	1	1						3 $ 126,262.00	**$ 126,262.00**
Construction, Closing	**Preventive** **25. Water-oil separator**													0 $ -													0 $ -						1	1	1								3 $ 16,480.00	**$ 16,480.00**
Site Preparation, Construction, Closing	**Prevention** **26. Settling tank / rain damper**					1	1	1						3 $ 15,000.00													0 $ -																	0 $ -	**$ 15,000.00**
Construction, Closing	**Preventive** **27. Fire Protection System**													0 $ -													0 $ -										1	1	1	1	1	1	6 $ 119,295.00	**$ 119,295.00**
Construction, Closing	**Preventive** **28. Leak Detection System**													0 $ -													0 $ -												1	1	1		3 $ 16,000.00	**$ 16,000.00**
Site Preparation, Construction, Closing	**Preventive** **29. Wellflow monitoring equipment and monitoring wells**					1	1	1						0 $ 3,100.00													0 $ -																	3 $ -	**$ 3,100.00**
Site Preparation, Construction, Closing	**Preventive** **30. Minimization of Disease Vectors**					1	1	1	1	1	1	1	1	8 $ 533.33	1	1	1	1	1	1	1	1	1	1	1	1	12 $ 800.00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16 $ 1,066.67	**$ 2,400.00**
Site Preparation, Construction, Closing	**Preventive** **31. Minimize the impact on marine habitat**					1	1	1	1	1	1	1	1	8 $ 275.86	1	1	1	1	1	1	1	1	1	1	1	1	12 $ 413.79	1	1	1	1	1	1	1	1	1								9 $ 310.34	**$ 1,000.00**
Site Preparation, Construction, Closing	**Preventive** **32. Detailed risk assessment and contingency plan**								1	1	1	1		0 $ 50,000.00 -	1	1	1	1									12 $ 50,000.00																	0 $ -	**$ 100,000.00**
Site Preparation, Construction, Closing	**Preventive** **33. Measures for disposal site of dredging material**							1	1					2 $ 6,900.00													0 $ -																	0 $ -	**$ 6,900.00**
TOTAL PER YEAR AND TOTAL PMA														**$ 251,502.35**													**$ 227,049.69**																	**$ 463,212.84**	**$ 941,764.88**

Table 2.5 – Environmental Management Program Operation Phase

Execution Stage	Project Activity	Description of Generated Environmental Impact	Environmental Measure	Description of Proposed Measure	Location of the Environmental Measure	Responsible for its execution	Calculated Amount of Environmental Measure	Time of execution	Expected result
Operations	NG burning to produce power in the engines	Emissions to the atmosphere	**Prevention** **1. Emission Monitoring**	Conduct emission measurements every year for the first three years, install a PEM (Emission Prediction Monitoring) and measure ambient air quality for nitrogen dioxide (NO2) for 20 continuous days	4 motors chimneys selected randomly, and Communications office (environment air)	EDP	$33,000.00	Annual	Emissions and ambient air levels below benchmarks
Operations	NG burning to produce power in the engines	NOise	**Prevention** **2. Noise Monitoring**	Measuring of noise levels during three years, annually. If there are major changes in equipment / operations that could produce an increase in noise, more would be needed.	The noise must be monitored at baseline points and at the plant property boundary.	EDP	$3,000.00	Annual	Noise in residential areas shall be less than 55 dB (A) during the day and not more than 3 dB (A) of the noise measured at baseline, at night: L1 50 dB (A), L2 54 dB (A), L3 56 dB (A) and L4 45 dB (A). 70 dB (A) on property boundary.
Operations	Storage, handling, use and disposal of raw materials, waste and hazardous waste	Accidental dumping of hazardous materials at the site with potential for: • Pollution of the environment (soil, surface waters, groundwater, sea water) • Exposure of workers to toxic or irritant materials • • Possible contamination of the human food chain (by contamination of sea water)	**Prevention** **3. Protective Equipment for personal and spills**	Use the Best Practices of the International Industry for the handling, storage, use of hazardous materials, including: • Overfilling and spill protection • Inventory Labeling and Control • The use of secondary containment • Incompatible materials stored in separate places • Easily accessible spill response and cleaning material (onshore and offshore) • Personal protective equipment available	All the plant and terminal	EDP	$9,860.00	Duration of operations	Low risk of significant environmental pollution from operations Low risk of significant exposure of workers or the human food chain to hazardous materials
Operations	Storage, handling, use and disposal of raw materials, waste and hazardous waste	Accidental dumping of hazardous materials at the site with potential for: • Pollution of the environment (soil, surface water, groundwater, sea water) The exposure of • workers with toxic or irritant substances • The potential contamination of the human food chain (from marine water pollution)	**Prevention** **4. Training environment, hygiene and safety**	Provide training on the environment, hygiene and safety for workers appropriate for their role and position Provide advanced training for workers handling hazardous materials	Project's site	EDP	$3,000.00	During operations	All workers will receive appropriate training for handling and management of hazardous materials

Table 2.5 – Environmental Management Program Operation Phase

Execution Stage	Project Activity	Description of Generated Environmental Impact	Environmental Measure	Description of Proposed Measure	Location of the Environmental Measure	Responsible for its execution	Calculated Amount of Environmental Measure	Time of execution	Expected result
Operations	Storage, handling, use and disposal of raw materials and hazardous waste	Accidental dumping of hazardous materials at the site with potential for: • Pollution of the environment (soil, surface water, groundwater, sea water) • Exposure of workers to toxic or irritant substances • The potential contamination of the human food chain (from marine water pollution)	**Prevention** **5. Environment, health and safety plans and procedures**	Use the Best Practices of the International Industry for the handling, storage, use of hazardous materials, including: • Personal protective equipment available • Avoid overfilling and spill protection • Signaling, labeling and inventory control • Use of secondary containment • Incompatible materials stored in separate places • Spill response and cleaning material available • Fire extinguishers available	Hazardous materials storage areas	EDP	$13,140.00	During operations	Low risk of significant environmental media pollution as a result of operations Low risk of significant exposure of workers or the human food chain from hazardous materials
Operations	• LNG delivery • FSU movements • Physical presence of facilities • General Operations Activities	• potential safety for artisanal fishermen and the general navigating public • The general relationship with the public and interested parties	**Prevention** **6. Relation with the community**	• Continue Community Liaison Program initiated during construction, including: • safety brochures for fishermen and boaters and for schools • security meetings • Response to complaints from stakeholders	Non-applicable	EDP	$33,750.00	Comprehensive safety disclosure prior to operations. Liason and assistance with the program as needed during operations	General knowledge of the risks of maritime safety, safety of navigation and navigation behaviour, and the danger of unauthorized entry. All complaints must be legitimately addressed.
Operations	General operations	Artificial lighting at the dock and near the coast may affect the behavior of marine fauna, including turtles	**Attenuation** **7. Maritime Terminal Lightning Plan**	Apply Lighting Management Plan: • Reduce lighting in non-essential areas, particularly during critical periods of life-cycle (ex: nesting of turtles) • Use guards to direct lights to areas requiring lighting • Direct light away from water	Areas of operation at sea	EDP	$1,000.00	During operations	Eliminate unnecessary lighting
Operations	Eviction	Loss of habitat and increased habitat fragmentation	**Compensation** **8. Maintenance to reforestation and Support to FIAES**	Maintenance: • Maintenance of 1,781 trees at the project site. • Maintenance of 18,114 trees on properties in the Municipality of Acajutla • The payment of $ 14,038.20 to FIAES for use in restoration works	• The areas identified on the property (Appendix 10A). • Properties of the municipality of Acajutla (Appendix 10B)	EDP	$142,957.80	During years until trees are well established	Establishment of the plantation. The work of restoration will be undertaken by FIAES which will compensate for the local loss of habitat.
Operations	Monitoring of water meters and physico-chemical characteristics.	The decrease of water flow and contamination by saline intrusion.	**Prevention** **9. Flow monitoring equipment and monitoring of wells**	•Monitoring of water flows from the potable water supply. •Monitoring of physicochemical parameters of the extracted water.	• Water extraction well • Monitoring of wells	EDP	$ 3,600.00	During operation time, well exploitation.	The groundwater flow rate and the quality of the groundwater will be kept at the appropriate level.
Total							**$243,307.80**		

Table 2.6 – Monitoring Program Stage of Operations

Execution stage	Environmental Activity	Parameters to consider	Place or Monitoring Point	Frequency of Monitoring	Method to Use	Responsible for Monitoring	Interpretation of Results	Feedback	Reference in Impact Description Text
Operations	**Prevention** **1. Monitoring of Emission**	NOx; PTS; O2; CO; CO2; Flow of gases; Composition; Production (MW) emissions when starting operations, the next two years only NOx sampling.	Sampling in port, in chimney of 4 motors chosen at randomly	Annually for the first three years; Then, during the life of the project, if the results are favorable, the monitoring will be done every three years.	Isocinetic Method, EPA Methods	EDP	Comparison to the World Bank Guide Issue Limits Project, 200 mg / Nm3	Perform diagnostic and maintenance for any engine that is emitting excess concentrations of NOx	Page 10-87
		Predictive emission monitoring	Engines in plant	Continuous	PEM equipment	EDP	Comparison to the Project Fuel cell Emission Limits	Perform diagnostic and maintenance for any engine that is emitting excess NOx	Page 10-87
		NO2 Soil Concentrations	Off-site, permanent monitoring site	Continuous 20 days for one year	According to NSO 13.11.01: 01, Table 1, electrochemical analyzer or similar	EDP	Comparison NSO 13.11.01: 01, Nitrogen Dioxides: 150 µg / Nm3, for 24 hours	Apply measures to reduce the concentration in the ambient air	Page 10-87
Operations	**Prevention** **2. Noise Monitoring**	(Off-site) Environmental noise, including low-frequency noise	In the four points in near residential areas, used for the baseline and in boundary	Annual and thereafter only if complaints are received from the population	Monitoring to be performed according to Acoustics international standard 9613-2	EDP	Noise in residential areas shall be less than 55 dB (A) during the day and not more than 3 dB (A) of the noise measured at baseline, at night: L1 50 dB (A), L2 54 dB (A), L3 56 dB (A) and L4 45 dB (A). 70 dB (A) on property boundary.	If the excess noise identified after analysis determines potential sources and remedial measures	Page 10-91
Operations	**Prevention** **3. Spills and Personal Protective Equipment**	Installation of all equipment and operation test	Tank yards, cargo rack and bottling plant	Biannual	Equipment Operations Report, Preventive Maintenance and Inventory of Spill and Containment Equipment	EDP	Preventive maintenance and inventory of spill and containment equipment	Replacement of defective equipment	Page 10-92
Operations	**Prevention** **4. Environment, hygiene and safety training**	Training and accident records	In offices to staff	Biannual	Interviews to personnel	EDP	Prevent damage to personnel, infrastructure and the environment	Updating of training topics	Page 10-93
Operations	**Prevention** **5. Environmental, Hygiene and Safety Plans and Procedures**	Containers for solid waste and handling of hazardous materials	Waste collection site	Monthly	Visual Inspection and Photographic Record	EDP	Prevent contamination of soil and water	Ensure transport and proper disposal and proper use of latrines	Page 10-94
Operations	**Prevention** **6. Relationship with the community**	Verify the information of the population about the project and conflicts that arise	Record of meetings and complaints	Monthly	Review complaints and their resolution	EDP	Verify that project information and conflict resolution have been provided	Improve the media and attention to complaints	Page 10-96
Operations	**Attenuation** **7. Dock lightning Plan**	Lighting on the jetty	Jetty	Monthly during construction	Visual Inspection and Photographic Record	EDP	Lighting should not be directed to sea water	Correct the lighting direction	Page 10-97
Operations	**Compensation** **8. Reforestation and Support to FIAES**	Number of species planted, donation record	Green Areas of the land	Monthly	Visual inspection and photographic record	EDP	Compensation for deforestation	Care and maintenance	Page 10-98
Operations	**9. Well Flow Monitoring Equipment and Monitoring Wells**	Well water	Water from extraction well and monitoring of wells	Biannual (2 times a year) for physicochemical parameters. Monthly (12 times a year) piezometer inspection.	Laboratory analysis method according to NSO 13.11.01: 01	EDP	Comparison with baseline conditions and water quality criteria	If the monitoring detects signs of intrusion, the project should review the consumption and look for alternative sources	Page 10-100

Table 2.6 – Monitoring Program Stage of Operations

Execution stage	Environmental Activity	Parameters to consider	Place or Monitoring Point	Frequency of Monitoring	Method to Use	Responsible for Monitoring	Interpretation of Results	Feedback	Reference in Impact Description Text
Operations	**10. Surface water quality**	Oils and Fats, Hydrocarbons	Wastewater discharge points, prior to discharge	Quarterly (4 times per year)	Laboratory analysis method according to NSO 13.11.01: 01	EDP	Comparison with standards	If monitoring detects project-related pollution, then take corrective action to stop additional pollution and investigate the need for corrective action	Non-applicable
Operations	**11. Water quality of effluent from domestic wastewater treatment system**	BOD 5, COD, pH, Oils and Fats Sedimentary solids Total Suspended Solids, Total Coliforms (CT)	Domestic wastewater from the treatment plant of Central Thermal PowerPlant , FSU and FSRU.	Quarterly (4 times per year)	Laboratory analysis method according to NSO 13.11.01: 01	EDP	Comparison with standards	If monitoring detects project-related pollution, then take corrective action to stop additional pollution and investigate the need for corrective action	Non-applicable
Operations	**12. Presence of disease vectors**	Presence of mosquito larvae	Areas of stagnant water, such as rainwater ponds and the site in general	Twice a week during the rainy season. Monthly during dry season	Visual inspection	EDP	Presence of breeding habitat, presence of larvae in water	If larvae are detected, corrective actions should be taken to solve the problem	Non-applicable
Operations	**13. Marine Fauna**	Presence of marine biota inside the breakwater of the terminal. Amount and type of fish caught	Marine Terminal	Weekly for one year and monthly after first year	Visual inspection	EDP	A significant number of species, particularly those considered significant, should not be trapped within the breakwater nor be captured through water intake.	Replace the grid in the openings of the breakwater and in the water intake openings, consideration of displacement screens/meshes if necessary	Non-applicable
Operations	**14. Water discharge from FSU and FSRU**	Temperature	Water discharge points	MOnthly	Temperature sensor	EDP	Should not be greater than 5ºC of the body temperature recipient	Take corrective actions to reduce temperature, prior to discharge	Non-applicable

Table 2.7 – Schedule of the Environmental Management Program, Operation Phase

Stage of Execution	Environmental Measure	Execution Time (Quarters since Start of Operations)												Estimated Amount of Environmental Measure
		YEAR 1				YEAR 2				YEAR 3				
		1	2	3	4	5	6	7	8	9	10	11	12	
Operations	**Prevention** **1. Emission Monitoring**													$33,000.00
Operations	**Prevention** **2. Noise Monitoring**													$3,000.00
Operations	**Prevention** **3. Spills and Personal Protective Equipment**													$9,860.00
Operations	**Prevention** **4. Environment, hygiene and safety training**													$3,000.00
Operations	**Prevention** **5. Environmental, health and safety plans and procedures**													$13,140.00
Operations	**Prevention** **6. Relationship with the community**													$33,750.00
Operations	**Attenuation** **7. Dock Lightning Plan**													$1,000.00
Operations	**Compensation** **8. Maintenance for reforestation and Support to FIAES**													$142,957.80
Operations	**Prevention** **9. flow monitoring equipment and monitoring of wells**													$ 3,600.00
TOTAL AMOUNT OF ENVIRONMENTAL MEASURES OPERATIONS PHASE														**$243,307.80**

Energía del Pacífico

Project: LNG to Power
Chapter 3: Purpose and Need

December 2016 – 16-3489

ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

DILLON CONSULTING

3.0 Purpose and Need

3.1 Objetive of the Project

The objective of the project is to build and operate an LNG terminal, as well as an electricity generation plant based on natural gas, in the municipality of Acajutla, with the purpose to enable EDP to provide up to 355 MW of electric power to distribution companies in El Salvador.

3.2 Purpose and Need

El Salvador, like most Central American countries, has the need to: (i) have additional generation capacity to meet increasing demand for electricity and to replace inefficient and obsolete units; (ii) To diversify its energy sources or energy matrix, and (iii) to reduce the cost of electricity. Currently, 50% of the country's electricity generation comes from fossil fuels such as diesel and oil. This has resulted in high costs for electricity in recent years, with average prices of around US $ 180 / MWh and tariffs for end users above US $ 230 / MWh, until 2014, which has led to significant limitations to the economy, adversely affecting the competitiveness of local industries, as the matrix has not been diversified with the option of other fuels.

The project is consistent with the current energy policy of the Government of El Salvador, which aims to reduce the dependence of the generation of electricity derived from oil up to 15%. The project will collaborate with this objective, through the development of facilities to import, store and vaporize LNG, and thereby provide the natural gas to feed the power plant.

The project represents the first real opportunity to build an LNG terminal in Central America, which may serve not only to generate cleaner and cheaper electricity, but it could also mean the introduction of natural gas to industry, transport sector, and households in El Salvador and its neighboring countries. Another important benefit of the project is the possibility of converting other power plants, that are currently using petroleum products, to natural gas. The project also represents the largest investment made by the private sector, in an infrastructure project in the history of the country.

Well-structured natural gas-fired power generation plants have the potential to reduce Central America's dependence on imported petroleum-derived fuels. LNG can meet the fixed energy needs. As well, the ability for rapid start-up and shutdown of gas fired engines, will complement renewable energy generation in the region. This supports the current energy policy of the government of El Salvador that aims to increase the share of alternative and renewable energy above 50%.

Finally, the introduction of natural gas as fuel to other customers, such as power plants and other uses, will significantly reduce emissions of harmful pollutants such as nitrogen oxides, sulfur dioxide and

particulate matter. It also produces approximately 37% less carbon dioxide per unit of energy, compared to oil, and 50% less than coal. In this way, natural gas is considered by many as a "bridge fuel" that can help nations reduce their carbon emissions while making the transition from fossil fuels to renewable or carbon-neutral forms of energy. The recent boom in natural gas production in the United States, for example, contributed to a 3.8 percent drop in carbon emissions in 2012.[1]

3.3 Legal Base of the Project

The Project is the result of a competitive bidding process launched by the Government of El Salvador. In order to achieve its objective of increasing electricity generation through sources other than petroleum-derived fuels, as well as reducing overall electricity prices, Salvadoran electricity regulator SIGET, required from the electricity distribution companies to issue a competitive tender for long-term energy purchase agreements for a total of 355 MW.

On December 20, 2013, EDP signed fourteen supply contracts with distribution companies, and thereby establishing the legal basis for the development and operation of the Project. The contracts were executed with the following seven distribution companies (two contracts per distribution company) in accordance with the volumes of energy to be supplied, as indicated by means of a tender and in accordance with the objective of the bidding process coordinated by the SIGET: CAESS, S.A. de C.V.; DELSUR, S.A. de C.V.; AES CLESA y CIA. S. en C. de C.V.; EEO, S.A. de C.V.; DEUSEM, S.A. de C.V.; B & D, S.A. de C.V.; and, EDESAL, S.A. de C.V.

Energía del Pacífico

Project: LNG to Power
Chapter 4: Project Description and Its Alternatives

December 2016 – 16-3489

ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

DILLON CONSULTING

4.0 Project Description and Its Alternatives

The “LNG TO Power Project” consist in the installation of a Thermal Power Plant for electrical energy generation with a net capacity of 378 MW, using natural gas as fuel and a Marine Terminal to receive the Liquefied Natural Gas (LNG) and to transform it in Natural Gas (NG).

At the Marine Terminal, the LNG is transferred from the Liquid Natural Gas Carrier (LNGC) ship to the Floating Storage Unit (FSU), the FSU is permanently moored at the Marine Terminal for LNG storage. From the FSU, the LNG is transferred to the Floating Storage and Regasification Unit (FSRU), the LNG is regasified and sent to land to the Power Generation Plant through a pipeline, a section of the pipeline will be on or under the seabed, and a section on-land, where it will be buried below surface.

The electrical power plant of 378 MW, will consist of:

- 19 internal combustion engines Wärtsilä 18V50SG with 18.3 MW of capacity each one, for a total generation of 348 MW.
- One steam turbine of 30.0 MW. The steam turbine will use the exhaust engine gases for a combined cycle.
- Electrical energy substation.
- Support facilities, such as parking lots, guardhouse, fire system, among others.

The Marine Terminal will protect the FSRU barge within a cellular structure or breakwater. The FSU will be moored at the Marine Terminal and will be permanently docked, except for extreme weather conditions.

The LNG Marine Terminal, shall consist of the following components:

- One FSU (Floating Storage Unit), vessel ship almost permanently moored to the breakwater.
- One FSRU (Floating Storage and Regasification Unit), vessel ship moored permanently and surrounded by the breakwater.
- One breakwater, consisting of a cellular cofferdam or caissons to protect the FSRU, and for the mooring of the FSU and LNG vessel.
- LNG transfer systems and access platforms.
- Natural gas pipeline, subsea pipeline section and on-land (underground) pipeline section, which will transport the gas supply from the FSRU to the power plant, with ground protection and measurement equipment.

The Project is located in the Port of Acajutla, within Acajutla Municipality, Sonsonate Department, El Salvador. The geographical coordinates of the project site at the Port of Acajutla are: 13 ° 34'59 "N and length 89 ° 49'43" W. See Figure 4.1.

4.1 Alternatives Analyses and Project Optimization

4.1.1 Project Alternatives

The international public bidding process, coordinated by DELSUR in 2013, awarded to Energía del Pacífico (EDP) to provide 355 MW of new electricity capacity to be delivered to seven distribution companies in the country. The tender followed the regulations specified by the CNE[1] and SIGET[2], which established the following:

- Agreement for the purchase and sale of energy for a period of 20 years; and,
- Prohibited the use of oils and petroleum coke as fuel.

Two proposals were received for the tender:

- A 170 MW coal-fired power plant, with a price of $ 135 / MWh, offered by AES FONSECA ENERGÍA ("AES-FE Offer"); and,
- A natural gas-based 378 MW generation plant, priced at $ 119 / MWh, offered by EDP ("EDP Offer").

The bids were evaluated considering the electric power costs and the technical criteria of the Project. The bidding documents (APPENDIX No.2, INTERNATIONAL PUBLIC TENDER, No. DELSUR-CLP-001-2012) indicated that the qualification process would evaluate the following parameters:

1. Provision of fuel for the Project;
2. Experience in the development of energy generation projects;
3. Experience in the operation of power generation plant projects;
4. Compliance with the environmental regulations associated with the Project;

[1] The National Energy Council (Consejo Nacional de Energía CNE) is the supreme, governing and regulatory authority in matters of Energy Policy and coordinator of the different sectors of the energy sector. Its mission of being the Governing Body of the National Energy Policy.

[2] The General Superintendence of Electricity and Telecommunications (Superintendencia General de Electricidad y Telecomunicaciones SIGET) is an autonomous non-profit public service institution with powers to apply the rules contained in the international treaties on electricity and telecommunications in force in El Salvador, Electricity and Telecommunications, and its regulations, as well as to apply in accordance with the provisions of the General Electricity Law the protection of the rights of users and all entities that carry out activities in the sector.

5. Electrical interconnection to the transmission system; and
6. Technical specifications of the Thermal Power Station.

On November 25, 2013, the results of the evaluation of the Bid were submitted through the document for adjudication for the process named "Licitación Pública Internacional No. DELSUR-CLP-001-2012", indicating that he association QUANTUM-GLU had been adjudicated. The company QUANTUM-GLU, once declared winner of the bidding process, proceeded to constitute the company Energía del Pacífico S.A. de C.V., the company in charge of developing the power generation project.

4.1.2 Alternatives designs and Optimization

During the project planning process, the following alternatives for the development of the Project were analyzed, and studies were carried out to optimize the project:

- Site selection;
- LNG storage system;
- Cooling system of the Thermal Power Plant;
- Water supply system for the Thermal Power Plant;
- Project Distribution; and
- Design of the Marine Terminal.

The analysis of each of these above points is detailed below.

4.1.2.1 Site Selection

To select the Project location, it was decided to search for a land parcel close to port facilities to facilitate the receiving of LNG/NG. Initially during project development, a Marine Terminal was not considered and natural gas is not available in the country.

The two main ports in El Salvador were evaluated, Acajutla and La Unión, and the port of Acajutla (managed by CEPA) was the one that offered the greatest advantages, since it is an operational port and has experience in the handling of fuels and hazardous materials. Through this Port, most of the liquid fuels into the country are received. Other advantages of this location were:

1. CEPA has land available for construction;
2. The equipment can be unloaded at the present pier;
3. The whole area surrounding the available land has industrial use; and
4. Greater proximity to highest energy demand in the country.

4.1.2.2 LNG Storage

Several alternatives for LNG storage were evaluated as part of the project planning phase:

1. FSRU with large capacity, this option implies:

    a. A cargo vessel equipped with LNG storage tanks and all equipment required for regasification;
    b. Pipeline to transport the natural gas produced by regasification, to the Thermal Power Plant;
    c. Onshore storage and LNG management systems to provide fuel to the Power Plant during periods of extreme weather and when both the FSU and FSRU must be moved offshore; and a jetty for access to the FSRU.

2. FSU and an onshore storage tank, this option involves:
    a. A vessel equipped with LNG storage tanks (FSU);
    b. LNG storage tank on land;
    c. Equipment for LNG regasification;
    d. Pipelines and cryogenic insulation for the transfer of LNG to the onshore storage tank and the regasification equipment; and a jetty for access to the FSU.

3. Vessel for regasification/storage (FSRU) and vessel for storage (FSU), this option involves:
    a. FSU for LNG storage and feeding of the regasification plant with LNG.
    b. FSRU with regasification and 50.000 m^3minimum LNG storage.
    c. Pipeline to transport the natural gas to the Thermal Power Plant.
    d. The FSRU will provide fuel to the Power Plant continuously, or storage when the FSU is at open sea.

Alternative three was selected as the optimal option for the reasons provided in Table 4-1. It is important to note that discontinuous gas delivery was one of the main reasons for eliminating alternative one. While alternative two was discarded due to the longer construction time, which made it impossible to deliver the energy within the required timeline.

Table 4.1 – Alternatives evaluation for the Marine Terminal			
Criteria	**Alternative 1 Large floating storage unit and regasification (FSRU)**	**Alternative 2 Floating storage unit (FSU) and storage tank onshore**	**Alternative 3 Vessel for regasification/storage (FSRU) and vessel for storage (FSU)**
Foot print and impact with respect to safety distances	Low, LNG at sea	High, LNG Tank onshore	Low, LNG at sea
Continuous availability of natural gas to the Thermal Power Plant	NO, in extreme weather situations	YES, from tank onshore	YES, from FSRU with protection structure
Compliance with the energy delivery time established in the PPA	Unlikely, by dock construction	NO, by tank on land construction and dock construction	YES, availability of boats
TOTAL	**NORMAL**	**NORMAL**	**LOW**

Source: Consulting Team.

4.1.2.3 Thermal Power Plant Cooling System

The power plant project has two cooling systems; the cooling system of the motors and the cooling system of the steam cycle.

The cooling system of the engines to be used in the project uses a closed water circuit with fin radiators and fans, which has a minimum water consumption.

Three alternatives were considered for the cooling of the steam cycle system, from which the radiator cooling system alternative was selected, same method as for the engine cooling. The following are the key attributes of each of the systems considered:

1. **One-step cooling system with sea water:** This system requires the construction of a structure for the water supply and pipes, pumping system, and structures, as well as pipes for discharge of cooling water.

One-step cooling systems draw water from nearby sources (e.g. the ocean), circulate it through pipes that absorb heat from vapor systems called condensers, and discharge the warm water back to the source. In one-step systems, the cooling water passes through the heat exchanger only once. When using large volumes of water, the temperature increase in the effluent is small and the mineral content is essentially unchanged.

However, this type of system can lead to impacts such as entrapment of marine species in the intake of water, periodic use of biocides and other chemicals to control corrosion and discharge of water at a temperature different from that of the effluent.

2. **System with cooling towers:** Open recirculation systems consist primarily of circulating the water through a cooling tower and from the cooling tower to the equipment to be cooled.

A cooling tower system for the project would use 300 m^3/h of water. This amount of water would need to be supplied from an onshore well, several kilometers from the project, to avoid interference with

other existing wells near the site and also, to avoid the risk of saline intrusion. In addition to the consumption of large amounts of water, the system would also generate considerable amounts of wastewater to be discharged into the ocean.

Cooling towers are also a source of noise, which is a cause for concern due to the proximity of certain residential areas to the project. Part of the analysis for the project, identified that noise from cooling towers could be a source of nuisance in the population.

3. **Cooling system with radiators:** This system uses air instead of water to cool the steam. This system uses minimal amounts of water, although it has a lower efficiency compared to water cooling systems and generally affects the fuel consumption of the Thermal Power Plant. For the Project, a radiator system mounted on the roof of the engine room, similar to those used in the engine cooling system of the vehicles, will be used.

In general, the radiator cooling system was selected as the preferred system for cooling the steam cycle. Although it is less efficient than water cooling systems, it avoids the negative effects on marine life associated with a seawater cooling system. Compared to cooling towers, it is less noisy, and would use much less water and avoids the need for new wells to be located outside the property, several kilometers away, and the associated water supply pipe.

4.1.2.4 Optimization in the Design of the Marine Terminal and the Thermal Power Plant

The arrangement for the location of the pipeline, the Marine Terminal/FSU/FSRU and the layout of the Thermal Power Plant, went through numerous reviews before reaching the final layout, as presented in this EIA (Environmental Impact Assessment) Report.

The key factors considered in the final design for the Marine Terminal include:

- Provide a minimum of 600m separation distance between the existing CEPA pier and the offshore facilities of the Project (FSU, FSRU and cofferdam/breakwater);
- Maintain a minimum separation distance of 500 m between the Project and the facilities of CENERGICA;
- Avoid CENERGICA pipes located to the north; and

- Have adequate water depth for safe maneuvering and mooring of FSU and LNGC vessels that will visit the site.

The location of the Thermal Power Plant was initially configured with the power house located towards the north end of the property, and the axis oriented from east to west. The LNG storage tank was to the south, in line with the dock and LNG pipeline. The initial design was modified to obtain the final design presented in this EIA report, considering the following factors:

- Reorientation of the engine room to the south, and in a north-south axis, first, to manage the propagation of noise to the nearest residential areas, and, second, to orient the Thermal Power Plant in line with the new electrical substation to be installed, with access to the ETESAL substation to the east and connection to the transmission line to the north;
- Provision of space for the installation of groundwater wells and possible facilities for wastewater management south of the property; and
- Orientation of the access points considering the changes planned by CEPA to the security controls of the port.

4.2 Site Location and Boundaries

4.2.1 Site Location

The "LNG TO POWER" project will be located within the existing industrial zone in the Port of Acajutla, within land leased to the COMISIÓN EJECUTIVA PORTUARIA AUTÓNOMA (CEPA). The location of the project in general is shown in Figure 4.1.

4.2.2 Property Area and Sector to Occupy

The total land owned by CEPA has an extent of 2,086,082.02 m^2, within which a portion of land has been leased to the project holder, comprising a total area of 126.431.09 m^2. The area is presented in the Table 4.1, it is included the land to establish for the pipeline easement, and the laydown area during the construction.

Table 4.2 – Areas to be Occupied by the Project Inside the CEPA Property	
Description	**Area (m^2)**
Land for the Thermal Power Plant	126,431.09
Land for NG pipeline from the Marine Terminal to the Thermal Power Plant	15,976.68
Land to be leased for the pipeline passage and collection area during construction	40,876.53
Total areas of the Project on land	183,284.30

Source: Own elaboration based on project plans

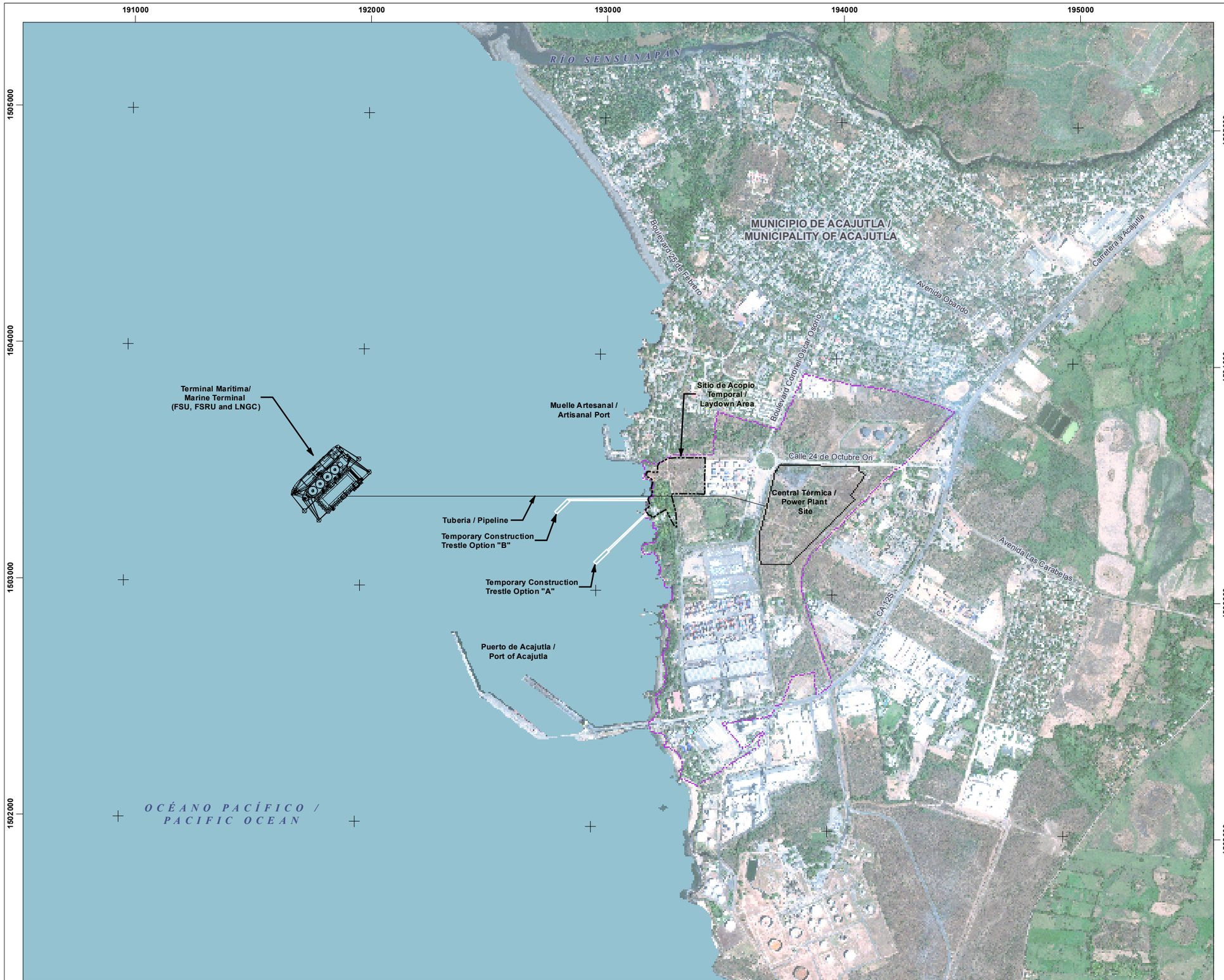
In Appendix 6E, it is presented a lease promise document between CEPA and EDP stating that the land for the pipeline and for laydown area is available for lease to EDP. Also within the lease of the main document it is established that an easement will be issued for the land where the pipeline will be located, land that is available as explained in the document in Appendix 6E.

4.2.3 Site Qualification and Construction Line

The feasibility of Site Qualification and Line Construction permit for the site of the Thermal Power Plant, issued by VMVDU ("Viceministerio de Vivienda y Desarrollo Urbano", Vice-Ministry of Housing and Urban Development), categorized the land as "Industrial" (based on the location, density and degree of urbanization). In Appendix 4A, it is included the "Site Qualification and Construction Line permit".

4.2.4 Topographical Plan

The land where the Thermal Power Plant will be located is flat, with a soft slope down to the south, with no existing buildings. Its current use is vacant. The plans are included in Appendix 4B, "Topographical plan of the property". Also included are the topographical plans of the pipeline and laydown area, which will be used during the construction.



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LNG TO POWER PROJECT

ÁREA DE UBICACIÓN DEL PROYECTO / PROJECT LOCATION

FIGURA 4.1 / FIGURE 4.1

- SITIO DEL PROYECTO / PROJECT SITE
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA
- TERRENO PROPIEDA DE CEPA / CEPA PROPERTY

0 100 200 400 m

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PROYECTO / PROJECT: 163489
ESTADO / STATUS: FINAL / FINAL
FECHA / DATE: 12/2/2016

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4.2.5 Boundaries

The land use of the properties to be used for the project are detailed below and are presented in the Figure 4.2.

1. Land use of the Marine Terminal
    a. NORTH: Artisanal fishers dock about 1 kilometer;
    b. SOUTH: Port of Acajutla about 730 meters;
    c. EAST: Lands of the Port of Acajutla, used as gardens and for residence of the port employees, and;
    d. WEST: Pacific Ocean (see Photo 4.1).

Photo 4.1 – North and South views of the Marine Terminal

NORTH: ARTISANAL FISHERS' PIER	SOUTH: PORT OF ACAJUTLA PIER

Source: Own elaboration Eco Ingenieros / Dillon

2. Land use of the pipeline and the collection area
    a. NORTH: Land owned by CEPA, current boardwalk Acaxual and parking lot used by the company OPSAL for trucks and trailers parking;
    b. SOUTH: Gardens, employee residences and harbor recreation area;
    c. EAST: proposed Thermal Power Plant site; and
    d. WEST: Pacific Ocean (see Photo 4.2).

Photo 4.2 – South and North views of the pipeline

SOUTH: PORT GARDENS AND SPORTS FIELD	NORTH: ACAXUAL BOARDWALK AND TRUCK PARKING LOT

Source: Own elaboration Eco Ingenieros / Dillon

3. Land use of the Thermal Power Plant

The closest boundaries are:

a. NORTH: Vacant CEPA properties and CENERGICA Fuel Terminal, separated by East "28 de Octubre" street;
b. EAST: Acajutla Thermal Power Plant (owned by Duke Energy International) and the site where CEPA's water well is located, and vacant property of ETESAL, with the railway line and easement of transmission line, also property of ETESAL in between;
c. SOUTH: Vacant land owned by CEPA; and
d. WEST: CEPA properties, used for trucks and trailers parking, with Boulevard Coronel Oscar Osorio and CEPA main access gate in between. (See Photo 4.3).

Photo 4.3 – North, South, East and West views of the Thermal Power Plant

NORTH: CENERGICA FUEL TERMINAL	SOUTH: VACANT PROPERTY OWNED BY CEPA
EAST: ACAJUTLA THERMAL POWER PLANT	WEST: TRUCKS PARKING LOT

Source: Own elaboration Eco Ingenieros / Dillon

4. Land for pipeline and collection area location:
    a. NORTH: Houses and Acajutla city Cemetery, with the 24 de Octubre street in between.
    b. SOUTH: Gardens and recreation zone of the port;
    c. EAST: Land owned by CEPA, leased for parking of trailers and containers; and
    d. WEST: Pacific Ocean. (See Photo 4.4)

Photo 4.4 – East and North views of the Laydown area

EAST: CONTAINERS PARKING LOT	NORTH: HOUSES OF THE CITY OF ACAJUTLA

Source: Own elaboration ECO Ingenieros/Dillon

193000
193500
194000
194500
1504000
1503500
1503000
1502500

MUNICIPIO DE ACAJUTLA /
MUNICIPALITY OF ACAJUTLA

Boulevard 25 de Febrero
Boulevard Coronel Oscar Osorio
Carretera a Acajutla
Calle 24 de Octubre Ori
CA 12S

Escuela / School
Zona Urbana / Urban Area
Zona Urbana / Urban Area
Zona Urbana / Urban Area
Muelle Artesanal / Artisanal Port
Sitio de Acopio Temporal / Laydown Area
Estacionamiento Para Camiones / Truck Paving
Baldío / Vacant (CEPA)
Terminal Combustibles / Fuel Terminal (Cenergica)
Servygram
Estación de Policía / Police Station
Estacionamiento Furgones / Van Parking (OPSAL)
Baldío / Vacant
Well/Pozo (CEPA)
Baldío / Vacant
Parque "Malecon Acaxual" / "Malecon Acaxual Park"
Residencias Empleados / Employees Residence (CEPA)
Baldío / Vacant
Complejo Deportivo / Sports Complex
Central Térmica / Power Plant Site
Línea de Transmisión / Powerline Corrrídor(ETESAL)
Central Térmica / Power Plant (Duke Energy)
Subestación / Substation (ETESAL)
Baldío / Vacant (CEPA)
Bodegas / Storage Area (CEPA)
Baldío / Vacant (ETESAL)
Comunidad Informal / Informal Community
Patio Contenedores / Shipping Containers (MARUSA)
Lubricantes / Lubricants (TEXACO)
Terminal Comubstibles / Fuel Terminal (PUMA)
PROFESAL
FERTICA
GASOHOL
ALCASA
SUMA
IMINSA

Tuberia / Pipeline
Temporary Construction Trestle Option "B"
Temporary Construction Trestle Option "A"
Puerto de Acajutla / Port of Acajutla

OCÉANO PACÍFICO / PACIFIC OCEAN

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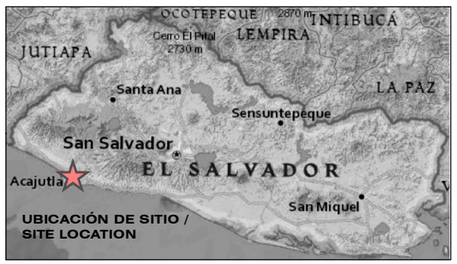
USO DE TERRENOS ADYACENTES / PROJECT ADJACENT LAND USE

FIGURA 4.2 / FIGURE 4.2

- SITIO DEL PROYECTO / PROJECT SITE
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA
- TERRENO PROPIEDA DE CEPA / CEPA PROPERTY



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PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL / FINAL
FECHA / DATE: 12/8/2016

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4.3 Access to the Project

4.3.1 Accesses to the site of the Thermal Power Plant and Laydown Area

The accesses to the project are detailed below:

1. Thermal Power Plant

The access to the site where the Thermal Power Plant will be built and the land for the pipeline and Laydown area will be by through the paved road that leads to the Port of Acajutla crossing in the 24 de Octubre East street to the Boulevard Oscar Osorio, where it is the current access to the property (seePhoto 4.5).

Photo 4.5 – 24 de Octubre East Street

Source: Own elaboration Eco Ingenieros/Dillon

For the collection of materials and equipment, which are not imported through the Port, it will be necessary to reopen a section of Calle 24 de Octubre, so that trucks and heavy equipment do not pass through the middle of the town. This stretch is currently closed, but it is already built and is feasible to use.

The access of imported equipment and materials will be through the Port of Acajutla, on the main road of the Port, crossing at 24 de Octubre Street. In this road light and heavy transport moves to and from the Port. The Figure 4.3 shows a diagram of the planned accesses during the construction of the project.

The heaviest project component to be transported through the Port of Acajutla are the engines and generators, which by their weight and dimensions will be taken directly to their final site of placement. The capacity of the pier to receive this size of load and the route, which is presented in Figure 4.3, was

reviewed by CEPA. For this defined route, there are no restrictions by weight and height to receive the load, except telephone lines and power lines (low voltage) that will be temporarily removed.

The rest of materials and equipment coming from abroad, will follow the same route, but as they come in containers, it is not necessary to remove the mentioned power lines.

Local material: agretates, steell, cement blocks, sheets, wood, etc., will be taken to the Thermal Power Plant using the road to the Port of Acajutla, crossing on 24 de Octubre Street.

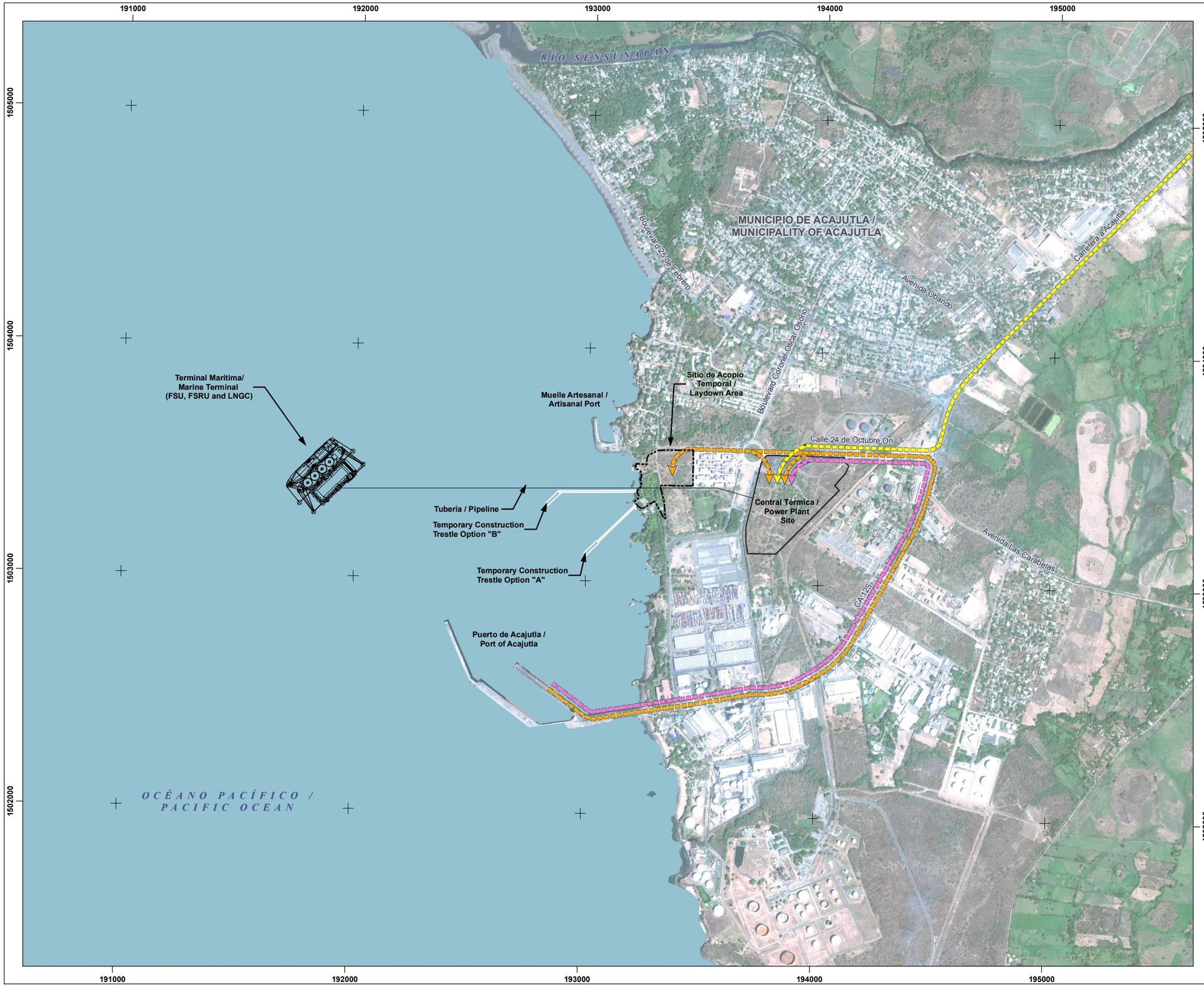
The 24 de Octubre Street is crossed by light and heavy vehicles, to and from the entrance of the Port. The traffic in this street can be considered low, counting of vehicles in peak hours ranging between 20 and 200 vehicles per hour.

4.3.2 Access to the Marine Terminal

For the loading and unloading of personnel, consumables and waste, the FSRU's protection structure will have an access platform. The access platform will be reached by means of the periodic use of a work boat of 20 to 30m in length.

On the platform, there will be cranes and equipment necessary for the movement of supplies and equipment. If necessary, the FSU may move away from the structure to facilitate direct access to the FSRU and larger equipment.

The project will load and unload crew, consumables and debris using a 20-30-meter workboat and existing CEPA facilities that will be leased to the project at regular rates.



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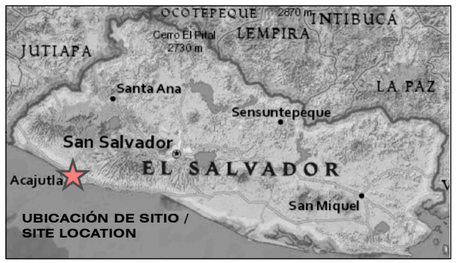
LNG TO POWER PROJECT

RUTA DE EQUIPOS Y MATERIALES PARA LA CONSTRUCCIÓN DEL PROYECTO/ PATH OF EQUIPMENT AND MATERIALS FOR THE PROJECT CONSTRUCTION

FIGURA 4.3 / FIGURE 4.3

- RUTA DE ACCESO MOTORES / ROUTE ENGINES ACCESS
- CAMINO DE ACCESO OTROS EQUIPOS DEL EXTERIOR / ROAD ACCESS OTHER EQUIPMENT FROM ABROAD
- ACCESO POR CARRETERA DE MATERIALES LOCALES / ROAD ACCESS LOCAL MATERIALS
- SITIO DEL PROYECTO / PROJECT SITE
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA



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PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL / FINAL
FECHA / DATE: 12/8/2016

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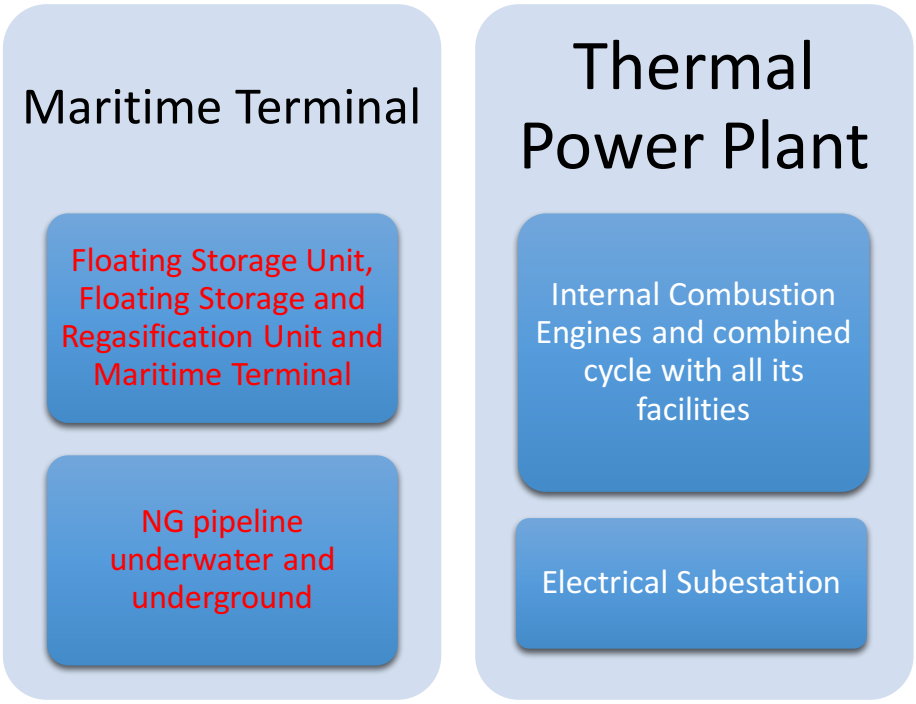
4.4 Scope of the Project

4.4.1 Elements of the Project

The Project consists of two main elements: Marine Terminal and Thermal Power Plant, as illustrated in Figure 4.4.

Figure 4.4 – Elements of the Project



Source: Own elaboration DILLON-ECO

4.4.1.1 LNG Marine Terminal

The Marine Terminal for the reception of LNGC tankers and storage of the product, consists of the following elements:

A FSU that will remain almost permanently docked to the Marine Terminal breakwater, within which the FSRU will remain moored. The FSU consists of a ship new or to be built, used to transport and store the LNG. The FSRU barge within the Marine Terminal will regasify the LNG; and a pipeline with underwater (sea) section and underground (onshore) section to transport the NG from the FSRU to the Thermal Power Plant.

4.4.1.2 Thermal Power Plant with Combined Cycle

The Thermal Power Plant with 378 MW of power capacity will operate with natural gas as fuel and will consist of:

- 19 internal combustion engines Wärtsilä 18V50SG with 18.3 MW of capacity each one, for a total generation of 348 MW;
- A combined steam cycle that will use engine exhaust gases to produce steam to be used in a steam turbine of 30.0 MW; and
- Electrical substation.

4.4.1.3 Delivery of Energy

To interconnect the project to the national electricity grid, it will be required the construction of a high voltage transmission line of 230 kV. This transmission line is being developed through another evaluation process.

4.4.2 Phases of the Project

The project comprises the following phases:

1. Site preparation, construction, start-up tests;
2. Operation, where the energy will be generated from natural gas; and
3. Decommissioning, the decommissioning phase is described, although the Thermal Power Plant and the Marine Terminal with adequate maintenance can operate more than 20 years covered by the signed contract.

4.4.3 Scope of the Thermal Power Plant

The gross capacity of the Thermal Power Plant in environmental conditions of design is detailed:

- Active electrical power (engine generators): 356 MW;
- Active electrical power (steam turbine): 30 MW; and
- Total active electrical power: 386 MW.

The internal consumption of the Thermal Power Plant is 8,501 kW, which is necessary for the operation of the own equipment that make operate the plant. The net capacity of the Thermal Power Plant in environmental conditions of design is detailed:

- Net power will be: 378 MW; and
- Heat Rate: 7800 BTU / kWh (Higher Calorific Content).

The Thermal Power Plant is designed to operate in optimum combined cycle, but can operate in single cycle when the steam turbine is under maintenance. The combined cycle includes the single cycle (combustion of fuel in the engine) and a second cycle which is the use of hot exhaust gases from the

engine to produce steam which drives a steam turbine. If the power plant operates in a single cycle, the specific consumption of the plant (or each engine) is 8,256 Btu / kWh HHV, while operating in the combined cycle the specific consumption of the plant (or each engine) is 7,800 Btu / kWh HHV. To operate the combined cycle, at least four motors must be operated.

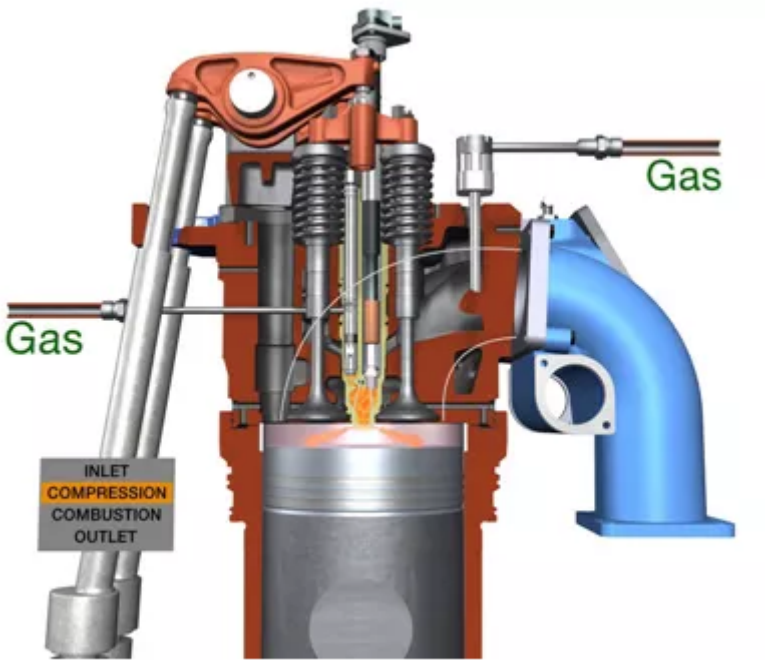
The estimated LNG consumption for the Power Plant is between 70,000 m^3 and 100,000 m^3 per month, which means that given the size of the LNG vessels mentioned in section 4.8.4, it is expected to require about 8 LNG deliveries per year. If it were possible to sell natural gas to other companies, it has the capacity to provide up to three times the amount required for the Thermal Power Plant, which would result in up to 32 LNGC deliveries per year.

4.4.4 Type of Energy Conversion System

The engines operate with the "Otto" combustion cycle, with low pressure gas. In this process, the gas is mixed with air before the inlet valves. During the period of admission, the gas is also fed into a small pre-chamber, where the gas mixture is rich in air as compared to the gas in the cylinder. At the end of the compression phase the gas / air mixture in the pre-chamber is ignited by a spark plug (Figure 4.5). The flames in the pre-chamber nozzle ignite the gas / air mixture throughout the cylinder. After the working phase the cylinder is emptied of the exhaust gas and the process starts again. The balance of energy and mass of the Thermal Power Plant is presented in Section 4.8.1 and is shown in Figure 4.13.

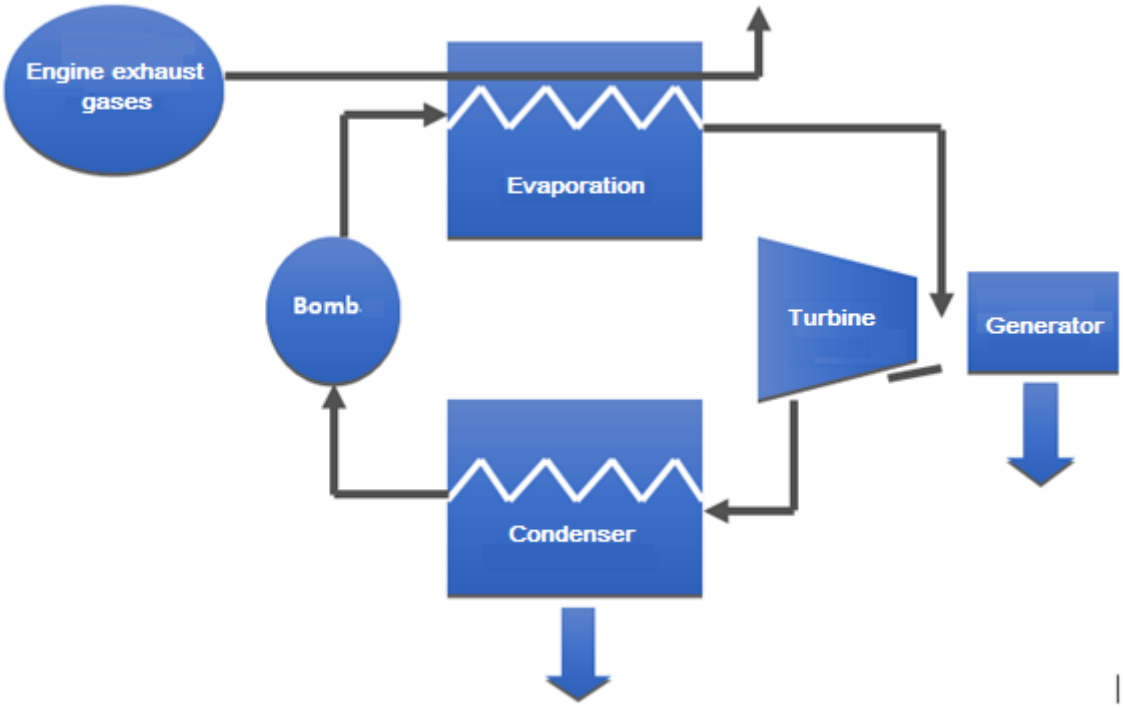
And the conventional water / steam turbine (Rankine cycle), for the combined cycle, is shown in Figure 4.6. The configuration of the Thermal Power Plant will allow the project to have a net efficiency of 49.4%.

Figure 4.5 – Combustion Cycle Compression Phase



Fuente: Wärtsilä 2014

Figure 4. 6 – Combined Cycle Operation Diagram



Source: Own Elaboration ECO- DILLON

4.4.5 Facilities and Infrastructure Description

The project will be located in the facilities of the Port of Acajutla, on land owned by CEPA, as already mentioned. The main components of the project with their respective areas are presented below. In Appendix 4C, each of the areas to be occupied by the Project is presented in detail (see Table 4.3, Table 4.4 and Table 4.5).

Table 4.3 – Areas to be occupied by the Project in the field of the Thermal Power Plant and Electrical Substation

Description	Area (m^2)	Percentage
Electrical Substation	23,254.27	18%
Main building	21,019.53	17%
Retention pond	1,252.48	1%
Parking lot	702.39	1%
Various structures	1,819.26	1%
Streets	5,700.26	5%
Area for 4 wells	314.60	0%
Area of future use	49,337.03	39%
Green space Area	23,031.27	18%
Total Area	126,431.09	100%

Source: Own Elaboration Eco Ingenieros/Dillon

Table 4.4 – Areas to be occupied for the Project off the Terrain Leased for the Thermal Power Plant and Electrical Substation

Description	Area (m^2)	Percentage
Land for LNG pipeline from the wharf to the Thermal Power Plant	15,976.68	28%
Laydown area for collection material during construction and passage of the pipeline	40,876.53	72%
Total, complementary areas	56,853.21	100%

Source: Own Elaboration Eco Ingenieros/Dillon

Table 4.5 – Areas to be Occupied Over the Sea

Description	Area (m^2)	Percentage
Cofferdam containing the FSRU	15,660.00	34%
Floating Storage Unit	17,147.73	37%
Pipeline under the sea bed	13,000.00	28%
Total areas over the sea	45,807.73	100.00%

Source: Own Elaboration Eco Ingenieros/Dillon

Figure 4.7 shows an outline of the distribution of the different elements of the Thermal Power Plant within the terrain.

The LNG Marine Terminal and the Thermal Power Plant consider the following areas:

1. Marine Terminal

The Marine Terminal will consist of a dredging area, underground pipeline and a breakwater or cofferdam, also called a double-walled "Vault" designed to support loading platforms and protect and surround the FSRU barge. The Marine Terminal includes:

Vessels:

- One FSU, ship semi-permanently docked to the breakwater.

FSRU, barge that will be docked permanently protected by the breakwater
Infrastructure:

- The breakwater, including the walls of circular cells or caisson, and the interior area where the FSRU will be located.
- Structural system of mooring posts, which will be located outside the breakwater. They will be installed on posts or on circular cellular structures. For the environmental assessment, the installation of circular cellular structures was assumed, which is the concept that could present the greatest environmental impacts.
- An underground pipeline of approximately 1,300m with an easement area of around 20m wide, the final width will depend on the final alignment. The easement is defined for maintenance of the pipeline and to define a construction exclusion zone around it. In the environmental impacts assessment, a 40m wide area has been defined where the pipeline could be located.

The exact location and size of the project elements may vary during the execution of the detailed design. The boundaries of the area where structures can be located are set out in Appendix 4D. The area of the Marine Terminal includes the space for the installation of a dock for construction, which is detailed in section 4.6.5.

Removal of marine sediment (dredging) during the construction of the breakwater is to occur prior to the construction of circular cells or caissons. Additional dredging at the FSU or freighter vessel location site may be necessary to facilitate vessel movement.

2. Thermal Power Plant

The Thermal Power Station will consist of the following components:

a. Engine room building: where the units will be located: engine - generator: The power station will use 19 units ENGINE-GENERATOR Wärtsilä 18V50SG which operate with natural gas at medium-speed.
b. Heat recovery boilers: one for each engine-generator unit, they are boilers that use the heat of the exhaust gases;

193600
193800
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Boulevard Coronel Oscar Osorio

Calle 24 de Octubre Ori

PORTÓN DE ACCESO / ENTRANCE GATE

PORTÓN DE ACCESO / ENTRANCE GATE

POZO DE MONITOREO 2 / MONITORING WELL 2

ADMINISTRACIÓN, MANTENIMIENTO Y PARQUEO / ADMINISTRATION, MAINTENANCE AND PARKING

ÁREA DE USO FUTURO / FUTURE USE AREA

ÁREA DE USO FUTURO / FUTURE USE AREA

PUERTA / GATE

PUERTA / GATE

POZO DE PRODUCCIÓN 1 / PRODUCTION WELL 1

POZO DE RESPALDO 2 / WELL BACK 2

CASA DE MAQUINAS / POWER HOUSE

POZO DE REPOSICIÓN CONTRA INCENDIOS / FIRE WATER REPLENISHMENT WELL

POZO DE MONITOREO 1 / MONITORING WELL 1

SUBESTACIÓN INTERNA / INTERNAL SWITCHYARD

ÁREA DE ESTANQUE DE AGUA EN LA SUBESTACIÓN / WATER POND AREA SWITCHYARD

ÁREA DE ESTANQUE DE AGUA / WATER POND AREA

CENTRAL TÉRMICA / THERMIC PLANT

CA 12S

Energía del Pacífico

ENERGÍA DEL PACÍFICO

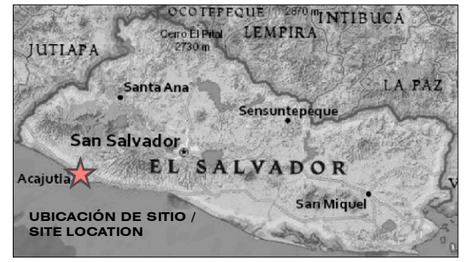
LNG TO POWER PROJECT

ELEMENTOS DEL PROYECTO / PROJECT ELEMENTS

FIGURA 4.7 / FIGURE 4.7

ELEMENTOS DEL PROYECTO / PROJECT ELEMENTS

SITIO DEL PROYECTO / PROJECT SITE



UBICACIÓN DE SITIO / SITE LOCATION

0 25 50 100 m

1:2,700

N W E S

FUENTE / REFERENCE
VISIÓN DEL MUNDO 2 IMÁGENES DE ALTA RESOLUCIÓN / WORLDVIEW 2 HIGH RESOLUTION IMAGERY (2014-02-12)

MAPA CREADO POR / MAP CREATED BY: PFM
MAPA REVISADO POR / MAP CHECKED BY: MW
PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONE 16 WGS84

ARCHIVO / FILE:
I:\GIS\163489 Acajutla\GIS\MXDs\Reporting - 2016\4-7 - Project Elements.mxd

PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL / FINAL
FECHA / DATE: 12/5/2016

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c. Exhaust gases management system: with two modules of six stacks grouped together and a module of four stacks and one of three stacks. The stacks are grouped with the purpose of improving the dispersion of exhaust gases;
d. 1 Steam turbine: to use the exhaust gases, steam turbine of 30 MW capacity; and
e. Cooling system: for the cooling of the steam turbine and the motors; it will have a radiators system mounted on the roof of the engine room.

3. Electrical Substation

Electrical Substation: To transform the energy that will be delivered to the transmitting company.

4. Supportive Areas:

a. Water supply system: water treatment for boilers and other processes and water storage, well, pumps;
b. Guardhouses. To control the access to the Thermal Power Plant;
c. Cafeteria, sanitary services and dressing rooms for employees;
d. Administration room. For the administration of all operations in the Marine Terminal and Thermal Power Plant, it includes the operations control room, where all activities are monitored;
e. Parking lots: for the administrative and technical specialists of the Thermal Power Plant, and for visitors;
f. Maintenance place, including warehouse, maintenance workshop and outdoor storage area and general store. It has independent parking lot for trucks unloading equipment;
g. Process water tank and fire system, 15 m in diameter, with a capacity for 1,500 m^3 and pump house of the fire system. It has been sized for 2 hours firefighting considering the largest fire possible according to international standards;
h. Green space; and
i. Circulations areas.

The perimeter of the land will have a wall and will have three entrance doors. Also, the electrical substation area will be fenced separately with a gateway. The wall will be 2.5 to 3 m high, with three rows of razor wire on top.

4.4.6 Operating System of the Thermal Power Plant

The Thermal Power Plant will be able to operate full load and full time, seven days a year for twenty-four hours, for a period of 20 years, but may also operate at partial load. The analysis in the present study is based on total production, but partial production effects have been considered when necessary.

4.4.7 General Project Program

On the next page, the Table 4.6 shows the summarized schedule of the main tasks of the project.

Table 4.6 – Project Schedule

ACTIVITY	2016		2017												2018												2019												2020					
	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Marine Works (Cofferdam)			-2	-1	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29									
Cofferdam ready to receive FSRU																																											
FSRU Engineering Procurement and Construction				-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30							
FSRU delivered																																											
FSU Retrofit									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27								
FSU delivered																																											
Gas availability																																											
Power Plant Construction		-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
T-line Construction								-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24									
Electrical Backfeed																																											
Commercial Operating Date																																											

Source: EDP 2016

4.4.8 Technical Standards Considered in Design

As a general rule, the national standards (Salvadoran) will apply, where they exist and European and / or American standards, it will be applied the more stringent. The standards to be applied are: El Salvador local laws and regulations; Design requirements and construction specifications; and the codes and standards detailed below.

It is essential for facilities to maintain a high level of availability in order to provide a steady supply of gas. The natural gas industry has developed standards to meet safety and reliability requirements which have been considered.

4.4.8.1 Codes and Standards Applicable to the Thermal Power Plant

Systems, equipment and others shall be designed, produced, constructed and installed in accordance with the standards detailed in Table 4.7

Table 4.7 – Codes and Standards Applicable to the Thermal Power Plant

Description	Code
Mechanical Systems	
Engine Testing	ISO 15550 Except for the calculation of fuel consumption, which is based on Wärtsilä's experience of this sort of engine.
Vibrations	ISO 8528 part 9
Design	EN 12100
Piping Design Calculations	EN 13480
Welding	EN 1011
Stairs and platforms	ISO
Dimensional standards for installation materials (pipes, beams, and others)	DIN, ISO, SFS y EN
Vertical Tanks	API 650 o EN 14015
Horizontal Tanks	EN 12285
Standards of typical material	DIN, SFS y EN
Pressure vessels	PED 97/23/EC o ASME
Gas System	EN standards
Pipes	EN13480 1-5
Hazardous Areas	EN 60079
Electrical Components Within Hazardous Areas	EN60079-14
Electric systems	
Generator	IEC 60034 and marked according to NEMA MG 1.
Transformer, oil type	IEC 60076
Transformer, dry type	IEC 60726
MV switchgear (Medium Voltage)	IEC 62271-200 o IEC 62271
LV switchgear (Low Voltage)	IEC 60439-1
Box protection	IEC 60529

Table 4.7 – Codes and Standards Applicable to the Thermal Power Plant	
Description	**Code**
Workstation Hardware	IEC 60950
Workstation Software	Applicable sections of VDE 3699
Ground grid	IEEE 80
Control panels	IEC 60439-1
PLC software	IEC 61131-3
Lighting Installation	IEC 60589
Fire Detection	EN 54
Protection of structures against lightning	IEC 1024
Civil Works Structures	
Wind load	UBC 1997
Geotechnical Design	EN 1997. Eurocode 7
Reinforced concrete structures	SFS-EN 1992-1-1. Eurocode 2
Steel structures	SFS-EN 1993-1-1…4. Eurocode 3
Embedded anchor bolts	EC3 SFS-EN 1993-1-1, EC2 SFS-EN 1992-1-1
Double-layer metal self-supporting panels	EN 14509
Road dimensions (structural design according to AASHTO, procedure for low traffic volume)	AASHTO 2001. Vehicle WB-15M
Buried works and structures	standard ASTM Applicable
Installation of prefabricated buildings	European Standard and ISO Standard
Ventilation and Air Conditioning	ASHRAE 62.1-2004 ASHRAE 55-2004
Sewer Pipeline	For polypropylene pipelines SFS-EN1451-1 or local equivalent Standard Polyvinyl Chloride pipelines SFS-EN1401 or local equivalent
Water Pipeline	Polyethylene Standard SFS-EN12201 or local equivalent
Classification and crane design	FEM
Storage tanks areas	NFPA 30
Steel structures painting	EN ISO 12944
Galvanization	EN ISO 1461
Stairs and platforms	EN ISO 14122. Fixed stairs and platforms
Evacuation routes	NFPA 101 is taken into consideration for fire emergencies or similar emergencies.
Noise measurement	ISO 1996, Acoustic description, measurement and estimation of environmental noise, Section 1-3

Abbreviations description:

DIN: German Standard (Deutsche Institute für Normung) – German Institute for Standards

EN: European Standard

ISO: The International Organization for Standardization

SFS: Finnish Standard Association

API: American Petroleum Institute
ASME: American Society of Mechanical Engineers
PED: Pressure Equipment Directive
IEC: International Electro-technical Commission
IEEE: Institute of Electrical and Electronics Engineers
EN: European Standard
VDE: The Association for Electrical, Electronic & Information Technologies
ASHRAE: American Society of Heating, Refrigeration and Air-Conditioning Engineers
ASTM: American Society for Testing and Materials
AASHTO: American Association of State Highway Transportation Official
ECCS: European Convention for Constructional Steelwork
EN: European Standard
ENV: European Pre-standard
FEM: European Federation of Materials Handling and Storage Equipment
NFPA: National Fire Protection Association
ISO: International Organization for Standardization
SFS: Finnish Standard Association
AISI: American Iron and Steel Institute
UBC: Uniform Building Code

4.4.8.2 Codes and Standards Applicable to the LNG Marine Terminal

For the Marine Terminal the following codes and standards will be applied:

4.4.8.3 Regional Codes

- Model Code of Construction for Wind Loads - Association of Caribbean States (May 2003)
- Model Construction Code for Earthquake - Association of Caribbean States (May 2003)

4.4.8.4 International Codes and Standards

Standards of design and structural material:

- American Concrete Institute (ACI)
  - ACI 318-14 - Building Code Requirements for Structural Concrete and Commentary, 2014.
- American Institute of Steel Construction (AISC)
  - AISC 360-10 – Specification for Structural Steel Buildings, 2010.
- American Society for Testing and Materials (ASTM)
  - ASTM A36 / A36M-14 - Standard Specification for Carbon Structural Steel, 2014
  - ASTM A307-14 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength, 2014.
  - ASTM A325-14 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength, 2014.

  - ASTM A500 / A500M-13 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes, 2013.
  - ASTM A501-14 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing, 2014.
  - ASTM A572 / A572M-15 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel, 2015.
  - ASTM F1554-15e1 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength, 2015.
- International Code Construction, 2010
- Steel Structures Painting Council (SSPC)
  - SSPC Painting Manual, Volume 1, Good Painting Practices, 4th Edition, 2011.
  - SSPC Painting Manual, Volume 2, Systems and Specifications, 2015.
  - SSPC SP 10 - Near White Blast Cleaning, 2006.
  - SSPC SP COM – Surface preparation commentary for metallic substrates, 2015.

Design of the marine structure:

- American Petroleum Institute (API)
  - RP 2A-WSD: Planning, Designing, and Constructing Fixed Offshore Platforms—Working Stress Design, 2014.
  - SPEC 2B: Specification for the Fabrication of Structural Steel Pipe, 2001.
  - SPEC 5L: Specification for Line Pipe, 2012.
- American Society of Civil Engineers (ASCE)
  - ASCE 61-14, "Seismic Design Standard for Piers and Wharves", 2014.
  - ASCE / SEI 7-10, "Minimum Design Loads for Buildings and Other Structures ", 2010.
  - "Mooring of Ships to Piers and Wharves ", Manuals and Reports on Engineering Practice, N° 129.
- British Standards Institution (BSI)
  - BS 6349-1-1, "Code of practice for planning and design for operations", 2013.
  - BS 6349-2, "Code of practice for the design of quay walls, jetties and dolphins",2010 (Notification reaffirmation 2015).
  - BS 6349-4, "Code of practice for design of fendering and mooring systems ", 2014.
- State Lands Commission of California (CSLC)
  - Marine Oil Terminal Engineering and Maintenance Standards (MOTEMS, California Code of Construction Chapter 31F 2013), 2013.
- Canadian Standards Association (CSA)
  - EXP276.1-2015, "Design requirements for marine structures associated with LNG facilities (DRMS), 2015.
- Oil Companies International Marine Forum (OCIMF)
  - Guide on Marine Terminal Fire Protection and Emergency Evacuation, 1987.
  - Mooring Equipment Guidelines (MEG3), 2008.

- Prediction of Wind Loads on Large Liquefied Gas Carriers (VLCCs), 1994.
- Safety Guide for Terminals Handling Ships Carrying Liquefied Gases in Bulk, 1993.
- Design and Construction Specification for Marine Loading Arms, 1999.

- Permanent international association of navigation congresses (PIANC)
  - Seismic design guidelines for port structures, 2002
  - Guidelines for the design of fender systems, 2002
- Society of International Gas Tanker and Terminal Operators (SIGTTO)
  - IP 14: Site Selection and Design for LNG Ports and Jetties, 1997
  - IP 15: List of design guidelines for LNG terminals, 1997
  - Prediction of Wind Loads on Large Liquefied Gas Carriers, 2007
- U.S. Army Corps of Engineers (USACE)
  - EM 1110-2-2503: Sheet Pile Cellular Structures Cofferdams & Retaining Structures, 1989
- United States Steel (USS)
  - Steel Sheet Design Manual, July 1984. Updated and reprinted by The Department of Transportation / FHWA USA with authorization.

Marine navigation

- International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA)
  - Aids to Navigation Guide (NAVGUIDE), 4th edition, 2014
  - 1023: The Design of Leading Lines, 2005
  - E-112-1: Recommendation for Leading Lights, 2005
  - E-200-2: Marine Signal Lights – Calculation, Definition and Notation of Luminous Range, 2008.
  - Guideline 1008, Remote monitoring and control of aids to navigation, 2009.
  - Maritime Buoyage System, brochure.
  - Permanent international association of navigation congresses (PIANC)
  - Criteria for movements of moored ships in harbors, 1995
  - AIPCN Report 121 - 2014, Harbor Approach Channels – Design Guidelines, 2014
  - Large tankers and their reception (data-channels-burglary), (Supplement to Bulletin 16), 1973
  - PTC2 WG04: Dangerous Goods in Ports – Recommendations for Port Designers and Port Operators: 1985, Port designers and port operators (Supplement to Bulletin 49),1985
  - PTC2 WG05: Under keel Clearance for Large Ships in Maritime Fairways with Hard Bottom (Supplement to Bulletin 51), 1985
  - PTCII-30 Harbor Approach Channels – Design Guidelines, (Supplement to Bulletin 95), 1997
  - AIPCN Report 116-2012, " Safety Aspects Affecting the Berthing Operations of Tankers to Oil and Gas Terminals", 2012
  - Marcom 55: Safety Aspects of Berthing Operations of Oil and Gas Tankers (Draft)
  - Society of International Gas Tanker and Terminal Operators (SIGTTO)
  - Liquefied Gas Handling Principles on Ships and in Terminals, (3rd Edition), 1999
  - U.S. Army Corps of Engineers (USACE)

- EM 1110-2-1613: Hydraulic Design of Deep-Draft Navigation Projects, 2006

Safety

- International Maritime Organization (IMO)
- International Ships and Port Security (ISPS Code)
- Safety of Life at Sea (SOLAS)

Corrosion

- National Association of Corrosion Engineers (NACE)
- SP0176-2007 (formerly RP0176), Corrosion Control of Submerged Areas of Permanently Installed Steel Offshore Structures Associated with Petroleum, 2007

LNG and Natural Gas

- National Fire Protection Association (NFPA)
- T59A: Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG); Seismic Performance Criteria, 2016
- Society of International Gas Tanker and Terminal Operators (SIGTTO)
- Liquefied Gas Handling Principles on Ships and in Terminals, (3rd Edition)
- IP 14: Site Selection and Design for LNG Ports and Jetties
- IP 15: List of design guidelines for LNG terminals
- IP 16: Ship/Shore Interface Safe Working Practice for LPG and Liquefied Chemical Gas Cargoes
- The Ship to Ship Transfer Guide for Petroleum, Chemicals and Liquefied Gases (1st Edition) published by CDI, ICS, OCIMF, SIGTTO, 2013

Coastal

- U.S. Army Corps of Engineers (USACE)
  - Coastal Engineering Manual, 2002
- Overseas Coastal Area Development Institute of Japan
  - Technical Standards and Commentaries for Port And Harbor Facilities in Japan, 2009

Electrical Lighting Site, Instrumentation and Controls

- International Electro technical Commission (IEC) – if it is applicable
- European Directive of Explosive Atmospheres (ATEX) - per the case
- Factory Mutual (FM)
- Underwriters Laboratories de EE.UU. (UL)
- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- American Petroleum Institute (API)

- API RP 2003, Protection Against Ignitions. Arising Out of Static, Lightning, and Stray Currents, 2015
- API RP 500, Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2,2012
- API RP 505, Recommended Practice for classification of locations for Electrical. Installations at Petroleum facilities classified as Class I, zone 0, zone 1, zone 2, 1997 (reaffirmation 2013)

- National Fire Protection Association (NFPA)
  - NFPA-30, Flammable and Combustible Liquids Code, 2014
  - NFPA 307, Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves.
  - NFPA-497, Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas, 2012
- National Electrical Manufacturers Association (NEMA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Illuminating Engineering Society: IES (IES)
- Instrumentation Society America (ISA)

Gas pipeline on land

- Department of Transportation (DOT)
- Requirements for pipeline safety, Parts 191 y 192, federal minimum safety standards, Title 49, Code of Federal Regulation Pipeline Safety Regulations, U.S.A. 2007, referred to DSE-280/2009.
- Gas Transmission and Distribution Piping Systems B31.8-2007, referred to DSE- 280/2009

Platform, Pipeline and Underwater Pipeline

- American Society of Mechanical Engineers (ASME)
- ASME B31.8 Gas Transmission and Distribution Piping Systems, 2014
- ASME B16.1 standards cover pipes and fittings in cast iron: classes 25, 125, and 250, 2015
- ASME B16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 to NPS 24Mm / Standard 2013
- ASME B16.9 Factory Made Wrought Steel Butt-welding Fittings, 2012
- ASME B16.34 Valves Flanged, Threaded and Welding End, 2013
- ASME B31.3 Process Piping Guide
- ASME Sec. IX Welding and Brazing Qualifications
- American Petroleum Institute (API)
- API RP14E Recommended Practice for Design and Installation of Offshore Production Platform Piping Systems 1991 - Reaffirmation 2013
- API 5L Specification for Line Pipe, 2012
- American Bureau of Shipping

- Submarine Pipeline Systems, 2014
- Det Norske Veritas (DNV)
  - DNV-OS-F101 Submarine Pipeline Systems, 2013
  - DNV-RP-F102 Pipeline Field Joint Coating and Field Repair of Linepipe Coating, 2011
  - DNV-RP-F103 Cathodic Protection of Submarine Pipelines by Galvanic Anodes, 2010
  - DNV-RP-F106 Factory Applied External Pipeline Coatings for Corrosion Control,2011
  - DNV-RP-F109 On-Bottom Stability Design of Submarine Pipelines, 2010

4.5 Project Construction Stage

4.5.1 Site Preparation Stage

In the site preparation, it will be done the ground cleaning, wall construction and installation of the building site.

4.5.1.1 Ground Cleaning

The Figure 4.8 shows the location of trees within the land, a total of 603 trees will be removed, Detailed is their location and also the number of trees to be removed by species. Trees removed are summarized in Table 4.8.

Table 4.8 – Trees to be Removed

Zone	Common	Threatened
Project site	207	0
Pipeline site	112	0
Laydown area	284	2
Total trees to be felled	**603**	**2**

Source: Own elaboration ECO Ingenieros/Dillon

4.5.1.2 Fencing

The fencing of the perimeter of the land to be used for construction staging and pipeline installation will be undertaken, in order to be delimited the area in relation to the lands of CEPA and not allow access of foreign personnel onto the construction area. The project site is already fenced in, and the fence will be maintained during construction, until the final walls are installed

4.5.1.3 Demolition of Buildings and Other Structures

The demolition of structures (homes, sidewalks, streets, fences) will be necessary at the construction staging site of the project; the site will be used in future expansion. The demolition material will be collected on site and taken to an authorized site by the MARN for final disposal.

4.5.1.4 Installation of Temporary Trestle and Access Road

To access the construction work areas, an ocean trestle will be constructed. The installation of the trestle includes:

- Land excavation for access road construction from the staging area to the trestle.
- Slopes construction on the sides of the road.
- Road paving.
- Construction of foundations, piles, metal structure, reinforced concrete.
- Installation of signaling, electrical wiring, lighting, railings and exterior works.

4.5.2 Construction Stage

4.5.2.1 Equipment Manufacturing

The following equipment will be manufactured out of country: engines, generators, boilers, auxiliary equipment, tank parts, pumps, compressors, transformers, switching equipment, water tanks, and others. These will be transported to the site.

4.5.2.2 Physical Built Works

The construction of the buildings, floors and walls will be carried out. The main tasks are: excavation of foundations, reinforcement and casting of foundations, reinforcement and casting of concrete floors, walls, slabs, ceilings and finishes.

Concrete foundations will be built at the sites where outdoor equipment and tanks are located: water tank, lubricating oil tank, compressors, pumps, chimneys, etc.

Simultaneously the installation of the NG pipeline will be done. Also paving of areas of vehicular traffic and sidewalks of pedestrian circulation will be undertaken.

4.5.2.3 Construction of LNG Marine Terminal

It includes the dredging area, the construction of breakwaters, mooring posts, structures, and the piping installation; installation of platforms, lighting, and others.

4.5.2.4 Assembly of Equipment

It includes the assembly of compressors, auxiliary equipment, firefighting system, and others.

4.5.2.5 Electrical Installations

It includes the installation of electrical substation and wiring.

4.5.2.6 Construction of Circulation Streets (Inland)

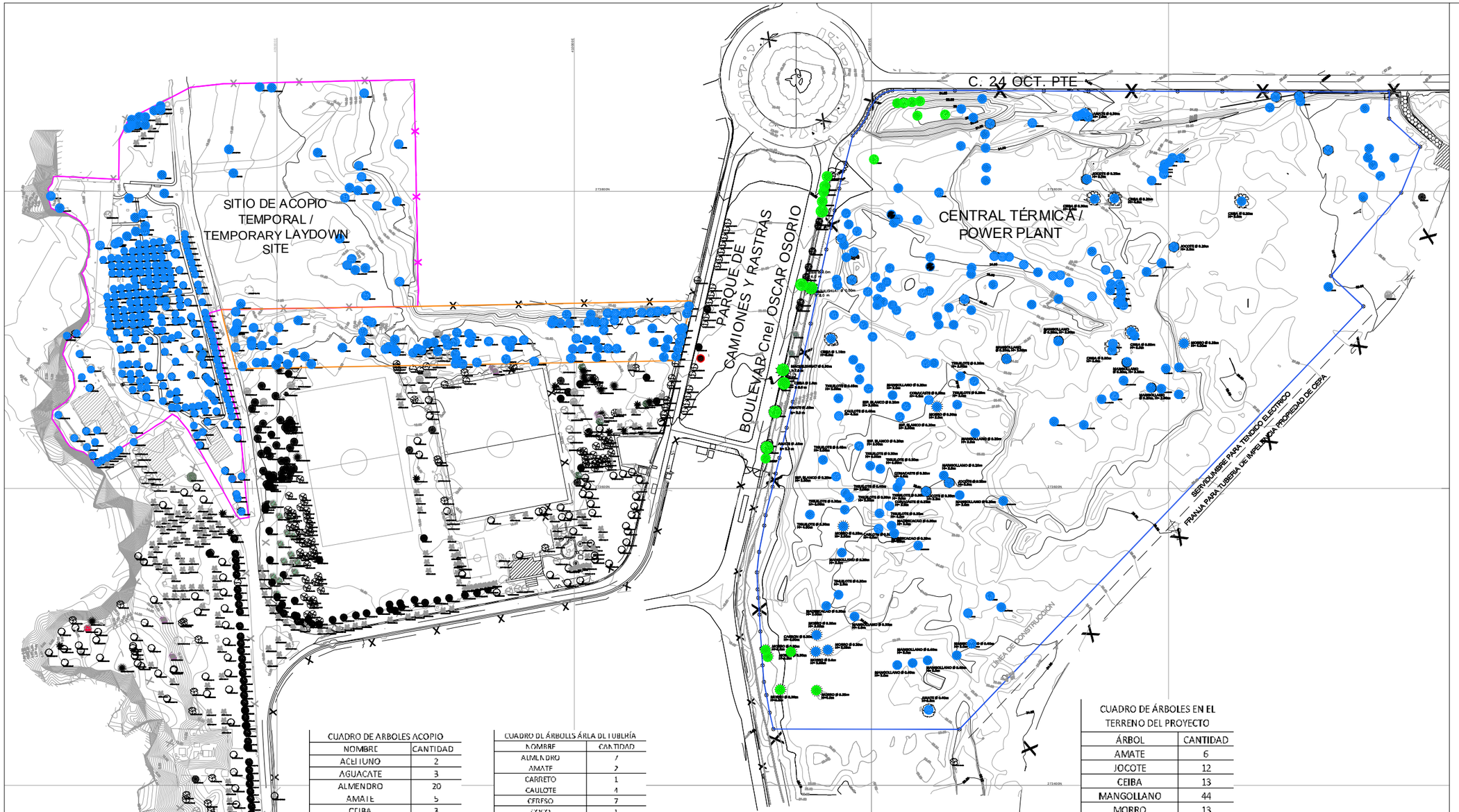
Internal streets will be constructed that will give access to the plant and the rest of the land for future use.

4.5.2.7 Adequacy of Green Zones

It includes the planting of trees and planting of grass in areas of gardens, as well as ornamental plants for the beautification of the plant.

4.5.2.8 Construction Closure

The site will be erected and general cleaning of the work areas will be carried out.



CUADRO DE ARBOLES ACOPIO	
NOMBRE	CANTIDAD
ACEITUNO	2
AGUACATE	3
ALMENDRO	20
AMATE	5
CEIBA	3
COCO	138
COCO ENANO	3
CONACASTE	1
GUACHIPILIN	1
IZOTE	1
MADRECACACO	16
MAGOYANO	1
MANGO	33
MANGOLLANO	5
MAQUILISHUAT	7
MARAÑÓN	2
MORRO	1
NANCE	1
NANCE INDIO	1
NARANJO	2
PALMERA	31
PALO DE SOPE	1
TAMARINDO	1
TIGUILOTE	4
UCAENA	1
TOTAL DE ÁRBOLES	284

ÁRBOLES A TALAR	281

CUADRO DE ÁRBOLES ÁREA DE TUBERÍA	
NOMBRE	CANTIDAD
ALMENDRO	7
AMATE	2
CARRETO	1
CAULOTE	4
CERREZO	7
COCO	1
CONACASTE	3
JOCOTE	1
MANGO	18
MANGOYANO	21
MAQUILISHUAT	24
MARAÑON	5
MORRO	2
PAPATURRO	1
TIGUILOTE	13
TOTAL DE ÁRBOLES	112

ÁRBOLES A TALAR	112

CUADRO DE ÁRBOLES EN EL TERRENO DEL PROYECTO	
ÁRBOL	CANTIDAD
AMATE	6
JOCOTE	12
CEIBA	13
MANGOLLANO	44
MORRO	13
MAQUILISHUAT	9
TIGUILOTE	29
MADRECACAO	10
GUAYABO	11
ESPINO BLANCO	30
CEREZO	1
CONACASTE	3
CAULOTE	14
CARBÓN	1
CAPULIN	9
CHILAMATE	1
JIOTE	1
TOTAL DE ÁRBOLES EN EL TERRENO	207

TOTAL DE ÁRBOLES A TALAR	183

TOTAL DE ÁRBOLES A CONSERVAR	24

Energía del Pacífico

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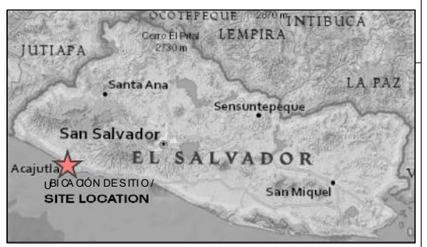
LNG TO POWER PROJECT

UBICACIÓN DE ARBOLES / LOCATION OF TREES

FIGURA 4.8 / FIGURE 4.8

- ÁRBOLES A CONSERVAR / TREES TO CONSERVE
- ÁRBOLES A TALAR / TREES TO CUT
- PERIMETRO DE CENTRAL TÉRMICA / PERIMETER OF POWER PLANT SITE
- PERIMETRO DE LA TUBERÍA / PERIMETER OF THE PIP
- PERIMETRO SITIO DE ACOPIO TEMPORAL / PERIMETER OF THE TEMPORARY LAYDOWN SITE



0 10 20 30 40 50 mt

N W E S

FUENTE / SOURCE:
ECO INGENIEROS / ECO INGENIEROS

MAPA CREADO POR / MAP CREATED BY: ECO INGENIEROS
MAPA REVISADO POR / MAP CHECKED BY: LF
PROYECCIÓN DE MAPA / MAP PROJECTION :
UTM ZONA 16 WGS84 / UTM ZONE 16 WGS84

ARCHIVO / FILE
C:/CAP 4,ECO,DRAWING 1, EL SALVADOR/ ECO INGENIEROS
C:/CAP 4,ECO,DIBUJO 1, EL SALVADOR/ ECO INGENIEROS

PROYECTO / PROJECT: 14-9114
ESTADO / STATUS : FINAL / FINAL
FECHA / DATE: 11/25/2016

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4.5.3 Earthworks

The earthworks and / or terraced activities of the project include excavations, cuts, fillings and removal of surplus material, which will be necessary to reach the projected levels of the land in the execution of the building and its exteriors; as well as to accommodate the elements that must be buried, such as foundations, pipes, etc.

The land where the project is located is relatively flat, with slopes between 2% and 5%, located between 22 and 26 meters above sea level. The project seeks to maintain the flat ground, level it, and remove only the material unsuitable for the foundation, which will be estimated according to the soil studies to be carried out.

As the site is flat, it is looking to create a single terrace. Typically buildings will be installed at a level 0.5 m above the surrounding area to facilitate drainage.

The remaining soil material will be sent to the landfill of Aya Cachapa, as detailed in section on waste and solid waste, in this document.

If fill material is required, it will be brought to the project site from material banks that have their environmental permit or if they are appropriate for the project, their environmental permit will be processed later.

4.5.4 Construction building site and Material Laydown area

Due to the size and complexity of the project, there will be offices and Laydown areas in: Within the field itself; destined for the collection of equipment and materials of the plant and, In the land destined for pipeline, leased to CEPA, it is considered for materials and equipment of the Marine Terminal.

The construction site will be installed in vans or in wood and sheet, for the installation of warehouses, offices of supervision of work, control of materials and labor, sanitary services and water supply.

Within the zone of these zones will be realized filling of fuels of smaller equipment: concrete, polishing, skid steer loaders, and others, as the greased from the same equipment. Major maintenance will be carried out outside the project grounds at sites authorized for this purpose.

Hazardous materials will be stored in both areas, which will be adequately handled as detailed in environmental measure 5, chapter 10 (see Photo 4.6).

Photo 4.6 – Image that shows the location of materials and equipment within the construction building site

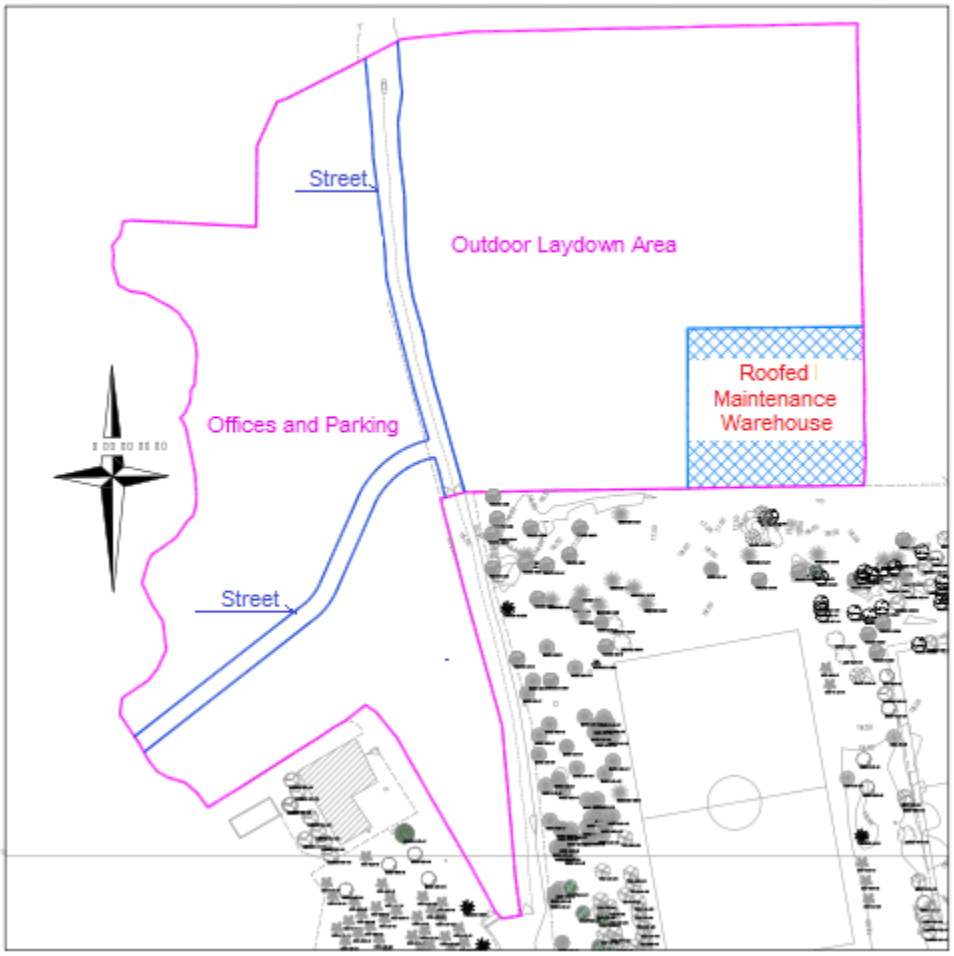
Source: http://www.indetailmagazine.com/en/issue/1/2013/#!13

Within the construction staging area, a concrete plant will be located with a production of 30m3 / h that will provide concrete that is not brought from outside the site.

The construction staging area of the project, will have the space and the appropriate facilities to store the equipment, materials and necessary inputs for the construction; Will be formed by temporary constructions that will serve for: offices, warehouses, sanitary services, area for employees, area of fuel filling of equipment, workshop for minor equipment revision and / or maintenance (major maintenance will be done outside the Laydown area, in Sites authorized for this purpose) and any other installation that is required in the work for the execution of the works.

Figure 4.9 shows a general zoning for the material Laydown area of the Marine Terminal, which basically comprises: Maintenance area, outdoor storage area, office area and parking area. The zoning could change at the discretion of the project contractor.

Figure 4.9 – General Zoning of the Laydown Area



Source: Own elaboration based on project plans

The facilities of the laydown area will have drinking water, sanitation and electric power facilities. The workshop and warehouse area must have solid waste collection and drainage systems adequate to manage rainwater and avoid contamination of the soil and natural water courses.

The areas destined to the storage of granular materials, will have appropriate barriers that prevent trawling of sediments by rain water or runoff water.

4.5.5 Installation of Temporary Trestle

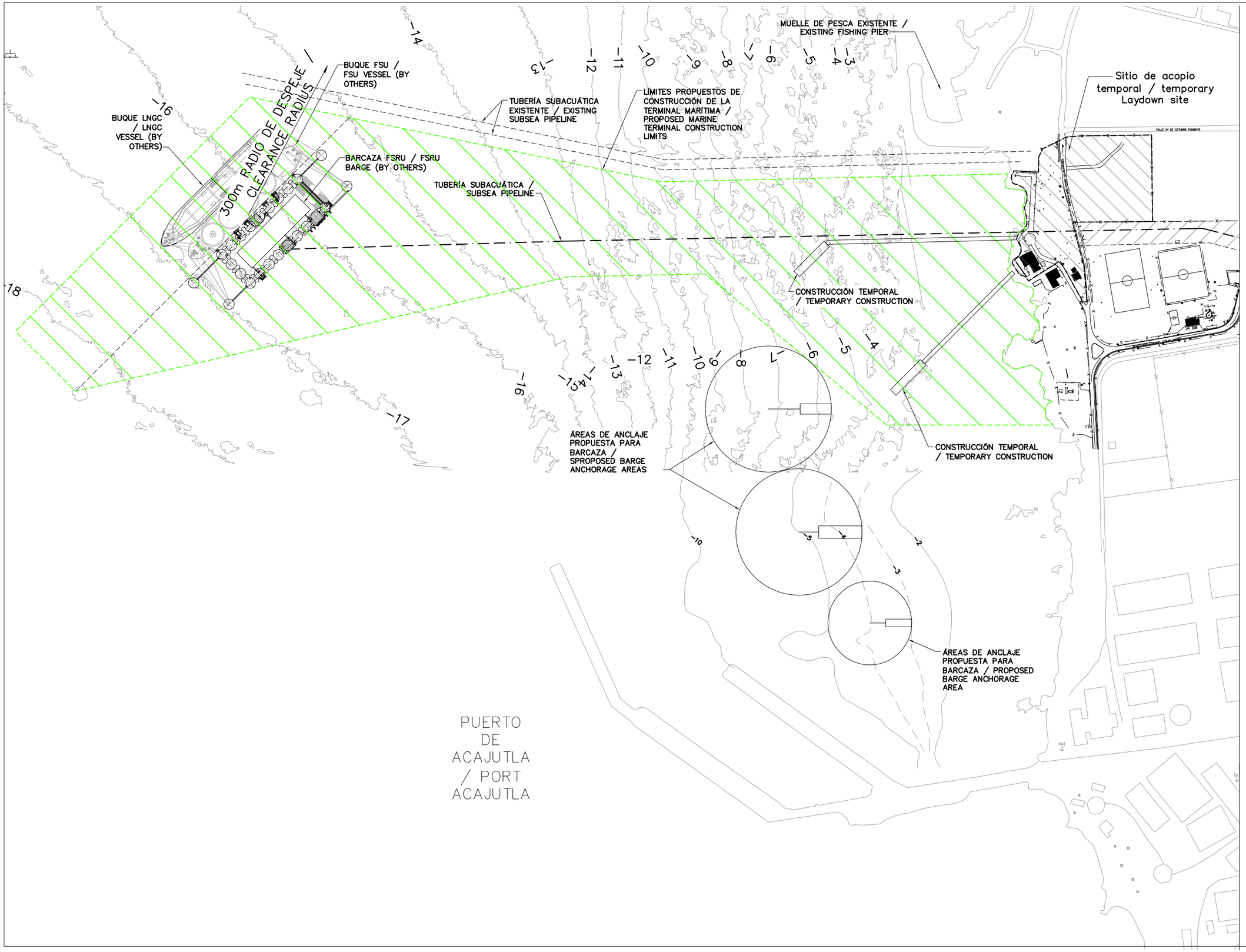
Within the land of the laydown area of the Marine Terminal will be installed a dock to facilitate the movement of people, materials and equipment. To get to the trestle site will require the construction of a ramp.

Two possible trestle location options are being evaluated. For the purposes of environmental assessment, both have been considered in terms of their impacts and measures, but in the end only one of the two options will be constructed.

The location of both options is presented in Figure 4.10, and Appendix 4D.

In both cases the trestle has been designed with a platform 75 m long by 5 m wide, raised 6 m above sea level in its final part; to reach the platform will have a ramp of 225 m in option A, with a 3.56% of slope and a 330m ramp in option B, with 2.42% of slope.

In total, option A occupies an area of 0.2625 Ha with a length of 300 m over water and option B occupies 0.34 Ha, with 411.5 m in length.



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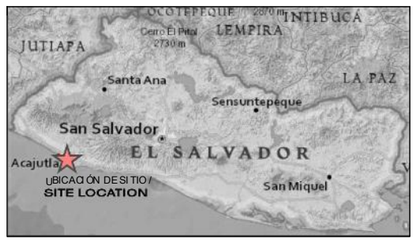
MUELLE TEMPORAL Y ÁREAS MARINAS DE RESTRICCIÓN (CONSTRUCCIÓN) / TEMPORARY JETTY AND MARINE RESTRICTION AREAS (CONSTRUCTION)

FIGURA 4.10 / FIGURE 4.10

LÍMITES PROPUESTOS DE CONSTRUCCIÓN DE LA TERMINAL MARÍTIMA / PROPOSED MARINE TERMINAL CONSTRUCTION LIMITS



0 50 100 150 200m

N W E S

FUENTE / SOURCE:
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The trestle will use an open galvanized grating or a wooden deck attached to steel frames supported on steel piles into the seabed (pre-perforated if the rock is present near the surface).

The trestle will line up with the prevailing wave direction to achieve the most favorable mooring for crew ships and construction support vessels. The structure will be located in waters of approximately 4m deep during low tide to safely accommodate loaded barges and tugs. Temporary lights will be used when necessary for night work. The trestle construction will start from shoreline and extend out to the sea.

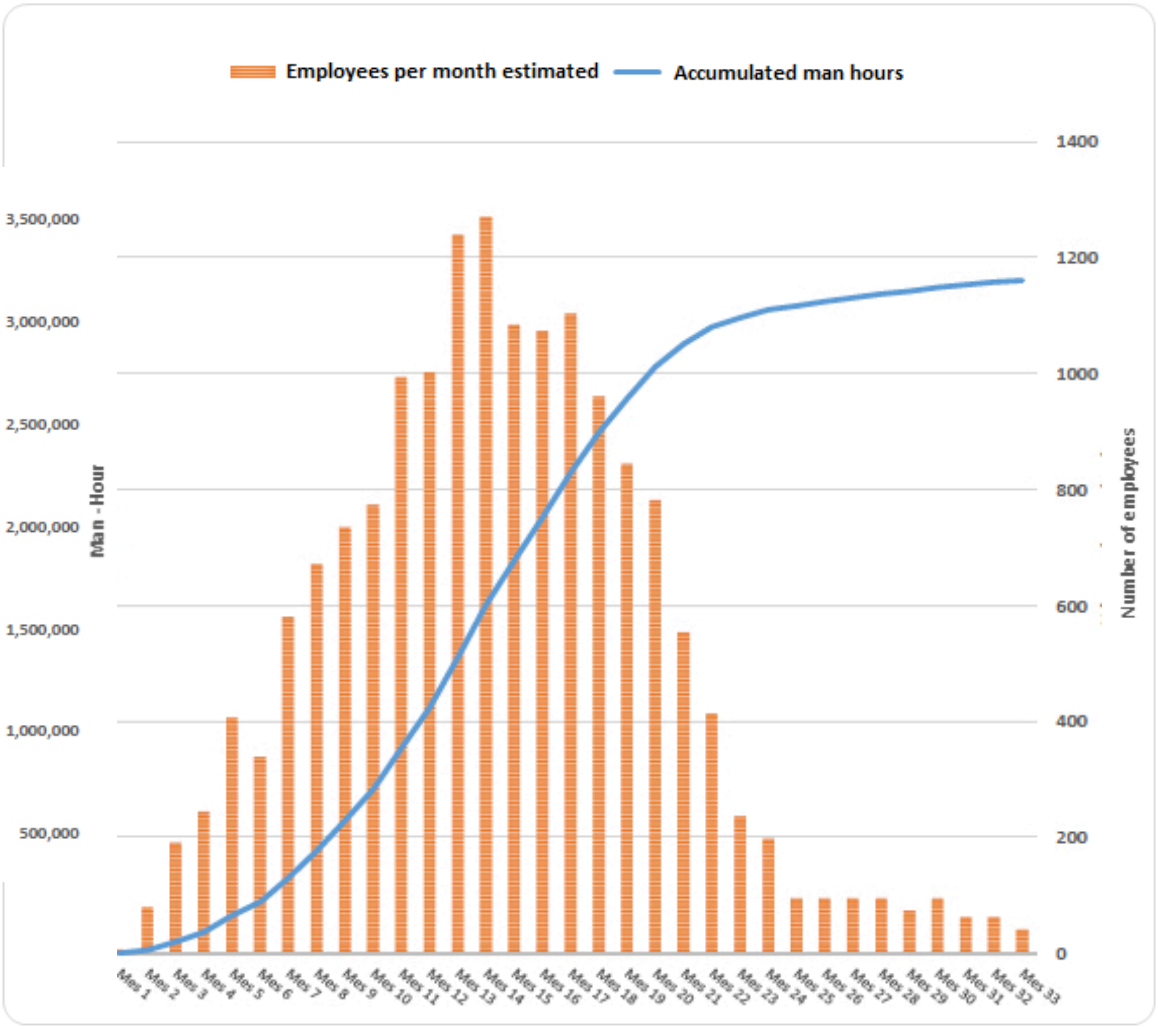
When the construction of the Marine Terminal is completed, the decommissioning of the temporary trestle will be carried out. A land crane located at the top of the trestle will operate backwards from the end of the deck and will remove the trestle and piles, bringing them back to shore. They will try to extract the piles in full; however, if it is unsuccessful, the piles can be cut off at sea bed level. The pile holes will not be filled unless necessary. Any cuts that have been required on the rock to provide access to the temporary pier shall remain after the construction is complete.

4.5.6 Workforce in Construction Stage

For the construction of the Marine Terminal, approximately 140 people will be employed, of which 25 to 30 will be local workers. There will be an average of 60-80 employees on the project monthly. There will be shifts between 8 and 12 hours, with a night shift for excavation and / or filling.

For the construction of the Thermal Power Plant there will be work shifts from eight to twelve hours each, to complete 44 hours per week per person. The following graph shows the estimated employees for the construction process, reaching up to 1,200 employees at the peak of construction, as shown in Figure 4.11.

Figure 4.11 – Estimate of Employees - Man-hours for the Construction of the Project



Source: Official presentation EDP/Wärtsilä, march 2014.

4.5.7 Construction and Technological System Works on Land

The buildings of the Thermal Power Plant will have the following characteristics:

1. Concrete or reinforced concrete floor, depending on the weight of the equipment;
2. Metallic of full body structure for support of buildings;
3. External walls consisting of lightweight sandwich panels between 100 and 200 mm, with steel faces and center of mineral wool. In buildings where insulation is not required, corrugated steel walls of 0.6 mm will be used;
4. The internal walls will also be of light sandwich panels, of 100 mm, with walls of steel and mineral sheet to the center;
5. The support of the ceilings will be made of light corrugated steel sheet. Insulation with non-combustible mineral wool will be used. Where necessary, a vapor barrier will be installed. The roof will be made of corrugated steel sheets, covered with polyurethane;

6. The doors will also be sandwich panel and glass windows with aluminum frame; And
7. False acoustic ceiling will be installed in offices.

The equipment will be mounted on reinforced concrete platforms designed according to their weight. Materials such as: stonework, cement, steel, concrete, blocks and bricks, windows, steel sheets, insulation, will be acquired in the local market.

All process equipment will be imported, and come in preassembled modules to be connected to the site and tested at the factory. As shown in Figure 4.12. This facilitates a quick installation.

4.5.8 Paving of Areas

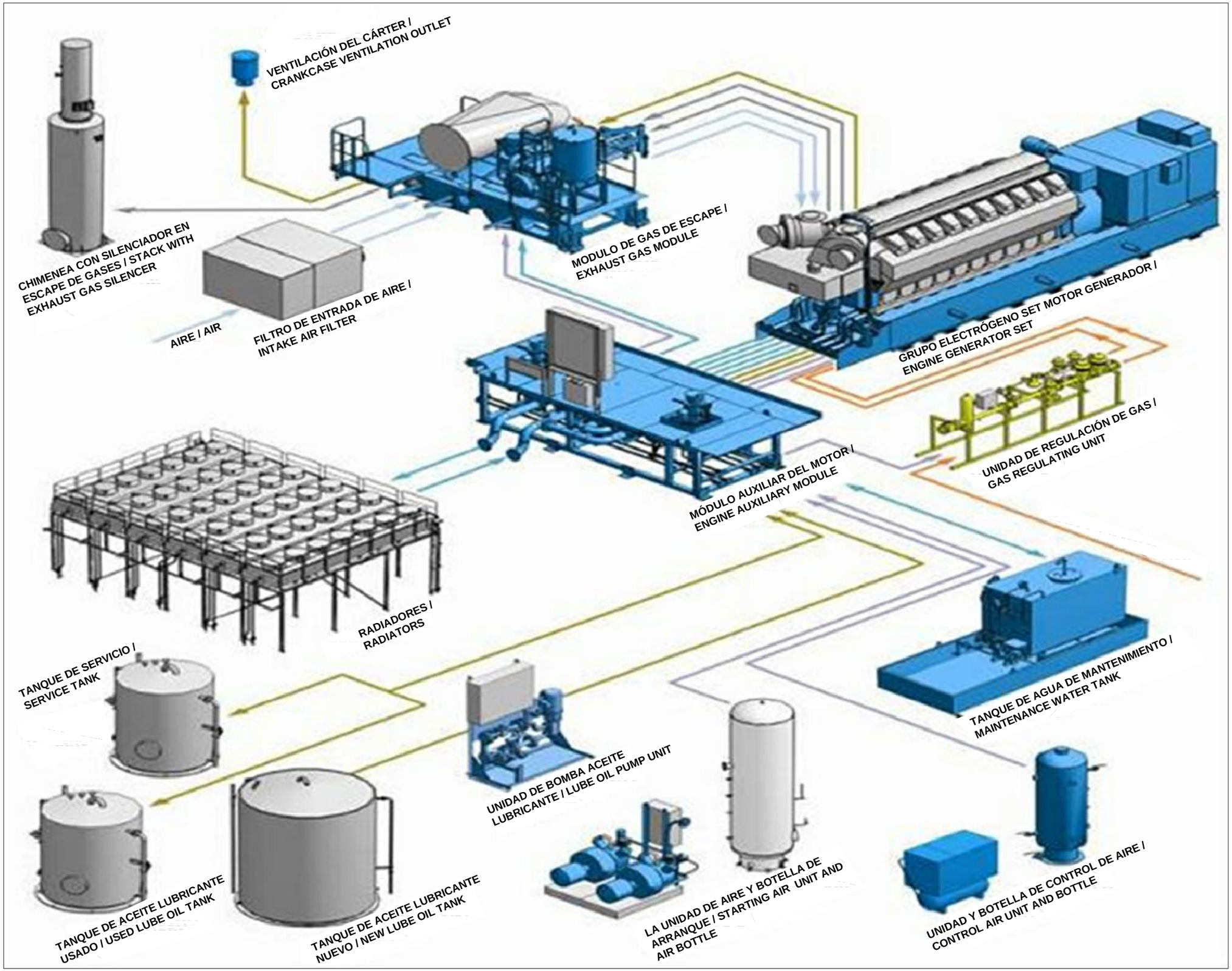
The type of coverage to be used for the Thermal Power Station and Substation area is detailed as follows:

- Access roads: pavement asphalt or concrete;
- Gravel in areas of tanks, substation; and
- Grass in gardens, where there is no traffic. In these areas will be used the land of excavations for filling.

The detail of the areas to be paved is shown in Table 4.9.

Table 4.9 – Paving of Areas				
Description	**Area (m^2)**	**%**	**To Pave**	**%**
Electrical Substation	23,602.61		23,602.61	18.67
Main building	21,019.53		21,019.53	16.63
Parking lot	702.39		702.39	0.56
Various Structures	1,819.26		1,819.26	1.44
Streets	5,700.26		5,700.26	4.51
Wells Area	314.60		314.60	0.25
Retention ponds	2,217.99		2,217.99	1.75
Green area	21,717.42			
Future use area	49,337.03			
Totals	126,431.09	100%		43.81%

Source: Own elaboration, 2016



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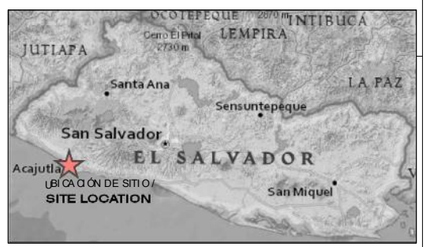
MODULOS PRE-ENSAMBLADOS CENTRAL TÉRMICA / PREASSEMBLED MODULES FOR THERMAL POWER PLANT

FIGURA 4.12 / FIGURE 4.12



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PROYECTO / PROJECT: 14-9114
ESTADO / STATUS : FINAL / FINAL
FECHA / DATE: 9/16/2014

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4.5.9 Activities that Generate Impacts in Construction Stage

The main activities that generate impacts are:

- Cleaning and preparation of the site;
- Earthworks;
- Construction of piles (on land);
- Dredging of seabed and deposition of dredged material;
- General construction activities on land and on the seabed;
- Traffic for construction materials and transport of personnel;
- Storage, handling, use and disposal of raw materials and hazardous wastes;
- Cleaning and pressure testing of tanks and pipes;
- Management of the construction of the labor force;
- Purchasing and supply chain; and
- Security.

As follows, we explain the aspects related to waste and solid waste management, wastewater, atmospheric emissions and noise during construction.

4.5.9.1 Handling and Final Disposal of Waste and Solid Waste

The solid wastes to be generated during the construction of the plant will be handled temporarily within the same area of the construction. These will be collected in an orderly way in containers (metal barrels) specially designed for this purpose, so that they do not represent a risk of accident or environmental contamination, and will finally be disposed in an authorized place.

The waste will be collected through municipal transportation and private transportation when it is necessary, and taken to the Salinas de Aya Cachapa sanitary landfill. The landfill operates under the administration of CAPSA DE C.V. And has its operating permits. There is feasibility of collection of the waste by the Municipality, which is included in Appendix 4E. This sanitary landfill has an environmental permit and the company carrying the waste will be required to have the corresponding permits.

The period of temporary storage of wastes produced during the construction phase is estimated to be up to 15 days, after generation and / or collection. Larger materials such as metal or scrap metal will be stored in a properly marked and marked area. These materials do not contaminate the soil by its characteristics.

Reusable materials such as wood, sheet metal, tubes and metal angles are sometimes donated to company personnel, sometimes marketed as scrap metal. Table 4.10 summarizes the main types of wastes that will be generated during the construction phase and the potential options for their disposal.

Solid waste of special type will be generated by lubrication and oil changes of the equipment. The maintenance of heavy equipment at the site of the plant will not be allowed, however, it is always necessary to keep the equipment lubricated, review that will be done periodically, and solid special waste and residues will be generated, such as used lubricating oil and oil deposits of new lubricant.

For proper handling, plastic containers of suitable capacity, with a lid, and properly marked to keep the waste labeled "Hazardous Waste" (contaminated with oils and greases) shall be installed.

The waste will be removed periodically and will be delivered to a company authorized for transportation and final disposal of this type of waste.

Table 4.10 shows a summary of the wastes that are expected to be generated in the construction phase of the project.

Table 4.10 – Wastes and Residues to be Generated in the Construction Stage *

Waste/Residue	Origin	Handling	Disposal
Fuel or used oil	Preparation of machinery and equipment daily	Storage in recyclable oil tank	Sale to be used as fuel
Used absorbent material (wipes, sawdust)	Preparation of machinery and equipment daily	Storage in closed containers or bags, properly closed and labeled as "hazardous waste"	Incineration by controlled methods, at sites authorized by the competent authority
Wood or firewood	Vegetation trimming and pruning, concrete formwork, scaffolding, and others.	Collection in a designated area. The wood will be cut and placed in piles.	Sale of wood or firewood
Leaves and branches	Deforestation	Gathering at a designated site on each work front	Eviction to authorized site
Paper	From office and packing	Store in a marked container	Sale for recycling
Domestic Waste (Dining room and offices)	Food, various	Storage in closed containers	With the cleaning train or authorized transport and transfer to the sanitary landfill
Glass	Containers	Storage in closed containers	Sale for reuse
Plastic Products Waste	Packing material	Storage in closed containers	Sale for recycling
Building construction waste	Of the construction, itself	Storage	Taken to a licensed dump
Metal pieces	Spare parts of support structures and metal	Storage	Selling as scrap

Table 4.10 – Wastes and Residues to be Generated in the Construction Stage *			
Waste/Residue	**Origin**	**Handling**	**Disposal**
	pipes		
Sterile earth moving material	Earthworks	Stacked in a defined land area	Eviction to site defined for filling
Seabed Soil	Dredging of seabed 130,000 m^3	Collection on barges	Deposited in sea area
Seabed Soil	From perforations in seabed	Stacked in a defined land area	Eviction to site defined for filling

** Hazardous wastes include: empty reservoirs, used lubricating oil, solvents and other reagents, batteries and other consumables.*
Source: Own elaboration ECO/DILLON.

The gravel will be taken to an appropriate disposal site, authorized by the City Hall and by the MARN.

The management and disposal of dredging material is explained in section 4.8.4.

4.5.9.2 Handling and Final Disposal of Ordinary Wastewater

During the construction phase, between 10 and 48 portable toilets will be available for the approximately 1,200 construction employees, one for every 25 employees, distributed in the construction area. Portable toilets will be maintained according to personnel at each stage (see Table 4.11).

Table 4.11 – Estimated Portable Toilets per Month		
MONTH	**Employees Estimated per Month**	**Number of Portable Toilets**
Month 1	6	1
Month 2	79	4
Month 3	190	8
Month 4	244	10
Month 5	406	17
Month 6	339	14
Month 7	580	24
Month 8	670	27
Month 9	734	30
Month 10	772	31
Month 11	993	40
Month 12	1001	41
Month 13	1239	50
Month 14	1270	51
Month 15	1084	44
Month 16	1072	43

Table 4.11 – Estimated Portable Toilets per Month		
MONTH	**Employees Estimated per Month**	**Number of Portable Toilets**
Month 17	1102	45
Month 18	959	39
Month 19	843	34
Month 20	781	32
Month 21	554	23
Month 22	412	17
Month 23	236	10
Month 24	197	8
Month 25	95	4
Month 26	95	4
Month 27	95	4
Month 28	95	4
Month 29	73	3
Month 30	95	4
Month 31	62	3
Month 32	62	3
Month 33	40	2
	Total units per MONTH	674

Source: Own elaboration ECO/DILLON based on information by EDP/Wärtsilä, 2014.

The portable toilets will be rented to companies that have the corresponding permits, who will be responsible for the cleaning and maintenance of the same, which will be done regularly. These will be distributed on the different work fronts.

4.5.9.3 Rainwater Management

During construction, a rainwater management plan will be developed with the following objectives:

- Prevent erosion of soils and sedimentation downstream of the project;
- Manage the flow of water in a way that does not exceed the capacity of existing collectors; and,
- Maintain current drainage patterns.

During construction, rain water will be handled through temporary drains to the existing CEPA drain located south-west of the land, while the final drainage of the project is being constructed.

The sites where lubricating oils and fuels are stored will be paved and drained to grease traps and oils.

4.5.9.4 Noise and Vibrations

Noise is produced in the construction of: ground cleaning, earthworks, foundations on land and at sea, heavy vehicle traffic, and general construction activities on land or at sea. It is worth mentioning that the

activity of passage of heavy vehicles already exists in the area, so the current noise and vibration levels are considerable.

4.5.9.5 Emissions to the Atmosphere

During the construction phase, dust will be produced by the movement of vehicles with materials, equipment and personnel, entering and exiting construction sites. Dust will also be produced during site grading works. Dust and emissions are also produced by the general activities of construction on land, by the use of equipment and its mobilization. To mitigate the impact of dust generation during construction, environmental measures are proposed that are included in the Environmental Management Program, EMP. There will also be emissions of construction equipment and vehicles.

4.6 Operation Stage

The main activities in the plant will be:

1. Liquefaction of the tanker and LNG discharge, when there is a scheduled discharge, it is estimated that it can last up to 36 hours;
2. Transfer and storage (at cryogenic temperatures and atmospheric pressure) of LNG from the methane tanker to the FSU;
3. Transfer and storage of FSU LNG to the FSRU.
4. Management of boil-off gas (BOG);
5. Regasification and transfer of the NG from the FSRU to the plant and measurement of natural gas on a permanent basis;
6. Generation of energy, by the combustion of natural gas and steam turbine;
7. Cooling system operation;
8. Injection of energy in the substation; and
9. Equipment Maintenance.

4.6.1 Fuel Management Diagram

The thermal power station will use 19 Wärtsilä 18V50SG ENGINE-GENERATOR units, which operate on medium-speed natural gas in combined cycle configuration (FlexicycleTM). Flexicycle is a Wärtsilä concept for a highly efficient and flexible combined cycle plant based on Wärtsilä's standard design. Each generator has a net power of 18.3 MW and will have a heat recovery steam generator supplying steam to a steam turbine of 30 MW of capacity.

This configuration will allow the project to have a net efficiency of 49.4%. The following table shows the main components of the Flexicycle Thermal Power Plant in Wärtsilä.

The modular configuration is illustrated in Figure 4.13 and the Operation Diagram in Figure 4.14

4.6.2 Equipment Technology and Specifications

4.6.2.1 Marine Terminal for Natural Gas

Three tube housing re-gasifiers will have to operate with mixture of water and glycol for regasification. There will also be three heat exchangers water glycol / water.

The auxiliary equipment in the FSU and FSRU includes: electric generators for the FSRU and boiler and / generators for the FSU, other equipment such as air compressors and nitrogen generators, emergency generators (diesel). The equipment is described below.

Nitrogen Generator

The purpose of the nitrogen generator is to produce sufficient nitrogen to protect the LNG tank from sub-atmospheric conditions that may arise during discharge. All purging tasks are also performed using nitrogen.

There will be two nitrogen generators to produce enough nitrogen to protect the LNG storage tank from the sub atmospheric conditions that may arise during the discharge. One generator will be located in the FSU and the other in the FSRU, with a purity of 97%. The nitrogen generator in the FSU will have a capacity of 2x60m3 / h and the generator on board the FSRU will have a capacity of 1,000m3 / h.

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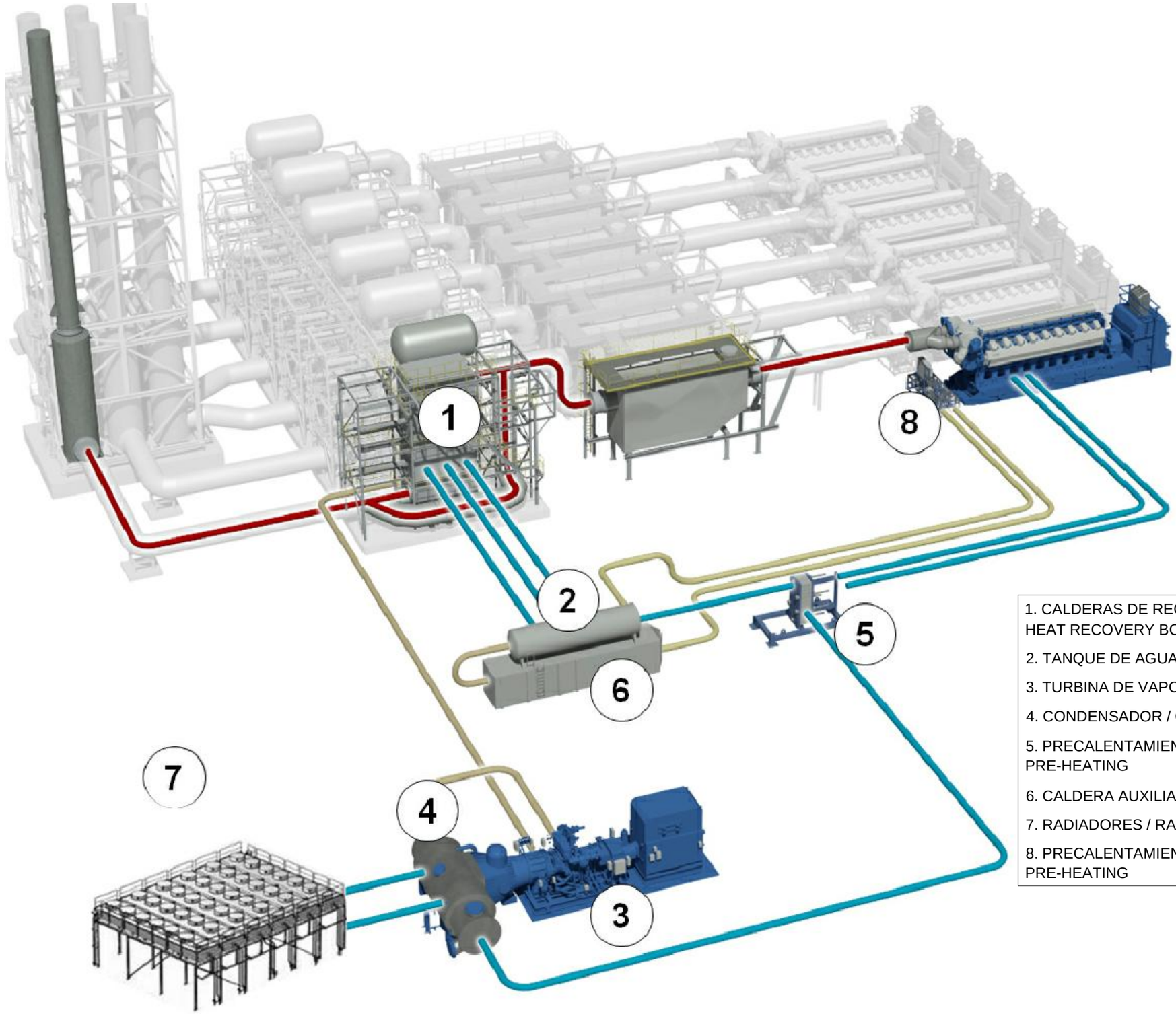
SISTEMA DE CICLO COMBINADO / COMBINED CYCLE SYSTEM

FIGURA 4.13 / FIGURE 4.13



1. CALDERAS DE RECUPERACIÓN DE CALOR / HEAT RECOVERY BOILERS
2. TANQUE DE AGUA / WATER TANK
3. TURBINA DE VAPOR / STEAMTURBINE
4. CONDENSADOR / CONDENSER
5. PRECALENTAMIENTO DE AGUA / WATER PRE-HEATING
6. CALDERA AUXILIAR / AUXILIARY BOILER
7. RADIADORES / RADIATORS
8. PRECALENTAMIENTO DEL MOTOR / ENGINE PRE-HEATING

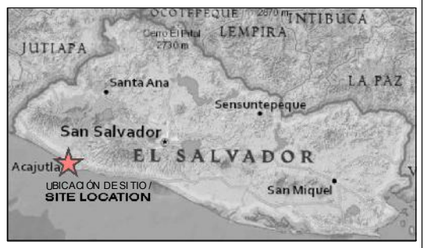


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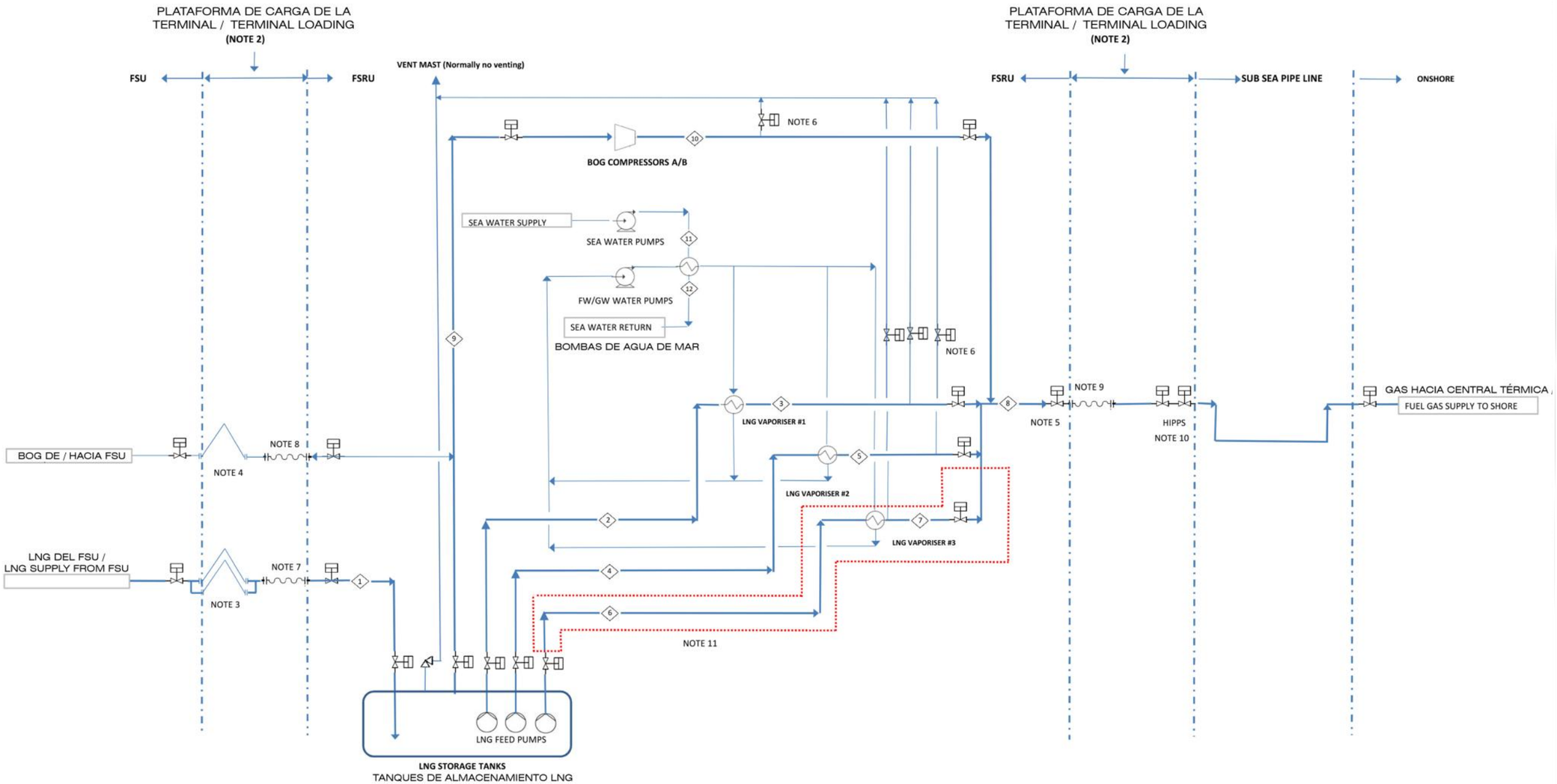
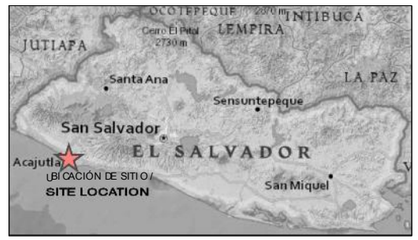
DIAGRAMA DE OPERACIÓN DE LA CENTRAL TÉRMICA / DIAGRAM OF OPERATION OF THE POWER PLANT

FIGURA 4.14 / FIGURE 4.14





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Instrumentation Air Generator

The purpose of the air generator is to produce sufficient instrumentation air for the operation of the valves of the terminal. The air is produced by drying and compressing the air in the environment.

Marine Terminal Control System

The objective of the control system is to ensure the safe and proper operation of the LNG Marine Terminal. There will be two control centers of the whole project; one inside the FSRU and the other inside the Thermal Power Station on land.

The FSU has its own internal control center, but normally no process control will be performed, which will be carried out at the FSRU control center, when the FSU is docked at the Marine Terminal.

In general, the control and monitoring of the Marine Terminal will be carried out by a small programmable logic control center (PLC) w / a SCADA / HMI system located in the FSRU. Within the FSRU control room all gas and pressure systems will be controlled via ESD systems.

During the transfer of LNG from the LNGC, an ESD control system will be available aboard the LNGC, to control the transfer of liquid and vapor. The operation of the FSRU will be full time (24 hours / 365 days). Generally, there will be no personnel on the platforms; they will only have access to maintenance activities.

All processes will be fully automated. Only a few steps will be required by the operator to start and complete operations, such as unloading of a tanker, transfer of LNG and delivery of natural gas.

The control system will interact with all other systems required for terminal automation. The system will also be linked to the control system of the Thermal Power Plant, allowing the exchange of data between them, by submarine fiber optic, high speed and broadband cabling. FSU / FSRU fiber-optic connection to FSU will be through a quick coupling system. Redundant telecommunications will be provided by microwave radio link.

A system of quick-release communications connectors will provide quick disconnection and release of connections between the FSU and the Marine Terminal in case of exit of the FSU by any climatic or emergency condition. The rapid release communication system shall be a burst voltage release system, which is activated when the ship is released from its mooring lines and begins to move away from the Marine Terminal; it can also be uncouple manually, if there is enough time to do so.

The following systems are interconnected with the terminal control system:

- Monitoring of pressure, temperature and volume of tanks;
- Detection of fire and gas leaks;

- ESD system (qualified SIL); and
- Control of load arms.

1. Emergency shutdown system

The emergency shutdown system will monitor the plant during critical situations. It will operate on engines and other equipment to prevent catastrophic failure.

All arms and hoses, steam and liquid, will have an emergency opening system.

2. Fire detection and gas leak detection system

Instruments dedicated to the detection of fire and gas will be installed in all areas of the plant. Gas detection immediately activates emergency shutdown systems to prevent gas spreading and prevent the risk of ignition. Gas detectors will also be installed at the CEPA wharf as recommended in the project risk study.

Fire signals will also be sent to the control system, and will activate emergency systems to stop fueling fuel fires. The fire protection system will also be activated to prevent the spread of a fire.

Fire Control System

The equipment at the Marine Terminal shall have sufficient fire extinguishing capacity for emergency care, including for the transfer platform, lifting platform, service platform, and two (2) emergency exit berths.

Fire extinguishing systems at the Marine Terminal shall have the following characteristics:

- LNG fire protection, including two (2) remotely controlled high expansion foam generators located adjacent to the LNG containment system adjacent to the transfer platform and two (2) manually or remotely controlled dry chemical monitors on the transfer platform
- Natural gas fire protection system including a dry chemical extinguishing system and two (2) remotely controlled dry chemical monitors located on the lifting platform
- Two (2) diesel engine-driven firewater pumps and controllers located on the service platform, with a capacity of 11,360 liters per minute or 3,000 gallons per minute. Sea water will be used.
- One (1) ground connection on one of the platforms and several fire water connection points on the service platform.
- Outputs for connection and fire hoses on all platforms and outlet springs.
- Dry and portable chemical fire extinguishers on lifting and transfer platforms.
- Water sprinkler system on all LNG transfer and elevation platforms.
- A system of automatic sprinklers suspended in the pumping station.

- Fire and vapor detection system located on lifting and transfer platforms.
- Low temperature detector located in the LNG tank basin and near the exit of the transfer platform.
- Steam detection system located on the service platform and emergency exit berths.

The FSU and FSRU will be equipped with their own fire protection systems. In the unlikely event of a fire at the Marine Terminal, ESD systems will be activated to eliminate the fuel source. The FSU and, if present, the LNGC will proceed to withdraw from the terminal.

Instruments
The instruments to be installed in the plant will be dedicated to one of two systems: Process control system or emergency shutdown system.

The process control instruments will be used for plant control, control, regulation, alarm and shutdown of the process. All instruments will be connected to the control system. Values will be available to the operator at all times. They will also be logged into a system to facilitate reporting, maintenance, performance monitoring, and troubleshooting.

ESD instruments will be used to monitor critical processes and initiate emergency actions to prevent catastrophic failure. All instruments will be connected to ESD controllers.

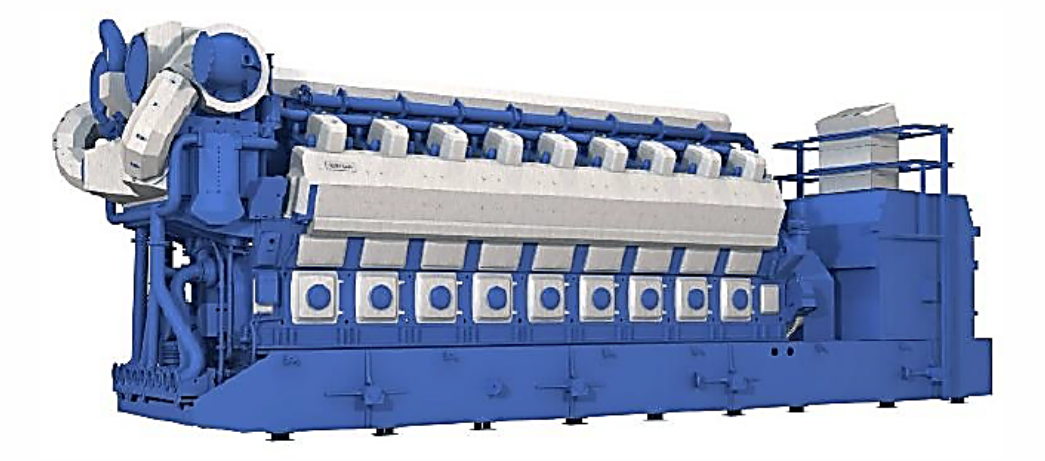
A large number of instruments and sensors of different types will be installed. In the area of emergency systems, the instruments to be installed include, but are not limited to:

- Gas flow, piping pressure, gas chromatographs, to analyze gas samples and calculate gross calorific value; and
- Instruments to detect densities and pressures inside tanks. Levels, temperature and density will be monitored.

4.6.2.2 Thermal Power Plant: Engine-Generator Unit

Wärtsilä 18V50SG engines and generators will be installed. Generator-engines of this type are mounted on a single platform, mounted in turn on a concrete foundation using steel columns. See Figure 4.15.

Figure 4.15 – Example of Engine/ Generator Set Type Wärtsilä 18V50SG



Source: Wärtsilä 2014

The dimensions of the set 18V50SG are:

- Length: 18782 mm;
- Width: 5321 mm;
- High: 6462 mm;
- Weight (dry): 358,470 kg; and
- Weight (wet): 373,470 kg.

Engine General Overview

The engine is four-stroke, with pre-chamber, spark-ignition, injection by port, piston trunk, and with internal cooling design. The engine has a built-in control system, to control the combustion process individually in each cylinder.

The motor is designed for continuous operation, at any load between 30% and 100% of rated load. The motor can be operated between 10-30% loads for a maximum period of 10 minutes, after which the load must be increased above 70%.

The main engine data are:

- Configuration: V (motor shape);
- Number of cylinders: 18;
- Inner diameter: 500 mm;
- Engine time: 580 mm;
- Speed: 514 rpm;
- Average piston speed: 9.94 m / s;
- Average effective pressure: 19.5 BAR;
- Cylinder volume: 96.4 dm3;
- Compression radius: 11: 1;

- Number of inlet valves: 2;
- Number of inlet valves: 2; and
- Direction of rotation towards the steering wheel: In the direction of the clock.

Generator Overview

The generator is 13,800 volts at 60 Hz. The generator is synchronous, three-phase, pole-type. The main generator data are detailed:

- Apparent generator power: 23449 kVA;
- Power factor measured: 0.8;
- Rated Voltage: 13800 v;
- Measured electrical current (in): 983 A;
- Adjusted voltage range: ±5 %;
- Frequency: 60 Hz;
- Speed: 514 rpm;
- Over-speed: 617 rpm;
- Short Circuit Current: > 2.5 x I_n;
- Insulation class: typo F[3];
- Temperature rise: typoF;
- Cooling method: By air;
- Enclosure: IP23; and
- Standard: IEC60034.

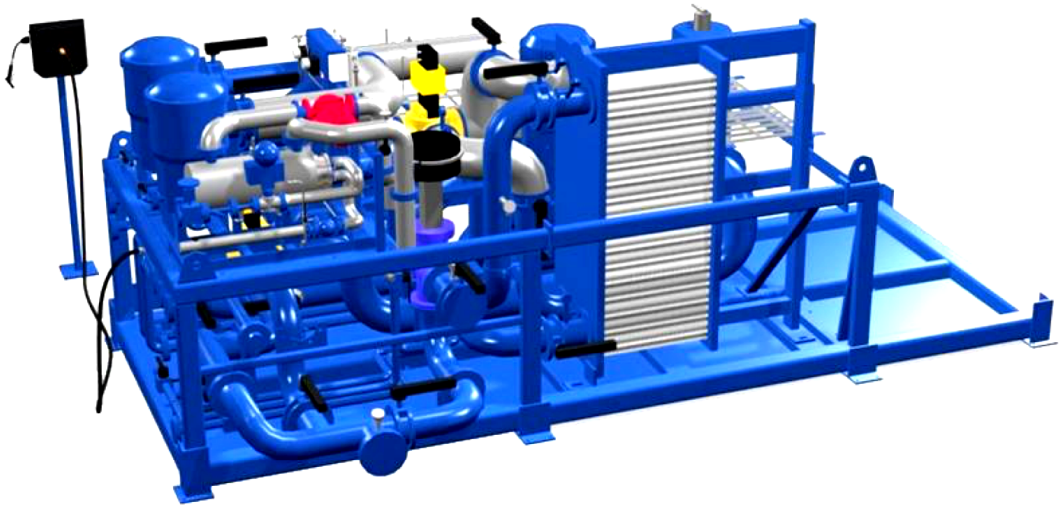
Auxiliary Mechanical Equipment

The operation of the plant depends on the auxiliary mechanical equipment. The proposed systems have been optimized for this particular application. The function of these systems is to provide the engine with: Fuel, lubricating oil, starting air, cooling water and cargo air, in the required quantities and qualities, as well as to dispose of the exhaust gases properly.

To ensure quality and reduce installation time, Wärtsilä has developed prefabricated auxiliary modules. These modules contain several pieces of auxiliary equipment (listed below) that are fully installed and installed at the factory, which saves installation and piping time on site. The complete auxiliary module is tested (in terms of pressure and operation), and then cleaned, painted and protected against corrosion prior to shipment to the site. All external connections are sealed and covered with steel sheets. See Figure 4.16.

[3]Isolation systems are rated by the National Electrical Manufacturers Association (NEMA) standard ratings in accordance with maximum permissible operating temperatures, type F supports a maximum temperature of 155 ^{o}C.

Figure 4.16 – Image of Auxiliary Engine Module



Source: Wärtsilä 2014

The module includes:

- Automatic lubricating oil filters;
- 1 lubricating oil cooler;
- 1 pump for pre-lubrication oil;
- 1 preheating unit;
- 1 thermostatic valve for the backup lubricating oil cooler;
- 1 thermostatic valve for high temperature water system;
- 1 thermostatic valve for low temperature water system;
- 1 pressure lift pump;
- 1 pipes and insulation;
- 1 valves and meters; And
- Control panel module.

Exhaust Gas System

The exhaust gases are evacuated to the required height through a muffler and chimney. The muffler reduces engine noise. The stacks will have ladders, platforms and sampling ports to facilitate the monitoring of emissions. The characteristics of the tacks are detailed:

- Diameter: DN 1600;
- Material: COR-TEN A; and
- Height: 50 m.

Engine cooling system

The main task of the cooling system is to provide adequate cooling of critical engine components such as jackets, cylinder heads and turbochargers, as well as to cool the air and the load of lubricating oil entering the cylinders after it has been compressed by the turbocharger.

The engine cooling water cools the low temperature air cooler, lubricating oil, high temperature air cooler and engine jackets on a single circuit radiator. The cooling circuits of each motor are interconnected, but can be isolated from each other if necessary.

The refrigeration system shall consist of horizontally mounted roof-mounted refrigeration radiators with electric air-induced fans. Radiator fans can operate at different speeds as required, depending on the operating units, which improves plant efficiency.

Four maintenance water tanks, 10 m^3 each, will be installed, where water used for maintenance and for mixing chemical products will be stored.

Lubricating Oil System

The system will provide proper lubrication for all moving parts of the engine. It is responsible for the cooling and filtration of the lubricating oil and the entire lubricating oil system of the plant, with new and used oil storage.

For the storage of the new lubricating oil, a tank of 150 m3 of capacity, vertical, aerial type, with its stairs, valves, level indicators and sensors will be installed.

In addition, there will be two oil service tanks of 16 m3 each. Service tanks provide temporary storage of oil during engine maintenance. These tanks will be aerial, and of vertical type, also with their valves, stairs, level indicators and sensors, among others.

For the storage of used lubricating oil, it will be installed a tank of 100 m3 capacity, aerial, vertical type, with its stairs, valves, and level indicators and sensors, as the other oil tanks.

Other Auxiliary Equipment

Other auxiliary equipment is detailed:

1. Fuel system. Whose function is to provide the engine with fuel, in the correct flow, pressure and purity grade. The fuel system includes: flow meters, valves, gas regulation unit for pressure regulation and piping;
2. Compressed air system. It is used for ignition of motors and for control and instrumentation equipment. The air for this system is supplied by an air compressor and is stored in bottles until

used. The system will have: air ignition bottles, double start air compressor unit, compressor unit for air, pipes and valves; and

3. Air charging system. The air filter protects the engine from impurities in the cargo air and the cargo muffler reduces the noise generated by the load of air to the engine. It consists of the load air filter, with its protective head and duct.

Fire Control System

The Thermal Power Plant shall have a piped water fire system in accordance with the requirements of the "Class II NFPA14 support pipe system". In addition, mobile foam will be provided. For immediate action against small local fires, the engine room will be equipped with dry powder portable fire extinguishers in strategic locations, and portable CO2 fire extinguishers for electric fires (spacing according to NFPA10).

The system will be constructed using "NFPA24 private fire service principal" as a design guide. The design of the tank area will be based on NFPA30. The pump will be sized according to the NFPA 850 standards of the highest individual risk plus the hose margin, the capacity is expected to be 300 m3 h. Fire areas shall be separated from each other by fire barriers, space separation or other approved means.

The building of fire equipment will contain a main firefighting pump unit and its control system. The main fire water pumping unit will supply water from the water tank to hydrants and hose. There will be two centrifugal type fire pumps, a powered diesel engine and a powered electric motor. Each pump is capable of supplying the total amount of water for fire extinguishing purposes.
Inside the fire building will be:

- 1 Diesel engine driven pump unit
- 1 Pump unit driven by electric motor
- 1 Jockey pump
- 1 Control system
- 1 Sprinkler (set)
- 1 Portable fire extinguisher
- 1 Pipe (assembly)

The water tank will be a welded carbon steel tank. The interior is painted with immersion-proof epoxy coating. The total volume of the fire water tank is dimensioned for approximately 2 hours of operation with full pumping capacity of fire water.

4.6.2.3 Thermal Power Plant Secondary Electrical Production: Combined Cycle

The steam generation system is designed to deliver superheated steam to a steam turbine. The steam will be condensed in a steam condenser and the condensate is returned to the boiler system (closed circuit). All engines shall be equipped with separate water tube type boilers using the exhaust gas.

Heat Recovery Boilers.

The exhaust gas flow through the boiler is downward, passing first through the overheating section, then through the evaporator and finally through the economizer section. The water pipes are placed horizontally in the boiler and are equipped with an extended area of heating surface.

The economizer is located below the evaporator section. The feed water is pumped by centrifugal pumps directly from the water tank through the economizer and after a preheating, the flow is directed to the steam drum.

The evaporator is of the type of water tube. The water will be circulated from the steam drum through the evaporator using natural circulation. A part of the water is evaporated and the mixture of steam and water is returned to the steam drum where they are separated.

The superheat section of the boiler is fed with saturated steam directly from the steam drum and it heats the steam at the required superheated temperature. The superheater tubes will be located horizontally above the evaporator section of the boiler.

The bypass of the exhaust gas will be located before the exhaust gas boiler.

The capacity of the boiler is detailed:

- Generation of superheated steam: 2.5 kg / s;
- Overheated steam pressure: 15.5 bar;
- Superheated steam temperature: 352 °C;
- Saturated steam pressure: 16 bar;
- Saturated steam temperature: 201 °C;
- Exhaust gas flow: 31.4 kg / s;
- Exhaust gas inlet temperature: 382 °C;
- Exhaust gas temperature: 180 °C.

The system includes the superheater, evaporator, economizer, steam drum. The steam drum of the boiler is equipped with a water / steam separator to provide saturated steam to the superheater. The water level in the drum is controlled separately with a level controller connected to control valves in the

water supply pipe. The water is recirculated from the steam drum through the exhaust gas boiler, into the evaporator and back to the steam drum.

Auxiliary equipment for the steam generating system will be installed in a standard 40 foot container. All installation, piping, wiring, insulation, wiring, painting and testing of the equipment inside the container will be carried out at the factory, when assembled, reducing installation time at the site.

Auxiliary equipment:

- Water supply tank;
- Water pumps;
- Low-pressure evaporator pump;
- Flow meter for water supply;
- Chemical dosing unit;
- Tank for discharge;
- Local control panel; and
- Boiler that operates with diesel fuel for steam generation, to start operations and backup. The boiler includes all its auxiliary equipment, and will have a capacity of 2,000 kW, with feed water temperature of 142 °C, vapor pressure of 8 bar (a) and saturated steam temperature at 170 °C.

Other equipment

- Steam head (2 units). The superheated steam from all the boilers will be sent to a steam head. The steam head will be sent to the turbine for power generation. The head also separates possible drops of water in the steam and drains them to the condensate return system;
- Auxiliary steam head, the auxiliary diesel boiler has its own steam head.
- Steam meters;
- Water storage tanks for boiler washing; and
- Pumps.

Steam Turbine System

The Steam Turbine Generator set consists of a horizontal condensing steam turbine, multiple gears and a generator for additional energy production.

The characteristics of the steam turbine are detailed:

- Gross delivery according to site environmental conditions: 30,150 kW (el.);
- Steam mass flow: 47 kg / s;
- Inlet steam pressure: 15 bar (a);
- Entry steam temperature: 347 oC; And
- Output vapor pressure: 0.2 bar (a).

The system will have a gear for speed reduction, whose function is to reduce the rotation of the turbine to the speed of rotation of the generator. The characteristics of the generator are:

- Rated capacity: 37,688 kVA;
- Nominal voltage: 13.8 kV, adjustment range of ± 5%;
- Frequency: 60 Hz; Y
- Speed: 1,800 rpm.

Auxiliary equipment such as: steam inlet and outlet, condensate system, lubrication system, drainage, steam discharge, condensate drainage, condensate cooling system, piping, valves, electrical equipment, water treatment system, Water tanks, among others.

Condenser and Evacuation System

The steam leaving the turbine is brought to the condenser. The condenser keeps the turbine output vapor pressure as low as possible. The characteristics of the capacitor are detailed:

- Steam capacity to be condensed: 47.3 kg / s;
- Steam condensation pressure: 0.2bar;
- Condensation temperature: 60 ° C;
- Mass flow of cooling water: 2375 kg / s;
- Inlet temperature, cooling water: 45 ° C; and
- Exit temperature, cooling water: 55 ° C.

The condenser will be equipped with ducts and pipes, shutdown system and safety valves, steam trap and drainage system, instrumentation.

4.6.2.4 Electrical Distribution

Inside the plant there will be an electrical distribution system to distribute all the energy produced by the plant and to raise its voltage so that it can be delivered to the transmission network. The substation will have all the equipment for the transformation, power delivery, and network protection. The main systems are listed:

1. Low voltage system, to supply energy to the interior of the plant;
2. Direct current system, to supply direct current to some of the equipment; and
3. Electrical Substation.

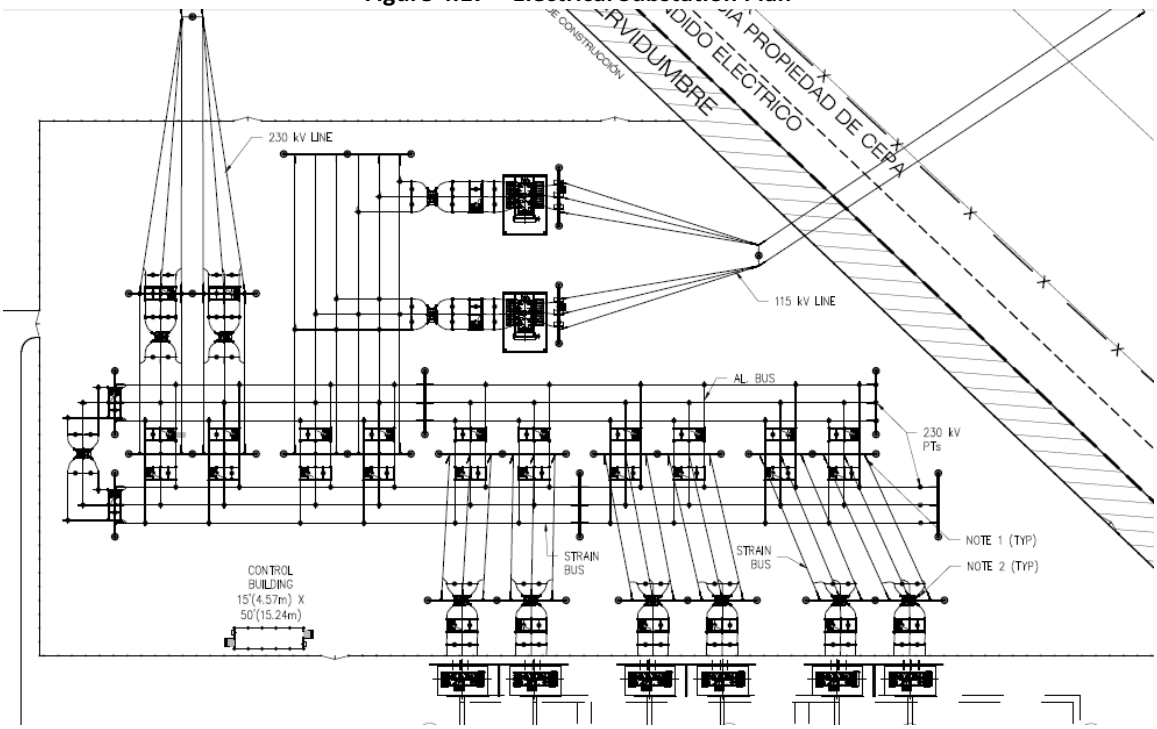
An electrical substation will be installed inside the site:

- Connection between 13.8kV / 230kV transformers on the high-voltage side and switch-type substation and medium at 230kV
- A dual ternary line in 230 kV from the Thermal Power Plant to the ES Ahuachapán 230kV owned by ETESAL

- Two transformers 230 / 115kV with 250 MVA
- A double ternary line in 115 kV, for the interconnection with the ES Acajutla of ETESAL

In the high voltage system, three power elevators transformers of 13.8 / 230 kV will be installed, three power transformers of 71 MVA, of 13.8 / 230 kV, with all their auxiliary equipment. The distribution in plant of the substation is Presents in the figure 4.17.

Figure 4.17 – Electrical Substation Plan



Source: M&N 2016

4.6.2.5 Automation System

There will be an advanced system for the operation and supervision of the entire plant. The system is designed to provide safe, reliable, efficient and simple operation of generation equipment, auxiliary equipment and electrical systems. Its modular design allows for easy system expansion.

The Thermal Power Station can be controlled from any Wärtsilä operator interface system (WOIS workstations, CWA901). The WOIS workstation and common control and generation control panels will be located in the control room, where all monitoring of the main plant is carried out.

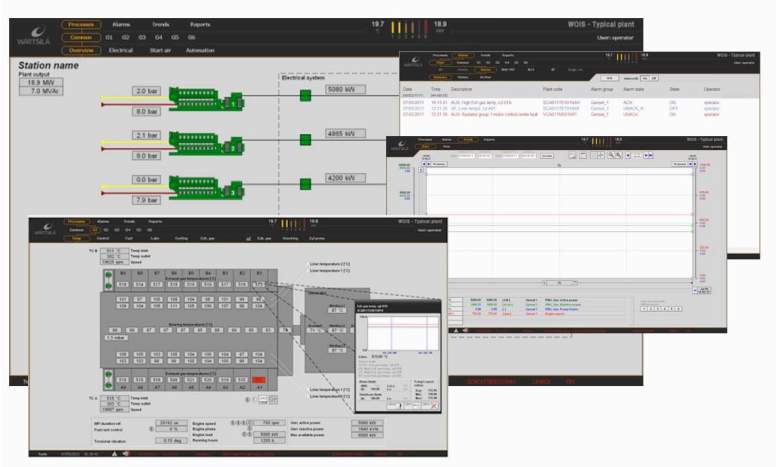
Operator Station

The Thermal Power Station will be controlled and supervised from the Wärtsilä operator interface system (WOIS workstation). All actions necessary for normal operation, such as starting and stopping start and stop of the generation, increment and load reduction sets, are activated and controlled by

means of the WOIS workstation, using the mouse, keyboard and the screen. The operator can also monitor key plant data such as various temperatures and pressures, as well as measurement of electrical variables such as generator power, voltage and frequency. See Figure 4.18. The workstation allows the following functions:

- Shows the status of processes and operations, using objects and graphs;
- Process trends, showing six combinations of measures such as pressure, temperature, speed, load, etc. The operator can combine these measurements according to his interest; Measures of up to 180 days are archived;
- Alarm indicator, which shows the last alarm occurred and informs the operator of potential problems in the processes; and,
- All this information can be printed;

Figure 4.18 – Example of a Typical Workstation WOIS

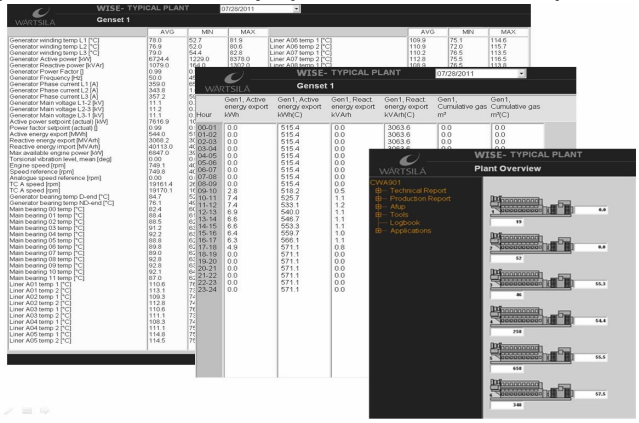


Source: Wärtsilä 2014

There will be a Wärtsilä Information System (WISE) that handles historical data and operational reports of the Thermal Power Station. The WISE station can generate the following information (see Figure 4.19)

- Daily reports of engines and plant, measured in an analogous way;
- Historical performance of engines and plant, showing trends;
- Report daily production, energy, as well as fuel consumption;
- Monthly production reports (with daily data), stored for 5 years; Annual reports are stored for 10 years;
- Production reports include minimum, maximum, average and total amounts for the period; and
- Electronic logbook with search facilities to store operation and maintenance activities.

Figure 4.19 – Typical WISE Station, Daily Operation, Production Report and Data Log Book



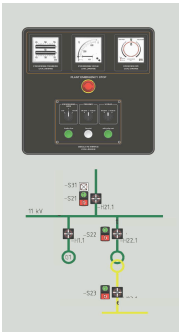
Source: Wärtsilä 2014

Control Panel

The common central control panel (CLS 901) contains operating switches, buttons and timing and mimic meters for the plant medium voltage system. It also contains the common PLC system. See Figure 4.20)

In addition, there will be central control panels and auxiliary module panels.

Figure 4. 20 – Common Control Panel Example



Source: Wärtsilä 2014

Electric systems

1. Service system (low voltage)

It allows distributing energy throughout the plant. It will have 6 auxiliary transformers from 13,800 V to 480 V, with all its accessory equipment.

For start-up operations in case of emergency, when there is no power in the grid, an emergency generator will operate with diesel fuel, with a capacity of 800 kVA, operating at 60 Hz. It will have its fuel tank, Radiator, fireplace and muffler, control panel.

2. Direct current system (DC)

The plant will be equipped with a direct current system that will provide power for control, automation, protection and alarm systems, to ensure safe operation, and shutdown of the plant in case of failure.

They are three DC current systems, one of 24 V and two of 110 V, both consisted of battery, with capacity of three hours, chargers, switchboard, among others.

3. High Voltage System

For the delivery of energy outside the plant, there will be:

- 3 Power Transformers of 94 MVA;
- Measured Power: 94MVA ONAF;
- Nominal Voltage, high voltage side: 230kV;
- Nominal Voltage, medium voltage side: 13.8kV;
- Voltage adjustment range: ±2 x 2.5 %; and
- Lost: < 0.5 % of the de Measured Power.
- 3 Power Transformers of 71 MVA
- Nominal potential: 71MVA ONAF;
- Nominal Voltage, high voltage side: 230 kV;
- Nominal Voltage, low voltage side: 13.8 kV;
- Voltage adjustment range: ±2 x 2.5%;
- Standard: IEC 60076 1...5;
- Cooling: ONAF;
- Increase in oil temperature: 55/65 K; and
- Lost: < 0.5 % of nominal potential.

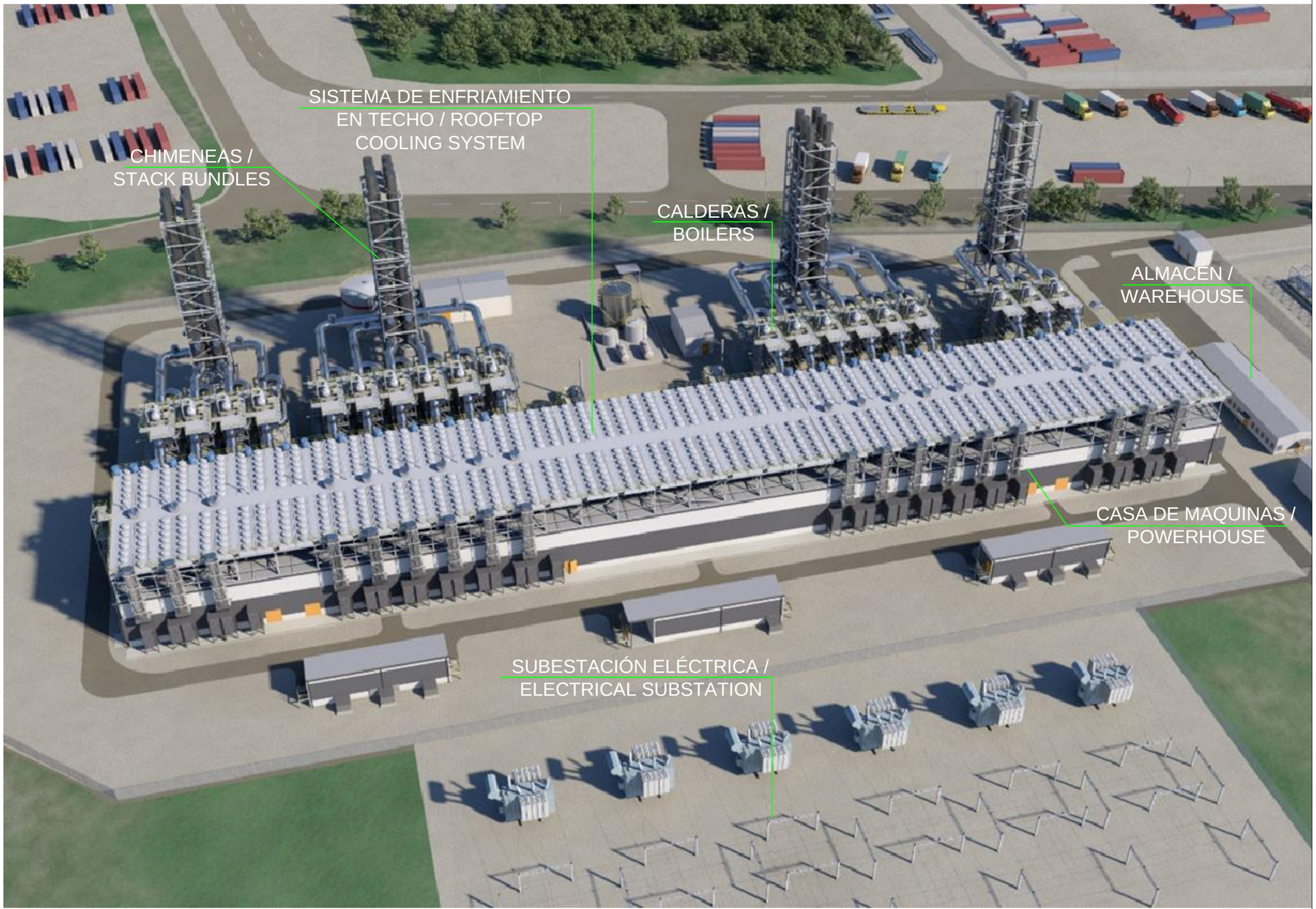
2 Power Transformers of 250 MVA

- Nominal potential: 250 MVA ONAF;
- Nominal Voltage, high voltage side: 230 kV;
- Nominal Voltage, low voltage side: 115kV;
- Voltage adjustment range: ±2 x 2.5 %;
- Standard: IEC 60076 1...5;
- Cooling: ONAF;
- Increase in oil temperature: 55/65 K; and
- Lost: < 0.5 % of nominal potential.
- The transformers will use transformer oil without PCB content; the volume of oil that is kept in each transformer is detailed:
- Transformer 94 MVA, 13.8 kV / 230 kV, quantity of oil: 30,000 kg, equivalent to 34 m^3;
- Transformer 71 MVA, 13.8 kV / 230 kV, amount of oil: 25,000 kg, equivalent to 28 m^3; and
- Transformer 250 MVA, 230 kV / 115kV, quantity of oil: 90,000 kg, equivalent to 84 m^3.

4.6.3 Techniques for Increasing Efficiency

These types of plants are more efficient compared to similar plants using diesel and without combined cycle. The efficiency of the plant can be maintained with different dispatches due to its modular design with the use of multiple primary engines and the capacity of the alternating motors to maintain a high efficiency in the operation at partial load.

Another advantage is the high availability of the installation. Maintenance can be accomplished by removing a single unit at a time. Removal of any unit under maintenance will have a less than 6% impact on plant capacity, while the heat rate remains stable. The output of the steam turbine is almost linear across the entire load curve of the plant. Figure 4.21 shows a 3D image of the Thermal Power Plant.



Energía del Pacífico

ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

IMAGEN 3D DE LA PLANTA A CONSTRUIR / 3D IMAGE OF THERMAL POWER PLANT

FIGURA 4.21 / FIGURE 4.21

FUENTE / SOURCE:
WARTSILA / WARTSILA

MAPA CREADO POR / MAP CREATED BY: WARTSILA
MAPA REVISADO POR / MAP CHECKED BY: WARTSILA
PROYECCIÓN DE MAPA / MAP PROJECTION :
UTM ZONA 16 WGS84 / UTM ZONE 16 WGS84

ARCHIVO / FILE
C:/CAP 4,ECO,DRAWING 1, EL SALVADOR/ ECO INGENIEROS
C:/CAP 4,ECO,DIBUJO 1, EL SALVADOR/ ECO INGENIEROS

PROYECTO / PROJECT: 14-9114
ESTADO / STATUS : FINAL / FINAL
FECHA / DATE: 11/29/2016

DILLON CONSULTING

ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

4.6.4 Labor during Operations

For the Thermal Power Plant there will be an estimated 40 people full time, distributed in shifts. The FSU will be a vessel capable of sailing on the high seas with sailors and operators qualified according to international standards which will navigate and operate the LNG equipment of the FSU and FSRU. Previously it is estimated that in the FSU there will be 15 sailors and in the FSRU 15 Operators, and more than 30 administrative employees.

During the operation phase there is an estimated 100 employees to work in the Thermal Power Station and Marine Terminal in different shifts, and an indeterminate number of temporary employees who will provide maintenance support.

4.6.5 Maintenance Operations

4.6.5.1 Thermal Power Plant

Maintenance of the engine and equipment is usually programmed based on working hours. Actual operating conditions will largely determine the maintenance required for the engine. Due to the difficulty in anticipating the various operating conditions that can be found in the field, the intervals indicated in the schedule should be used for orientation purposes only. Where any indication that the operation of a maintenance procedure is required before the recommended period is found, cautious industry practice dictates that the suggested maintenance procedure is performed.

The main maintenance activities of the Thermal Power Plant are presented in Table 4.12

Table 4.12 – Maintenance Activities Based on Work Intervals

Mandatory Works	Intervals (hrs)
Check Cooler(s) Drains	50
Check and record all operating values	
Check water levels in expansion tank(s)	
Check pressure drop indicators (Gas, lubricating oil)	
Cleaning the compressor with water	
Check valve clearance	
Check water quality	500
Check the operation of the waste gate valve	
Measure the pressure drop on the load of the air cooler	
Turbine cleaning with water	
Take lubricating oil sample for laboratory analysis	
Check operation of mist detector in the oil	
Clean centrifugal filter	
Check pressure bypass valve function	

Table 4.12 – Maintenance Activities Based on Work Intervals	
Mandatory Works	**Intervals (hrs)**
Check the tightening of the motor fixing screws	1,000
Replace the gas filter cartridges on the reg. Of gas	
Clean the gas filter cartridges (with mounted motor)	
Re-lubricate the lubricating oil pump	
Checking the operation of control systems	2,000
Do the leak test (gas system)	2,000
Visual inspection of valve rotators	
Check yoke and valve clearance	
Replace fresh air filter and oil mist detector	
Spark Plug Replacement	
Clean and check the condition of the ignition coil	
Check and clean the lubricating oil filter	
Check connectors and cables	4,000
Clean and check discharge valve and actuator	
Inspect camshaft contact surfaces	
Check camshaft alignment	
Check alignment (of flexible mounted motor)	
Clean the load of the air cooler	
Replace the gas filter cartridges in the unit. Of gas	
Replace the gas filter cartridges (in the mounted engine)	
Checking the alignment of the flexible coupler	
Visual Inspection of Expansion Bellows	6,000
Inspect exhaust duct supports and bellows	
Inspection of flexible pipe connections	
Verify automation equipment	8,000
Clean and check pre-chamber valve	9,000
Greasing the drive shaft of the rotating device	12,000
General overhaul of the discharge	
Clean the filler of the air filter and the inside of the filter	
Dismantle and clean the turbocharger	
Renew flexible tubing connections	
Inspect (replace) turbocharger bearings	
Rotary device oil change	18,000
Check engine lock bolt adjustment	
Checking the function of the hydraulic jack	
Replace the ignition coil in the socket	

Table 4.12 – Maintenance Activities Based on Work Intervals	
Mandatory Works	**Intervals (hrs)**
Check thrust bearing free space	
Maintenance of the gas system	
Replacement of main gas inlet valves	
Pre-chamber tip replacement	
Pre-chamber valve replacement	
Inspect the camshaft of the transmission gear	
Inspect the crankcase head bearings, one / bank	
Inspect cylindrical tracers + tapered	
Checking the cylinder head	
Inspect the pistons and replace the piston rings	
Check the piston cooling tube, a cylinder / b	
Dismantle valve turners, cleaning and inspection	
Review of small end of bearing and piston pin, one / bench	
Inspection of main bearing	
Replacement of cylinder pressure sensors	
Reconditioning of the main start valve	24,000
Change expansion bellows	
Replacing the electronic unit	
Replace vibration dampers in control system	
Inspection of turbocharger parts	
Clean and inspect HT-water thermostatic valve	
Clean and inspect LT-water thermostatic valve	
Clean and inspect the thermostatic oil valve	
Examine the lubricating oil pump and the drive gear	
Examine the HT-water pump and transmission gear	
Examine the LT-water pump and transmission gear	
Check the flexible coupling	
Replacing the steering wheel bearings	
Replace thrust bearing halves	36,000
Replace crankshaft seal	
Replace Pre-Camera	
Cleaning the cooling cylinder liner spaces with water	
Checking of bearing spaces on lifting rods and rocker arms	
Changing the roller bearing bush of the lifting rod	
Check the piston cooling gallery, all cylinders	
Change valve rotators and valve guides	

Table 4.12 – Maintenance Activities Based on Work Intervals	
Mandatory Works	**Intervals (hrs)**
Change input and output valves and seats	
Inspect camshaft / cam follower	
Air distributor starting check	
Connecting Rod Bearings Replacement	
Replace main bearings	
Goby Tip Bearing Replacement	
Changing the exhaust pipe support places	
Replacing the intermediate gear thrust bearing	
Disassembly of the damper on the crankshaft, condition check.	
General overhaul of the spring coupling (camshaft)	
Replace water chiller charger	
Replacement of expansion bellows (turbocharger- air intake)	48,000
Replace turbocharger rotor	
Inspection of the gas inlet / outlet boxes of the turbocharger	

Source: Wärtsilä 2014.

4.6.5.2 LNG Marine Terminal

Maintenance consists of the periodic review of instrumentation, pipelines, tanks, pumps, valves, loading arms, regasification equipment, to evaluate their condition and operation and proceed with cleaning, repair and / or change of parts (See table 4.13).

Table 4.13 – Maintenance of Equipment in FSU / FSRU		
System	**Equipment**	**Maintenance activities**
General	Electric engines	6-month electric motor electric resistance test (CbM)
		6-month electric motor vibration measurement (CbM)
	Helmet	Annual lubrication of electric motor bearings
	Hydraulic Actuators	5 annual class inspection
	All bearings	3-month functional test
	Ballast tanks	Ultrasound Measurement (CbM)
Structure and tanks		Test hydrostatic inspection and tank tank 5 years
	Air Ventilation Heater	Tank inspection
	Breakwater	Annual visual inspection
	Distilled water tank	5-year breakwater study
	MDO tank	Hydrostatic test inspection, cleaning and tank tank 5 years
	HFO Drainage Tank	Hydrostatic test inspection, cleaning and tank tank 5

Table 4.13 – Maintenance of Equipment in FSU / FSRU		
System	**Equipment**	**Maintenance activities**
		years
		Test hydrostatic inspection and tank tank 5 years
	Fresh water tank	6-month test level alarm
	Helmet	Test hydrostatic inspection and tank tank 5 years
		Annual tank inspection and cleaning
		6 month analysis of drinking water
	Oily Bilge Tank	Test hydrostatic inspection and tank tank 5 years
		6-month test level alarm
	Oily Drainage Inspection Tank	Hydrostatic test inspection, cleaning and tank tank 5 years
	Tank LO	6-month test level alarm
		5-year visual inspection and tank cleaning
		Annual check valve operation
	Sludge tank	Test hydrostatic inspection and tank tank 5 years
		6-month test level alarm
	Empty space	5-year study of empty space
		Annual inspection of empty space
Anchor, mooring and trailer	Anchors and mooring winches	3 month inspection and functional testing
In your case		Annual brake test
		5 years to renew the oil bath
		Renovate annually bathroom oil changes
		6 month lubricant analysis oil and water content test
		5-year anchor chain calibration / measurement
	Hydraulic power pack	3-month electric motor vibration measurement
		6-month electric motor electric resistance test
		Annual lubrication of electric motor bearings
		5-year review of oil cooler pump
		Check hydraulic pump after 20000 rhrs
	Emergency towing system	Monthly functional test
		2-yearly control
Load	Freight heater	Annual inspection 5
	Cooling and sealing of water systems	Annual inspection 5
	Electrical installation	Annual inspection 5

Table 4.13 – Maintenance of Equipment in FSU / FSRU		
System	**Equipment**	**Maintenance activities**
	Pressure and vacuum devices	Annual inspection 5
	Main load pumps	Checking the pump after 10000 rhrs (CbM)
		Electric resistance test of submerged motor 6 months
	Extraction and spraying pumps	Check pump after 10000 rhrs
		Electric immersion motor test 6 months (CbM)
	Safety valves	5 year valve test (some of them annually)
	Spray Nozzles	Spray Condition Check Nozzle Inlet Filters
		6 months leakage check and nozzle operation
	Vacuum pump	Cleaning filter strainer after 3000 rhrs
		Renewal of lubricant oil cylinder after 2000 rhrs
		Check pump after 4000 rhrs
Regasification	Check Valves	3 month functional test
	Hydraulic Actuators	3 month functional test
	Safety valves	5 year valve test (some of them annually)
	Electric motors	6 month electric motor (CbM) electric resistance test
		6 month electric motor vibration measurement (CbM)
	BOG Compressor	Preventive maintenance 4000 rhrs
		Preventive maintenance 8000 rhrs
	Measuring unit	Annual calibration
	Emergency power pump	6 month electric motor (CbM) electric resistance test
		Check pump after 10000 rhrs
	Heating Water Booster Pump	6 month electric motor (CbM) electric resistance test
		Check pump after 40000 rhrs
		6-month visual inspection and functional test
	Vaporizers	Annual inspection
		Annual calibration instrumentation in vaporizer
oat-to-ship STS	Saddles	6 months lubrication
	STS Hoses	Renewal every 5 years
		Annual pressure and conductivity test
	Emergency release coupling	Annual review of links
	Reel piece	Check out the annual dye
Auxiliary diesel	Motor	According to Wartsila Maintenance plan, preventive

Table 4.13 – Maintenance of Equipment in FSU / FSRU		
System	**Equipment**	**Maintenance activities**
engine		maintenance check after 4,000 rhrs 8,000 rhrs, 12,000 rhrs, 16,000 rhrs, 24,000 and 32,000 and 48,000 hours.
	MDO pump	5 year review
	Pilot fuel pump	Check pump after 20,000 rhrs
Ballast water system and sea	Ballast pumps	Functional verification of 2-monthly air injector
		Alignment check every 5,000 rhrs
		Grease pump bearings every 1000 rhrs
		6 - monthly functional test
	Sea water pumps	Grease pump every 5000 rhrs
		Check pump after 20,000 rhrs
		6 - monthly functional test
	Sea water circulation pump and sea water cooling water pump	Check pump after 20,000 rhrs
Freshwater system	Pumps of fresh water	6 month electric motor (CbM) electric resistance test
		6 month electric motor vibration measurement (CbM)
		Grease electric motor every 2,000 rhrs
	Filter and filters	Inspection and annual cleaning
	Freshwater Generator	Chemical cleaning of 4 months and internal control
	Cool Water Coolers	Annual cleaning
	Sea water filter	2-month sea water filter cleaning

Source: EXMAR 2016.

4.7 Fuels

The fuel to be used in the engines for the generation of energy is the Natural Gas coming from the vaporization of LNG. The expected lower calorific value of the gas will be at least 36 MJ / m3 N and the expected methane number is 80. The specific fuel consumption of the fuel will be 78007750 BTU / kWh (HHV), with efficiency close to 50%.

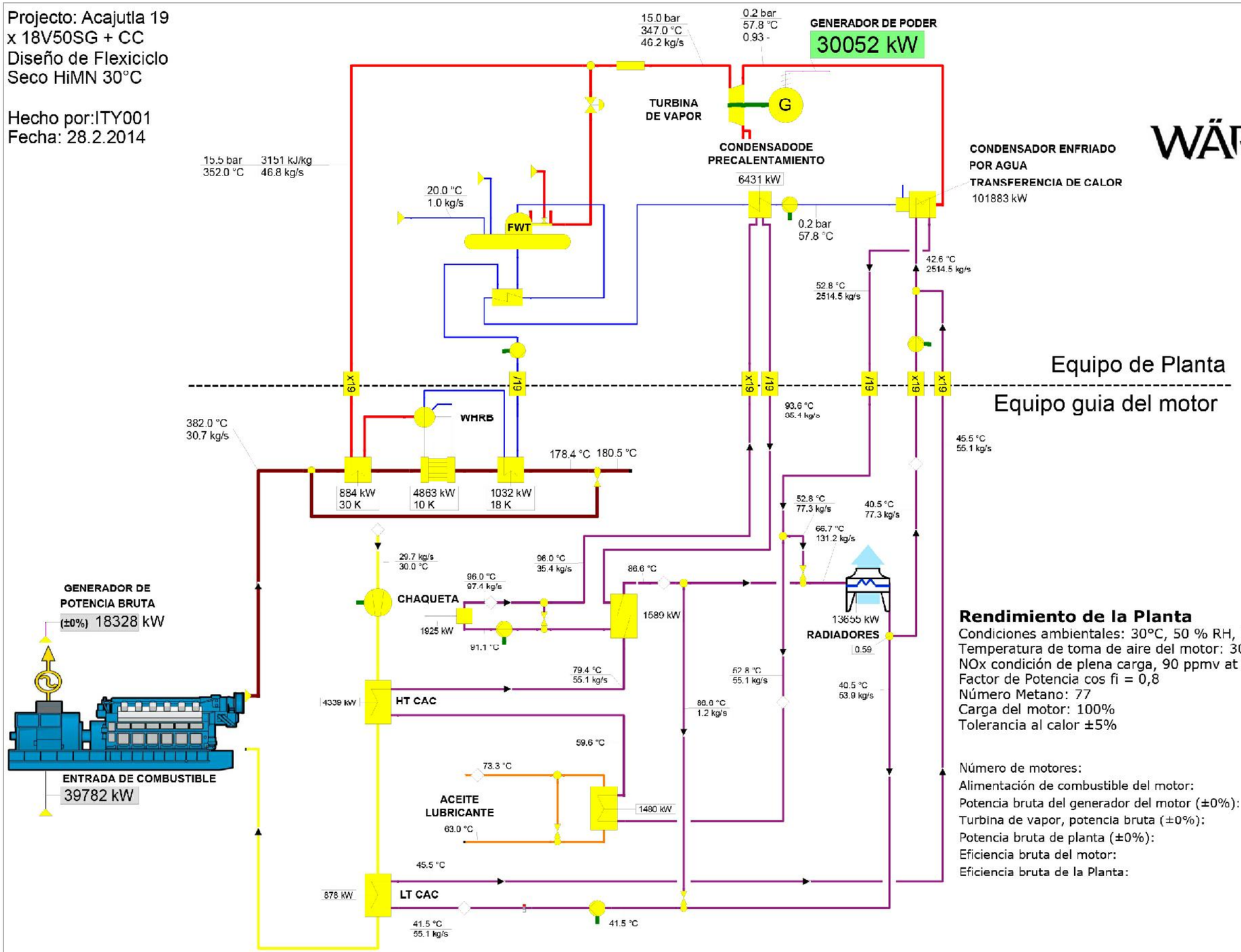
4.7.1 Mass and Energy Balance

Figure 4.22 shows mass and energy balance.

For each of the engines 39,782 kW of fuel is consumed and 18,328 kW of crude energy comes out. In addition, 1,582 kW is produced per engine in the steam turbine, which operates with steam from the heat recovery boilers of each engine.

Projecto: Acajutla 19 x 18V50SG + CC
Diseño de Flexiciclo Seco HiMN 30°C

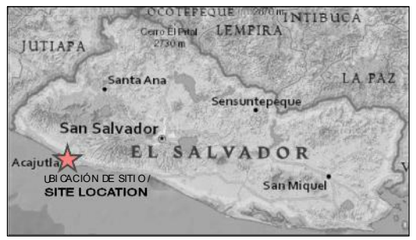
Hecho por:ITY001
Fecha: 28.2.2014



Rendimiento de la Planta

Condiciones ambientales: 30°C, 50 % RH, 100 m.a.s.l.
Temperatura de toma de aire del motor: 30°C
NOx condición de plena carga, 90 ppmv at 15 % O2
Factor de Potencia cos fi = 0,8
Número Metano: 77
Carga del motor: 100%
Tolerancia al calor ±5%

	1 Motor	19 Motores
Número de motores:		
Alimentación de combustible del motor:	39782 kW	755858 kW
Potencia bruta del generador del motor (±0%):	18328 kW	348232 kW
Turbina de vapor, potencia bruta (±0%):	1582 kW	30052 kW
Potencia bruta de planta (±0%):		378284 kW
Eficiencia bruta del motor:		46.1 %
Eficiencia bruta de la Planta:		50.0 %



FUENTE / SOURCE:
WARTSILA / WARTSILA

MAPA CREADO POR / MAP CREATED BY: WARTSILA
MAPA REVISADO POR / MAP CHECKED BY: WARTSILA
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PROYECTO / PROJECT: 14-9114
ESTADO / STATUS : FINAL / FINAL
FECHA / DATE: 9/16/2014

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BALANCE DE MASA Y ENERGÍA / MASS BALANCE AND ENERGY

FIGURA 4.22 / FIGURE 4.22

4.7.2 Fuel Composition

The expected composition of natural gas is detailed in Table 4.14.

Table 4.14 – Composition of Natural Gas

Component	Symbol	Percentage
Methane	CH_4	88.42 mo-%,
Ethane, max.	C_2H_6	10.44 mo-%
Propane, max.	C_3H_8	0.31 mo-%
i-Butane, max.	C_4H_{10}	0.01 mo-%
n-Butane, max.	C_4H_{10}	0.01 mo-%
i-Pentane, max.	C_5H_{12}	0 mo-%
n-Pentane, max.	C_5H_{12}	0.01 mo-%
Hexane and other hydrocarbons		0 mo-%
Nitrogen	N_2	0.80 mo-%
Carbon dioxide	CO_2	0 mo-%
Total sulfur, max.	S	5 mg/kg

Source: Wärtsilä 2014

The process of liquefaction of natural gas requires the extraction of some of the non-methane components such as water and carbon dioxide, to avoid solidification when the gas is cooled to the temperature of -256 °F. As a result, LNG is typically composed of methane, as presented in Table 4.14.

4.7.3 Hazard Characteristics and Material Safety Data Sheet

The Safety Sheet for Natural Gas and Liquefied Natural Gas is presented in Appendix 4F. According to the NFPA[4] classification, it is classified:

- Health: 1;
- Inflammability: 4;
- Reactivity: 0; y
- Special: N/A.

Natural gas is lighter than air (its relative density is 0.61, air = 1.0) and despite its high levels of flammability and explosiveness, leaks or emissions quickly dissipate in the upper layers of the atmosphere, making it difficult to form mixtures Explosive in the air. This feature allows for its preference and explains its increasingly widespread use in domestic and industrial installations and as fuel in internal combustion engines.

[4] NFPA: National Fire Association.

Natural gas is classified according to the SPECIAL REGULATION REGARDING HAZARDOUS SUBSTANCES, RESIDUES AND WASTES, as CLASS 2: GASES, Division 2.1 Flammable gases. The Properties of Liquefied Gas are summarized as follow:

- Toxic No
- Carcinogen No
- Flammable Vapor YES, if Vapor Spreads
- Choking Hazard Yes, but inside a steam cloud
- Extremely Cold Temperature Yes
- Other Health Hazards None
- Flash Point 4 (° F) -306
- Boiling Point (° F) -256
- Flammability in air, % 5-15
- Stored Atmospheric Pressure

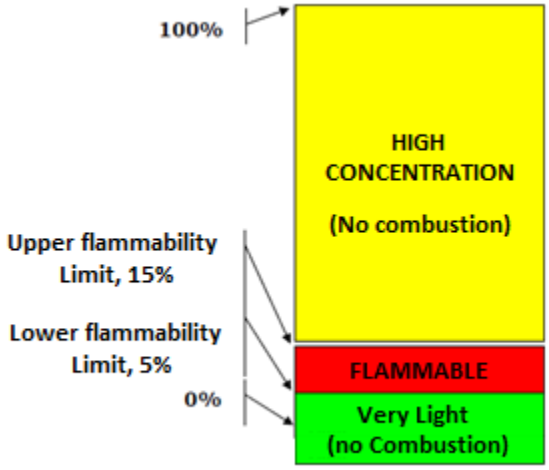
Behavior in cases of spillage It evaporates forming visible "clouds". Parts of clouds may be flammable or explosive under certain conditions.

The main characteristics of LNG are:
Under conditions of normal atmospheric pressure, LNG is a clear, non-corrosive and non-toxic cryogenic liquid;
It is odorless, in fact, to detect natural gas spills from water heaters and other natural gas equipment, must be added methane odorants;
Like any other gaseous material other than air or oxygen, LNG vaporized natural gas can cause suffocation due to lack of oxygen in closed and unventilated areas;
The LNG density is about 3.9 pounds per gallon, compared to the density of the water, which is about 8.3 pounds per gallon. Therefore, when it is spilled on the water, it floats and vaporizes quickly; and
If not properly handled in accordance with safety systems, it may be flammable and explosive when vaporized, but only under special conditions.

The flammability level is the range between minimum and maximum concentrations of vapor (percentage by volume) in which air and LNG vapors form a flammable mixture that can reach the ignition point. Fig. 4.21, Shows that the upper and lower flammable limits of methane, the dominant component of LNG steam, are 5% and 15% by volume. When the concentration of the fluid exceeds its upper limit of flammability, it cannot be burned because there is not enough oxygen. This condition may exist, for example, in a closed storage tank where the vapor concentration contains approximately 100% methane. When the fluid concentration is less than the lower limit of flammability, it will not burn because there is not enough methane. One example is the spilling of small amounts of LNG in a well-

ventilated area. In this situation, LNG vapor mixes rapidly with air and dissipates in a concentration of less than 5 percent. See Figure 4.23.

Figure 4.23 – Flammability Level



Source: Security Systems & LNG Protection, Center for Energy Economics, University of Texas, 2014

A comparison of the properties of LNG with those of other liquid fuels as shown in Table 4.15, Also indicates that the Lower Limit of Flammability of LNG is generally higher than that of other liquids, meaning that for ignition more LNG vapors would be needed (in a specific area) compared to Liquefied Petroleum Gas **(**LPG) or gasoline.

Table 4.15 – Comparison of LNG with Other Fuels

Properties	LNG	Liquefied Petroleum Gas (LPG)	Gasoline	"Fuel Oil"
Toxic	No	No	Yes	Yes
Carcinogen	No	No	Yes	Yes
Flammable Vapor	Yes	Yes	Yes	Yes
Form Clouds	Yes	Yes	Yes	No
Suffocation	Yes, but within a cloud of vapor	Same as LNG	Yes	Yes
Extremely Cold Temperature	Yes	Si, when refrigerated	No	No
Other Health Risks	None	None	Irritation to eyes, narcosis, nausea, other	Same as gasoline
Flash Point (^{o}F)	-306	-156	-50	140
Boiling Point (^{o}F)	-256	-44	90	400

Table 4.15 – Comparison of LNG with Other Fuels				
Properties	**LNG**	**Liquefied Petroleum Gas (LPG)**	**Gasoline**	**"Fuel Oil"**
Flammability range in air,%	5-15	2.1-9.5	1.3-6	N/A
Stored pressure	Atmospheric	Under pressure (atmospheric if cooled)	Atmospheric	Atmospheric
Behavior in cases of spillage	It evaporates forming visible "clouds". Parts of clouds may be flammable or explosive under certain conditions.	Evaporates into vapor clouds that may be flammable or explosive under certain conditions.	It evaporates forming flammable puddles; it will have to be cleaned	Same as gasoline

Source: Security Systems & LNG Protection, Center for Energy Economics, University of Texas, 2014

Methane gas reaches the ignition point only when the proportion or mixture of gas vapor in the air falls within the limited flammability range. A frequently-awaited risk is ignition due to flames or sparks and therefore LNG facilities are designed and operated under rules and procedures that eliminate this risk and to create flames or sparks, have sufficient detection and protection systems against the fire. The auto-ignition temperature is the lowest temperature at which the flammable gas vapor can ignite spontaneously without the need for an ignition source after several minutes of exposure to a heat source. A temperature higher than the auto-ignition temperature will cause ignition after a shorter period of exposure. With respect to very high temperatures within the flammability range, the ignition can be virtually instantaneous.

The auto ignition temperature is above 1000 ° F (540 ° C) for methane vapors derived from LNG and a mixture of fuel and air of about 10 percent methane in the air (approximately Half of 1-15 percent of the flammability limit) at atmospheric pressure. This extremely high temperature requires a significant source of thermal radiation, heat or a hot surface. If an LNG spill on land or water that produces flammable gas vapor finds no source of ignition (flame, spark or heat source of at least 1000 ° F [540 °]), then the vapor generally disperses in the atmosphere and a fire does not occur.

When compared to other liquid fuels, LNG steam needs a very high temperature for self-ignition to occur, as shown in Table 4.16.

Table 4.16 – Comparison of LNG with Other Fuels	
Fuel	**Auto Ignition Temperature, ^{o}C**
LNG (mainly methane)	540
GLP	454.44-510
Ethanol	422.78
Methanol	463.89
Gasoline	257.22
Diesel fuel	Aprox. 315.56

Source: Security Systems & LNG Protection, Center for Energy Economics, University of Texas, 2014

4.7.4 Sources of Supply

EDP held meetings with major LNG suppliers such as BP, BG, Gas Natural Fenosa, Shell, Total and GDF Suez, among others, to discuss alternatives for project location, probable monthly consumption and types of LNG ships used by these suppliers. The supplier selected was Shell.

Under trade negotiations for the long-term supply to El Salvador, it was concluded that the size of the Marine Terminal should be compatible with the existing and future fleet of vessels carrying LNG over long distances. In this way, the project was structured to receive LNG vessels of various sizes, from 136,000 to 180,000 m3 of LNG cargo.

Shell is a supplier of LNG called a portfolio, that is, they have LNG in several places in the world. This minimizes the risk of LNG delivery, since the supplier has several sources of fuel to compensate for the eventual lack of natural gas in a specific place.

Shell will supply the LNG from different sites, which may include from Peru, the United States, Libya, among others.

4.7.5 LNG Conditioning Operations

The only conditioning of the LNG will be to regasify it and convert it to NG, whose process is explained in section 4.13. "Regasification".

4.7.6 Temperature of Maintenance

Despite the efficiency of the insulation, these do not maintain LNG at the required cooling levels. LNG is stored as a boiling cryogenic - a liquid that at a certain storage pressure is extremely cold at its boiling point. Stored LNG is analogous to boiling water, only 244 ° C colder. The temperature of the boiling water (100°C) does not change even though the heat is increased because it is cooled by evaporation (steam generation).

Similarly, the LNG will remain at about the same temperature if the pressure remains constant. This phenomenon is called self-cooling. While steam (boil-ignited LNG) will be allowed to leave the tank (the LNG tank), the temperature will be constant. This evaporation is captured by LNG facilities and ships and is used as fuel. There will be a nitrogen generator to protect the tanks from temperature rise.

4.8 Installation of Marine Works

The Marine Terminal will be formed by a FSRU floating inside a structure of protection, breakwaters that will serve as berth for the FSU and LNGC. The FSU and LNGC will be moored by the structure through conventional mooring systems for Marine Terminals. The FSU is expected to remain moored semi-permanently, with exception of extreme weather events. The FSRU barge will be moored permanently inside the breakwater.

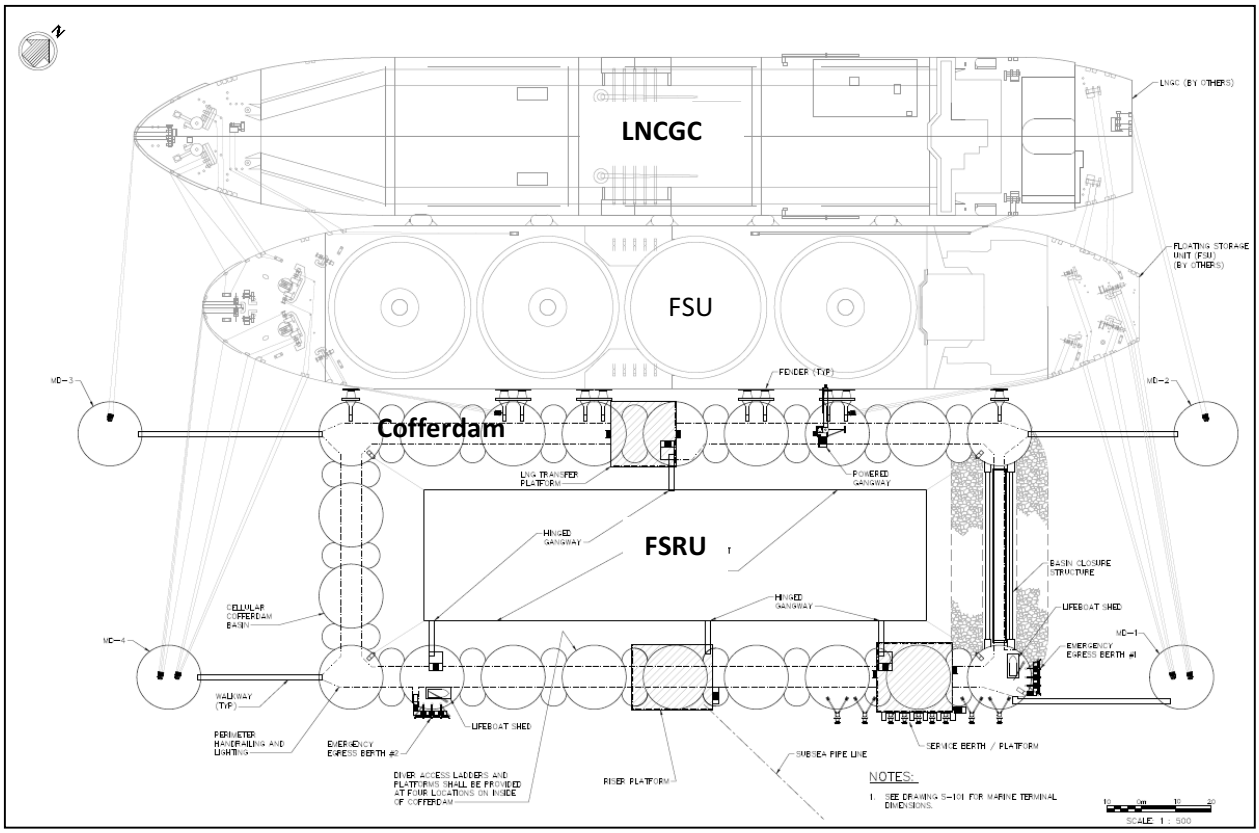
The LNGC will moor only when it is necessary to supply the FSU. The LNGC will moor at one side of the FSU. Floating foam or air defenses will be placed between both boats for protection during docking. LNGC mooring lines will be secured to the mooring posts and / or the FSU.

The Marine Terminal consists of the following components:

- A breakwater (of cellular structure or caissons) that will support the lifting platform, transfer platform, service platform, fenders, corridors and walkways
- A LNG transfer platform supporting the loading / unloading arms or hoses, cryogenic piping, and other superstructure equipment and systems
- A vertical support platform for gas discharge arms or hoses, pipe lift and other superstructure equipment and systems
- Fenders and anchor train for the FSU
- Mooring posts with the equipment used for the mooring of both FSU and LNGC
- Walkways / steps between transfer platform, climb platform and mooring posts
- A service platform with the installation of bumpers and mooring equipment for support boats. The service platform can also facilitate the transfer of supplies and maintenance equipment, potable water and wastewater

Figure 4.24 shows a typical design of the Marine Terminal with the option of cellular cells.

Figure 4.24 – Proposed design for the Marine Terminal



Source: M&F Feed Drawings, 2016

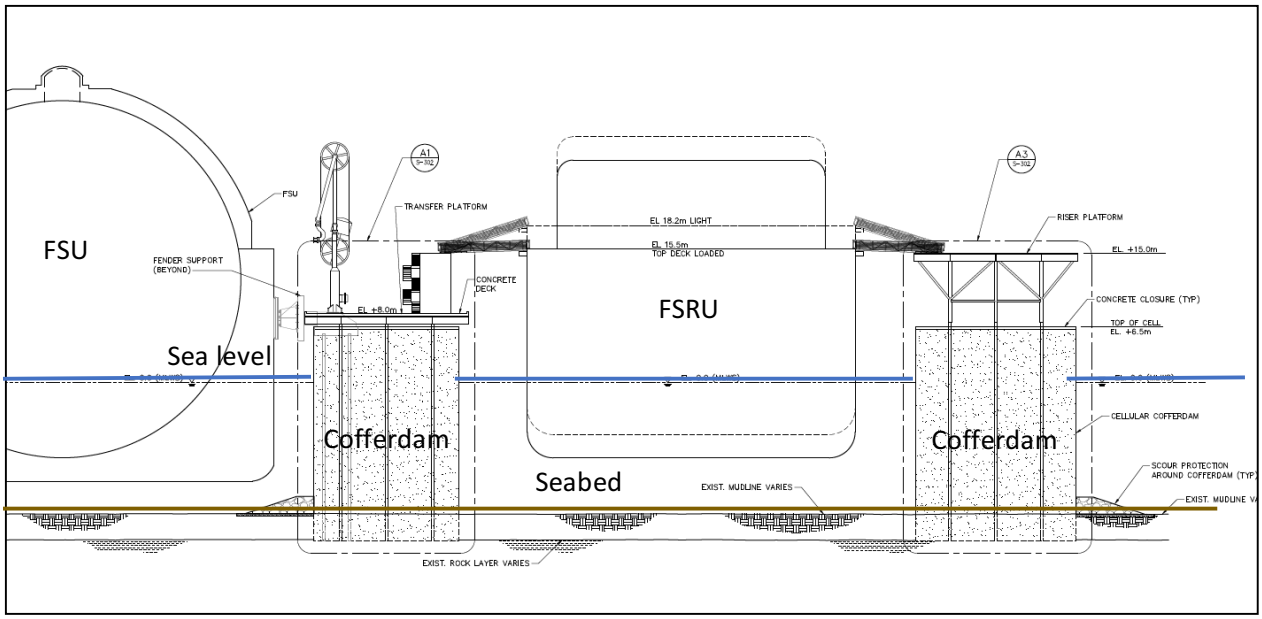
Example of arrangement and mooring of the Marine Terminal and its different elements

The supply of natural gas, already re-gasified to be provided by the FSRU, will be transported through an underwater pipeline and then on-lane (below surface) to the point of connection with the Power Plant.

The Marine Terminal will include a measuring station, pipeline integrity indicator, PIG launcher / receiver station, emergency shut off valves (ESD) and purge valves. This ground infrastructure will be located within the fenced land of the Thermal Power Plant.

In Figure 4.25 is presented a detail seen in profile of the main elements of the terminal, with the option of breakwater type cellular cofferdam.

Figure 4.25 – Profile of Marine Terminal: Breakwater, FSU and FSRU



Source: M&F Feed Drawings, 2016

Figure 4.26 shows the distances that have been left towards the CEPA wharf and towards the buoys of CENERGICA, as detailed:

1. Space for maneuvers and entry of boats CEPA wharf: 600m minimum; and
2. Space for maneuvers CENERGICA buoys: 500m, minimum

This spacing is the one that was considered for design purposes, and not for the operation of the Marine Terminal.

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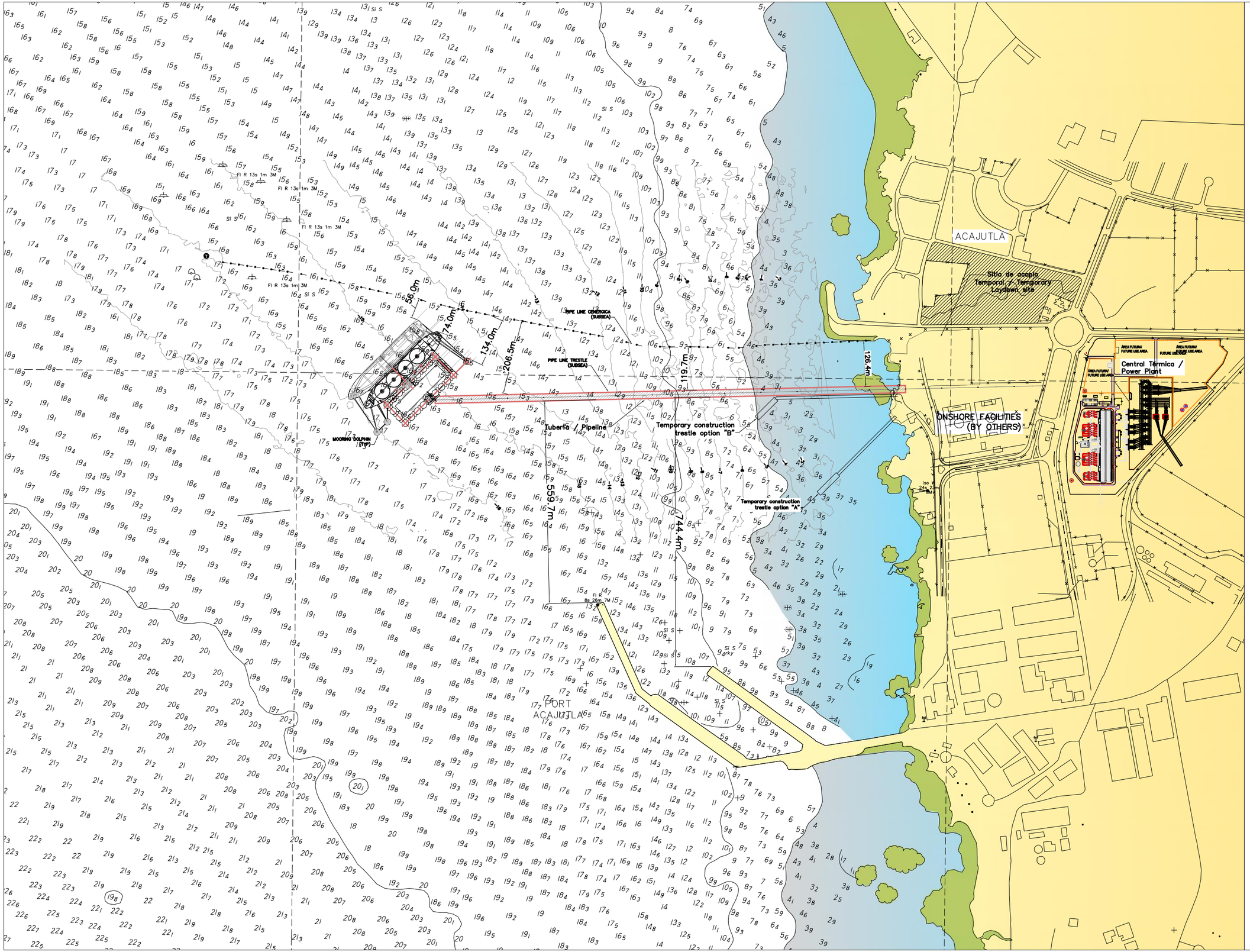
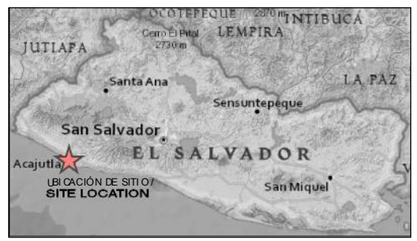
BATIMETRÍA DEL SITIO Y DISTANCIAMIENTO A CEPA Y CENERGICA / SITE BATHYMETRY AND DISTANCING TO CEPA AND CENERGICA

FIGURA 4.26 / FIGURE 4.26





0 50 100 150 200m

FUENTE / SOURCE:
AMP, CEPA, CNR, IDNO / AMP, CEPA, CNR, IDNO

MAPA CREADO POR / MAP CREATED BY: WARTSILA
MAPA REVISADO POR / MAP CHECKED BY: WARTSILA
PROYECCIÓN DE MAPA / MAP PROJECTION :
UTM ZONA 16 WGS84 / UTM ZONE 16 WGS84

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PROYECTO / PROJECT: 14-9114
ESTADO / STATUS : FINAL / FINAL
FECHA / DATE: 12/05/2016

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4.8.1 Design Parameters

All marine infrastructures will be designed to withstand extreme waves, water levels and wind events, including tsunami conditions. Different elements are designed for different conditions. The event data to be used for the final design is described below.

Acajutla presents cycles of semi-diurnal waves characterized by two high tides and two low tides, of different size, each lunar day. Tide information was obtained from the Sea Level Center of the University of Hawaii data between 1962 and 2012 and data taken by a wave buoy at the project site for a short period. See Table 4.17.

Table 4.17 – Design Considered Tide Information

Datum	Description	UHSLC082 Acajutla (m)	AWAC (m)
HAT	Highest astronomical tide	1.33	1.36
MHHW	Highest high tide mean	0.85	0.84
MHW	Average high level	0.75	0.76
MSL	Level average	0.0	0.0
MLW	Low level average	-0.75	-0.75
MLLW	Low tide lows	-0.79	-0.79
MLWS	Average low tide	-0.98	-1.0
LAT	Lower astronomical tide	-1.2	-1.2
MN	Average tide amplitude (MHW-MLW)	1.5	1.55

Source: Sea Level Center, University of Hawaii, Data between 1962 and 2012 and data taken by a wave buoy at the project site for a short period.

4.8.1.1 Wind

Wind data from Acajutla were taken from NOAA station 9648958 Acajutla covering a period of 2 years.

The winds blow mainly from the north and from the northeast, followed by the south winds. In the summer, the north winds are strongly dominant. Wind speeds greater than 5, 10 and 20 knots occur approximately 38%, 8.4% and 0.1% of the time, respectively. The highest recorded wind speed is 45.3 knots from the east-southeast.

For the final design, data from the meteorological and oceanographic studies will be used. The analysis of extreme values will be carried out after the calibration of the numerical model to determine the height of the waves and period of return of events and periods.

4.8.1.2 Currents

The current operating conditions at the site were obtained from a 1-year simulation with the MIKE 21 FM two-dimensional hydrodynamic model. The model was run with astronomical water levels from the Oregon State University database and calculated residuals from the water level measurement in Acajutla as well as OWI Hind cast winds.

In addition, an AWAC was deployed at the vicinity of the Marine Terminal to measure the direction and magnitude of the current. As of the date of this study, 8 months of wind, wave, averaged currents and tide data have been discharged and processed. At the end of the meteorological and oceanographic studies, the parameters for the final design will be defined.

The velocities of currents that can cause damage are low at the site, less than or equal to 0.1 knots about 13% of the time. The maximum current calculated is 0.28 knots.

4.8.1.3 Tsunami

A detailed numerical modeling study was conducted to assess the risk of tsunami at the terminal site. A total of 16 scenarios were modeled using 2 different numerical models to develop 32 separate time series that are used to develop exceedances curves for the project site.

Maximum peak elevations along the berth vary from 3.2 to 3.8m for the 10% exceedance condition, and 2.0 to 2.4m for the 50% exceedance condition. The maximum detractions are between -2.6 and -3.0 m for the exceedance condition of 10% and -1.8 and -1.9 m for the condition of exceedance of 50%.

Tsunami currents at the berth varied between 2.2 and 2.8 m / s for the 10% exceedance condition in the direction parallel to the berth. In other directions (e.g., perpendicular to the berth) the estimated current velocities are less than 2 m / s. The results of the simulation show that the first tsunami wave arrives approximately 40 minutes after the earthquake and the first crest of the wave arrives at about 5 minutes later.

The assessment of the Tsunami hazard indicates that the tsunami-induced currents in the area can be as high as 5.8 knots.

4.8.2 Conditions Operating Limits

The Marine Terminal will have established limits of operation, environmental parameters that when exceeded will result in not making the theft, stop operations or anchorage and leave the terminal. This section presents the safe operable limits for the terminal. The operations plan of the Marine Terminal will define the load limits, admissible movements for the connection to the ship manifold and operation

of the load arm. It will also include limits defined as permissible for mooring, for the defenses and movements of the boat while it is moored.

The operational limits of the Marine Terminal will include:

- Approach and berth limits. Climate limit conditions for the approach and docking of the FSU and LNGC in the terminal;
- Load transfer limit. Limit climate conditions for the FSU and LNGC docked at the Marine Terminal connected to any line, berthing buoy or fenders, or movement of ships as result of winds, currents, or wave action; and
- Output limits - climate limitation for the FSU and LNGC from the terminal.

Preliminary operational limits have been established based on the studies of tug, dynamic mooring and bridge made to the FSU and the LNGC approaching the site and berthing. These limits are preliminary and will be defined after further analysis at the final design stage in consultation with the regulatory authorities. Preliminary limits are also presented for the operation of FSU and LNGC anchored in the terminal.

4.8.2.1 Craft Type and Docking Criteria

The operating limits are based on the following vessel capacities, which are presented in Table 4.18.

Table 4.18 – Capacity of Ships to Establish Criteria for Designing Climate Limits

Design unit	Capacity (minimum)	Capacity (maximum)
FSU	125.000 m^3	125.000 m^3
FSRU	100.000 m^3	100.000 m^3
LNG Conveyors	136.000 m^3	180.000 m^3

Source M&N, Terminal Operating Limits Memo, 2016

The mooring systems of the Marine Terminal are based on the following:

- The FSU will leave the terminal when the limiting environmental conditions are presented or expected to be exceeded;
- The LNGC will leave the terminal when the limiting environmental conditions are presented or expected to be exceeded;
- Tugs will not operate under conditions above a wave height of HS = 1,5 m. If more tugs of greater capacity are obtained for the project, this restriction can be revised;
- For steel mooring lines, the permissible safe working load (SWL) is defined as 55% of the minimum breaking load (MBL) for OCIMF recommendations;
- For synthetic lashing lines, the safe working load (SWL) is defined as 50% of the minimum burst load (MBL) for OCIMF recommendations;
- The allowable workload on the defenses is the reaction rated in design performance analysis

- The FSU will leave the terminal when the limiting environmental conditions are presented or for the FSU attached to the structure, the load arm must allow the following limits of movement: Swell 4.0m, 4.0m swing and 2.0m pull; and
- For LNGC (moored to FSU), permitted ship movements are limited to the following: Swell 2.0m, 2.0m swing and 1.0m pull.

4.8.2.2 Limitation of Climate Conditions for Approach and Mooring of FSU and LNGC

The limitation of the conditions for the approach of both FSU and LNGC in the Marine Terminal will be those presented in Table 4.19:

Table 4.19 – FSU and LNGC Approach Limits

Activity (Normal functioning) [1]	Wind (knots) [2]	Wave Hs (m)[3]
FSU approach and berth	25	1,5 m
LNGC approach and berth	20	1,0 m

(1) Applicable for vessels up to 180,000 m3.
(2) Wind speed is the velocity measured at the standard reference height of 10 meters MSL and is representative of an average sustained velocity of 30 seconds.
(3) Provided hs limit is applicable for wave periods (Tp) less than 12 seconds. For Tp> 12 seconds, wave limits may be lower depending on the conditions and types of boat.
Source: M&N, Terminal Operating Limits Memo, 2016

Visibility

Limitations due to visibility will be at the discretion of the pilots.

Currents

Limitations due to currents will be at the discretion of the pilots.

4.8.2.3 Limiting Conditions for Load Transfer

The limiting conditions for the FSU and LNGC moored at the Marine Terminal that require completion of cargo transfer and / or exit from the Marine Terminal shall be those presented in Tables 4.20 y 4.21.

Table 4.20 – FSU Load Transfer		
Activity (Normal functioning)	**Wind (knots) (1)**	**Wave Hs (m)(2)**
Stop discharge (FSU)	30	1.75m
Disconnect the discharge arms (FSU)	35	1.75m
Resume discharge (FSU)	25	1,5 m
Leave the litter (FSU)	40	2,0 m

(1) Wind speed is the velocity measured at the standard reference height of 10 meters MSL and is representative of an average sustained velocity of 30 seconds.
(2) Provided hs limit is applicable for wave periods (Tp) less than 12 seconds. For Tp> 12 seconds, wave limits may be lower depending on the conditions and types of boat.

Source: M&N, Terminal Operating Limits Memo, 2016

Table 4.21 – LNGC Load Transfer (boat to boat)		
Activity (Normal functioning) (1)	**Wind (knots) (2)**	**Wave Hs (m)(3)**
Stop discharge (LNGC)	25	1.25m
Disconnect hoses (LNGC)	30	1.25m
Resume discharge (LNGC)	20	1,0 m
Leave the litter (LNGC)	35	1,5 m

1) Applicable for vessels up to 180,000 m3.
(2) Wind speed is the velocity measured at the standard reference height of 10 meters MSL and is representative of an average sustained velocity of 30 seconds.
(3) Provided hs limit is applicable for wave periods (Tp) less than 12 seconds. For Tp> 12 seconds, wave limits may be lower depending on the conditions and types of boat.

Source: M&N, Terminal Operating Limits Memo, 2016

Visibility

Limitations due to visibility will be at the discretion of the pilot.

Currents

Limitations due to currents will be at the discretion of the pilot.

Actual operable limits will be more refined during detailed design and during operations such as the experience of specific site facilities and become better understand the environmental interactions.

4.8.2.4 Monitoring of Meteorological Variables and Coastal Dynamics

The safe operation of the Marine Terminal is controlled through a combination of forecasting tools, such as weather forecasting, and real-time field measurements, such as water elevation meters and anemometers (wind speed). When ambient conditions, such as wind speed or wave heights exceed specified safety limits, cargo operations will be stopped and in extreme conditions the LNG discharge vessel may leave the berth.

In the case of tsunamis, the Marine Terminal will depend on tsunami alerts and Tsunamis information from the NOAA-led Pacific Alert Center (PTWC) located in Hawaii and the national tsunami warning center Of the Ministry of the Environment.

For the warning of extreme weather and ocean conditions, such as hurricanes or winds, tropical depression / waves, the Marine Terminal will be based on information from the NOAA National Hurricane Center (NHC) and national weather alerts. For non-storm weather events, the Marine Terminal will respond in local weather forecasts reports.

Real-time weather information and sea-state data will be collected at the Marine Terminal through the "Marine Environmental Monitoring Systems" (MEMS). This will allow the Marine Terminal to know the conditions that occur in real time and make effective decisions to ensure conditions of safe operation.

4.8.3 Constructive Method

The breakwater to be installed can be of two types: circular cell structure or caissons. Both are described herein. The Marine Terminal can be constructed in different ways, the optimal solution depends on the geotechnical parameters and the meteorological-oceanic conditions determined by the final studies, and the suitability of marine construction equipment given the local conditions.

4.8.3.1 Breakwater Type Cell Structure

It includes the construction of the breakwater of circular cellular structures. Cell structures can be constructed either dry or wet, without prefabrication, at their final site, using conventional construction equipment and techniques. Cell structures require relatively little preparation of the foundation bed.

The circular cells are made of hot-rolled steel sheet with web structure, placed in a cylindrical configuration, represented by large circles when viewed in plan. The equidistant circular cells connected with small semicircles of the same material; the two shapes are connected by specially fabricated "Y" hooks, and are usually intersected at 30, 35 or 45 degree angles. Both fully circular cells and arc areas are filled with granular material to complete the shape of the structure by gravity.

The general methodology and sequence of the construction of the cellular structures of sheet piles of the breakwater is the following:

1. Because the work is done at sea, it is expected that most of the construction process will be completed from a specialized barge with lifting platform. Specialized platform barges need conditions in the sea where it does not rise more than 1 to 1.5m for installation, this type of sea state (1 to 1,5m) is expected to be available and will not be difficult. Pre-construction placement. Once it rises, the barge rises above the waves the height of 1.5m. It is expected that

most waves are less than 1 m, there is approximately 15% wave surplus with wave heights greater than 1m.

2. Preparation of the subgrade, by dredging or general excavation methods, to remove all loose, compressible, and not suitable material inside the footprint where the cellular structure will be located. The competent material, such as dense sand, need not be removed, provided it remains fully consolidated and without discomfort.
3. Location and installation of the sheet pile template. Sheet piling are usually configured with structural steel frame, with leg or piles of tubes used to support their weight and maintain position during installation. A two- or three-level template will be required for an exposed environment such as Acajutla.
4. The sheet piles come pre-fabricated, to the needs of the project, supports and with the pre-installed cover. With the template installed and secured, each individual sheet is lifted with a crane and placed around the template, and is hooked with the sheet previously placed. This process is repeated until the circle is completed with all the leaves extended approximately equal distance on the template.
5. Machined equipment, such as Dawson sheet pile equipment, which supports the sheets while being elevated in position and helps in alignment and threading of sheets, may be necessary due to moderate winds making the threading more difficult, in addition to providing a better efficiency in the placement of sheets in windy conditions, the device together with remotely operated shackles allows all work done from ground level or deck to be controlled from an elevated position, which is a significant security advantage.
6. With the sheets placed around the template, the individual blades are lowered incrementally using a vibrating hammer to "push" the blades into position. When necessary as designed, the leaves can be lowered further and seated at foundation level (for example, when there is dense alluvium or soft rock) using an impact hammer.
7. The template for the interconnecting arcs is set down and the arc-shaped sheet is installed in a manner similar to the circular cells.
8. Once the circular cell piling is installed at the required elevation, the template is removed, and the cell filled with granular material. Once both sides of the bow sheet are completed the area between the circular cells is ready for filling. Both operations can be done using concha-type conveyor belts or any other method of handling bulk materials.
9. Once the cells are finished they are ready for the installation of structures and support equipment that will be placed on these for the operation of the terminal.

As the finished sheet pile circular structures can be placed concrete deck slabs for the loading platform and vertical platforms to support mooring devices, mooring dolphins and fender systems, concrete covers, protective rocks, and utilities. If desired, extended foundations, non-displacement piles (e.g. "H" piles, steel tube piles) and sheet piles could be considered and installed within the cell filler, without affecting the overall structure.

It is possible that piles are installed inside the breakwater structure to support working platforms (transfer platform, lifting platform and service platform).

Only three sides of the sheet pile breakwater will be built to their full height, the top of the lift cell approx. 6.0m. The fourth side of the breakwater either is built at a later time or will be partially built for a higher elevation of - 4.5m. Once the FRSU barge is floated in position and is tied to the inside, the fourth side of the breakwater will be closed.

The total amount of concrete to be used in the sea has been estimated at approximately 5.915m3. The molds to be used will be sealed to prevent leakage, and good management practices will be applied, which prohibit the cleaning of concrete equipment in the ocean.

4.8.3.2 Caisson Type Breakwater

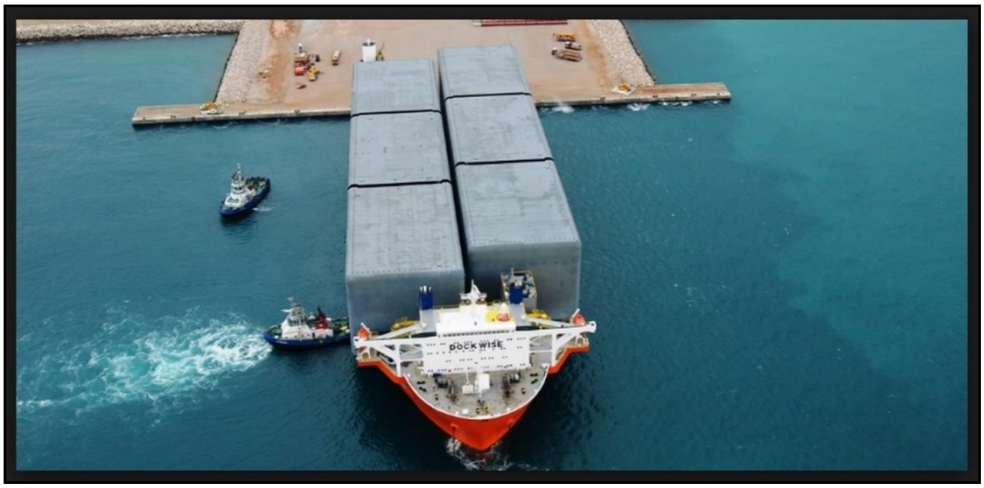
One construction option under consideration is the use of concrete caissons. The advantage of this system is that the same mold is used for the construction of the caissons that are reinforced concrete modules. The final height and width of the caissons will depend on the local conditions and the length may vary depending on the molds, springs and equipment that the contractor owns for its floating construction.

Preliminarily, it is expected that the caissons to be installed will be approximately 70m long, with a width of 24m and a maximum height of 31m, in which about 10,000 cubic meters of concrete will be used for each caisson, with type V cement, and with reinforced steel. It is estimated that approximately 80,000 cubic meters of concrete would be used in total.

The caisson option could be constructed in one of two methods. The first method is to bring the pre-built caissons to be placed in their final position in the project. These pieces can be transported on special vessels that can be immersed enough to allow the heavy pieces to be housed on their platform and then transported to their final destination. (See Photos 4.4, 4.5 and 4.6).

The caissons would then be towed using a transport barge to their position.

Photo 4.7 – Steps 3 and 4 Transportation in Barges



Source: EDP, 2016

Photo 4.8 – Transport to the Final Site

Source: EDP, 2016

The finished caisson is moored and towed. Once placed in the position where it is to be placed, it is filled with water by submersible pumps until it sinks and reaches the seabed that has been prepared and leveled previously.

Once in place, the caissons are filled with filler material (sand or other) and sealed with concrete. Each caisson is placed in its position and forms the Marine Terminal.

Photo 4.9 – View of elements under construction on finished caissons

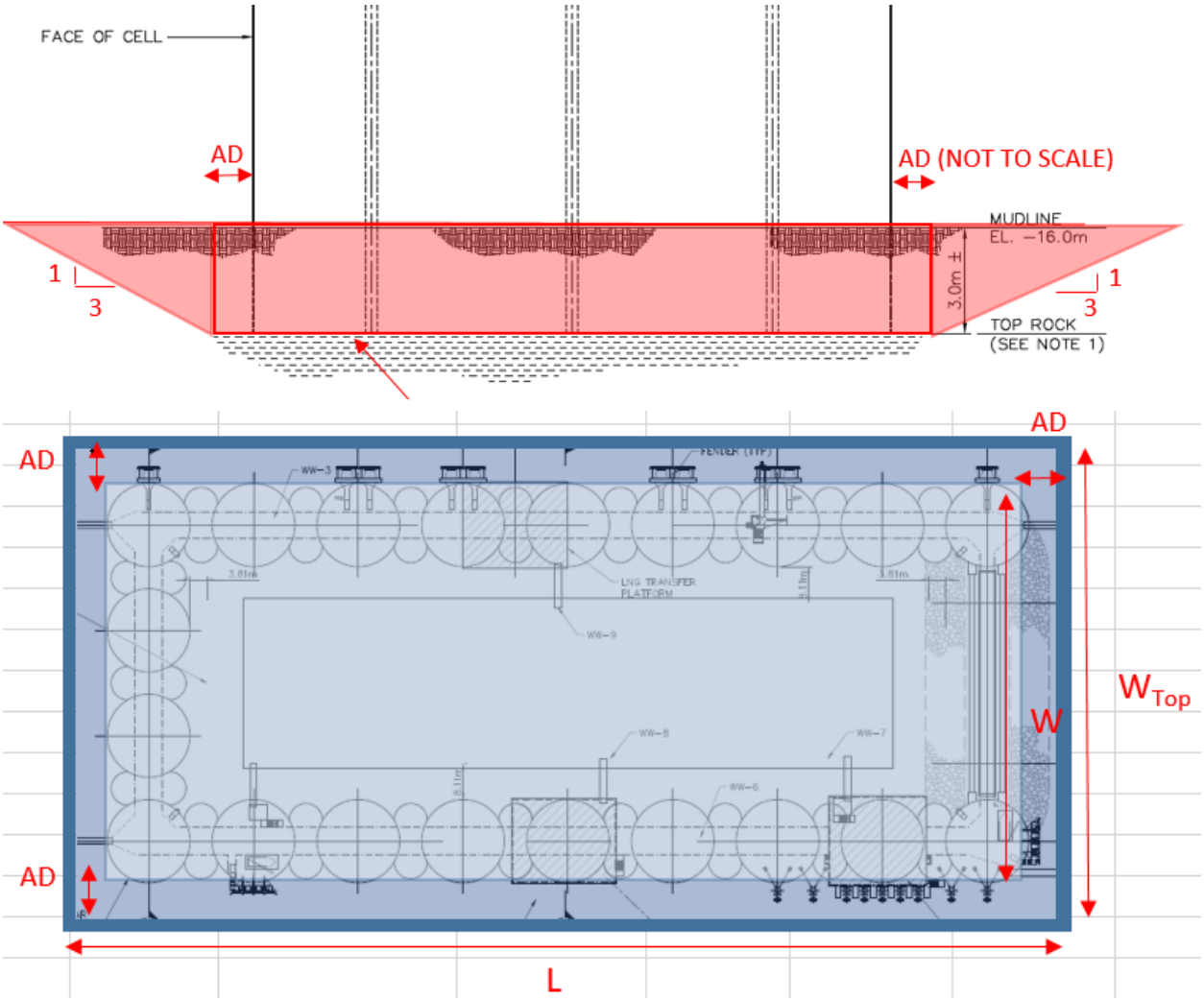
Source: EDP, 2016

The final step is the construction of the elements of the Marine Terminal on the caissons.

4.8.4 Preparing the Base of Breakwater: Dredging

It is estimated that, to prepare the base of the support floor of the structures, whether they are caissons or cellular cofferdam, it will be necessary to remove the non-suitable or liquefiable marine sediment material estimated at 130,000 m^3. See Figure 4.27.

Figure 4.27 – Dredging work needed for the breakwater



Source: M&N, 2016

Data were requested from the dredging industry on the most likely methodologies and rates of extraction of the material to model a scenario as representative as possible during the sedimentation dispersion study that was performed. The following dredging methods have been considered to dredge the footprint of the Marine Terminal and perform the trench of the submarine pipeline:

- Trailer suction dredge;
- Backhoe dredger with side loading of the barge; and
- Bucket dredger

Given dredging volumes and dredging rates (confirmed by reviewing literature, experience and consultation with the dredging industry), the duration of dredging and the corresponding work schedule were estimated. Dredging is expected to be completed in approximately 18 days.

Figures 4.28 to 4.30 show the possible types of dredger to use.

Figure 4.28 – Trailer suction dredge

Source: Images from B3D-design, Wasa Dredging and East Marine

Figure 4.29 – Backhoe dredger with side loading of the barge

Source: Images from B3D-design, Wasa Dredging and East Marine

Figure 4.30 – Bucket dredger

Source: Images from B3D-design, Wasa Dredging and East Marine

During dredging turbidity, will occur in the water due to suspended solids. The effect of the sediment suspension was modeled and explained extensively in Chapter 7.

The alternative of using anti-turbidity curtains was evaluated; however, it was rejected because the installation of turbidity screens around the work area under open ocean conditions is extremely difficult, due to the swells, anchors and the doors necessary to Access to ships. Likewise, the turbidity screens required in several projects elsewhere have been shown to have very little efficiency in containing fine-grained suspensions. The current flow fields and ocean / wave conditions prevailing at the site of Acajutla will induce considerable drag on the screens and could even induce turbulence that is likely to re-suspend the sediments of the seabed. Exposed to bad weather conditions the risk of curtains in drift due to mooring or razor failure will be constant. This induces hazards to shipping vessels and when landing on reefs these curtains can cause significant environmental damage.

The control method selected has been through the monitoring of turbidity at points of interest and the interruption of the work, to start when the sediments have been dispersed.

Disposal of Dredged Sediment

The selection of an appropriate site for the disposal of the material for the proposed dredging of marine sediment (hereinafter SDMDO "Ocean Dredged Material Disposal Site") was made considering the recommendations made in USACE EM 1110-2-5025 for dredging and management of dredging materials (July 2015).

The following requirements have been established for the selection of an SDMDO. The site must:

- Be located within an economically feasible distance from the point of dredging;
- Be established in such a way as to minimize potential damage to critical resources, and to minimize interference with other beneficial but incompatible uses of the ocean environment;
- Provide the required storage capacity to meet the dredging requirement and to provide this capability while minimizing potential adverse impacts to the aquatic environment and human health; and
- Do not cause, in the short term / construction phase, nor in the long term / permeant phase, a danger to navigation.

The technical considerations in the selection of a SDMDO, considering the objectives mentioned above, include: water depth, physical characteristics of the dredged material, nature of disposal operations, and environmental forcing characteristics (waves and currents). These technical factors have been determined during the Phase of Engineering and Initial Design (FEED).

Specific criteria for the site were:

- Away from the Protected Natural Area of Los Cobanos
- Far from fishing routes, in consultation with fishing cooperatives, it was determined that between the project site and the area towards the border with Guatemala, approximately 5 vessels per day circulate, on average, in water of around 50m depth. So there is enough area so that the activities to be carried out do not affect fishing.
- Depth between 30 and 50 m
- In an area where the passage of ships is not affected, to and from the port. Bard positioning maps were revised.

Using the results of dredge sediment dispersion analysis (M & N 2016 ref.), local bathymetry and marine use, and considering the probable disposal operations, it is proposed that the SDMDO radius be 1.5 nm, with a 0.5 nm buffer area, with a center located at -89.8971, 13.5424 (WGS84) (See Figure 7.10, in chapter 7 7). This allows a buffer zone for the ship / waste dredge in terms of maneuverability and drift, while ensuring that the re-suspended sediments settle within the specified SDMDO.

The dredger would reduce its velocity when approaching the specified central point, then it would remain firm on the designated area or maintain a slow course within the radius of 1.5 nm. The additional 0.5 nm buffer provides a re-suspension zone.

Upon acceptance of the proposed SDMDO, it is expected that the site and its use will be issued as "Notice to Mariners" and that all vessels associated with dredging operations shall display lights and signaling in accordance with current legislation and authority.

Prior to the start of the work, a site characterization will be done, including sampling for benthic analysis, to determine if the site is feasible without affecting sensitive ecosystems.

4.9 Fuel Storage and Regasification

4.9.1 Discharging Process of the Freighter

The freighter (LNGC) will dock at the side of the FSU. Floating foam or tire protections will be placed between the boats and connected to the FSU. LNGC mooring lines will be secured to mooring dolphins and / or FSU. The LNG is transferred from the LNGC to the FSU through flexible hose systems. It is expected that the Marine Terminal will be able to receive LNGC vessels between 138,000 m3 and 174,000 m3 of capacity.

The LNGC will be supported by support tugboats during the approach to the Marine Terminal, all coordinated and in support of control personnel of the Port of Acajutla. A waiting tug will be required at

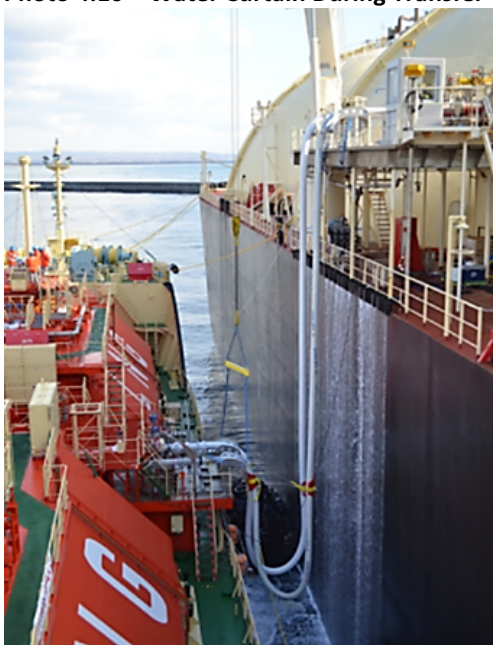
the Marine Terminal all times for FSU and when an LNGC is docked in order to serve ships for emergency response due to tsunamis, fires, or any other event.

The LNGC will be placed with the stern facing the side of the shore, matching the orientation to the FSU. The turning area will be in deeper waters west of the terminal. To exit the terminal, the LNGC will also be under tow support, and the vessel will exit straight forward into offshore areas. The FSU will be moored in a similar way; although, docking and decking of the FSU will occur on rare occasions.

During the discharge a "Water Curtain" will be applied on the side of the ship, so that in case of an LNG spill the metal of the ship is protected by the abrupt change of temperature.

The LNG will be the responsibility of the supplier company until it is discharged to the FSU. The gas will be measured and analyzed on each delivery.

Photo 4.10 – Water Curtain During Transfer



Source: Wärtsilä, 2014

4.9.2 Regasification Process

The regasification will be carried out to the demand of the power generation plant.

LNG will be pumped from FSRU storage tanks to shell and tube vaporizers where a fresh water cycle with glycol is used to vaporize LNG. The water with glycol is subsequently heated in a second shell and tube exchanger, the heat source will be sea water. The regasification unit is composed of three (3)

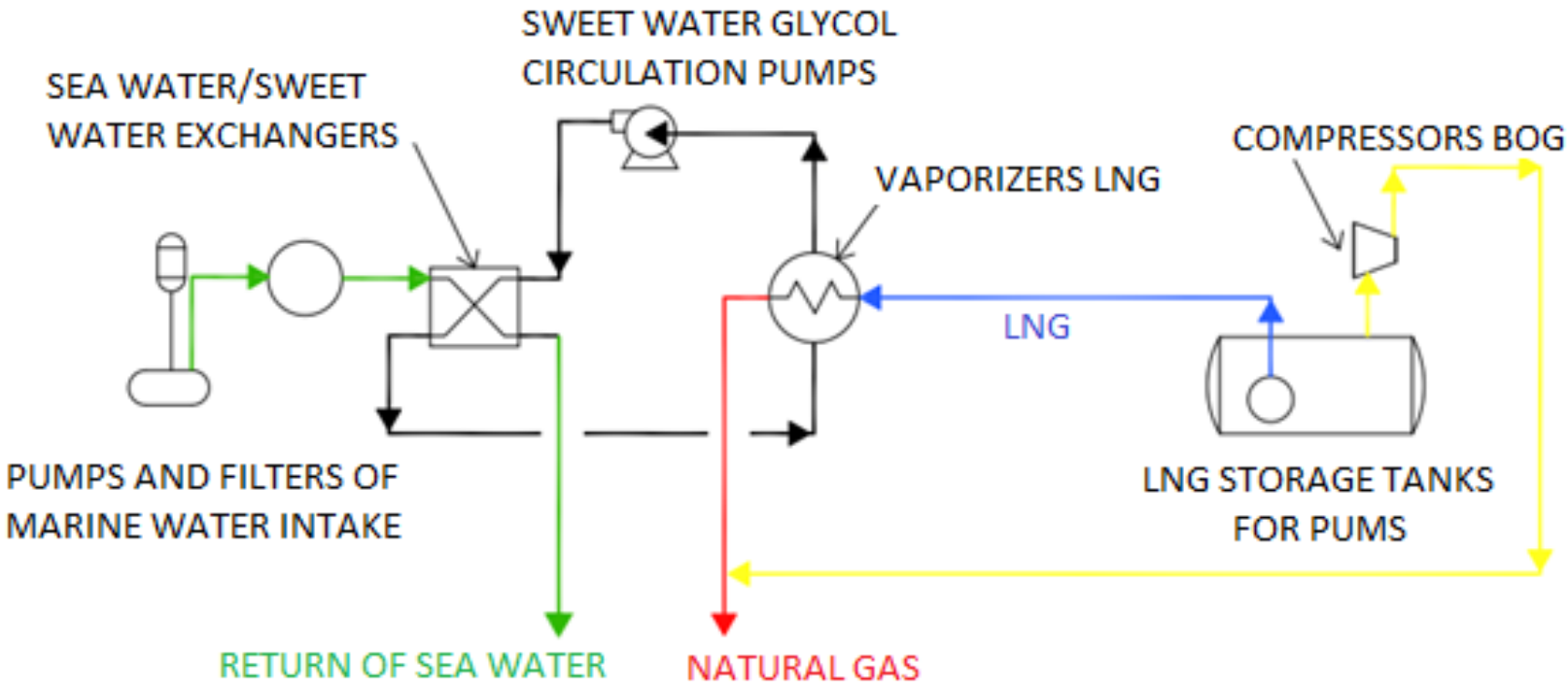
trains, which can operate completely independently. The three trains have a capacity of 93.3 million cubic feet per day (MMPCD) each.

At low gas delivery speed (4-12MMPCD), the load pumps in the FRSU are stopped and BOG is sent directly to the plant 10 bar to the manifold, through redundant compressors. The same compressors are used to supply fuel gas to the FSRU engines and to control the pressure in the cargo tank. This is done by sending the excess BOG (from FSRU and FSU) directly to the plant as part of the re-gasified gas that is sent. The combination of LNG vaporizers and BOG compressors will be used to deliver natural gas to ground facilities.

The heat from the regasification plant will be provided by seawater. Heating of the regasification system is performed with a closed-loop freshwater glycol system. The closed cycle system is heated by an open-cycle seawater system, as shown in Figure 4.31 y the diagram in Figure 4.32 and Appendix 4G.

The main characteristics of pipes, and the LNG and NG flows in the regasification and delivery process of the NG are presented in the Table 4.22.

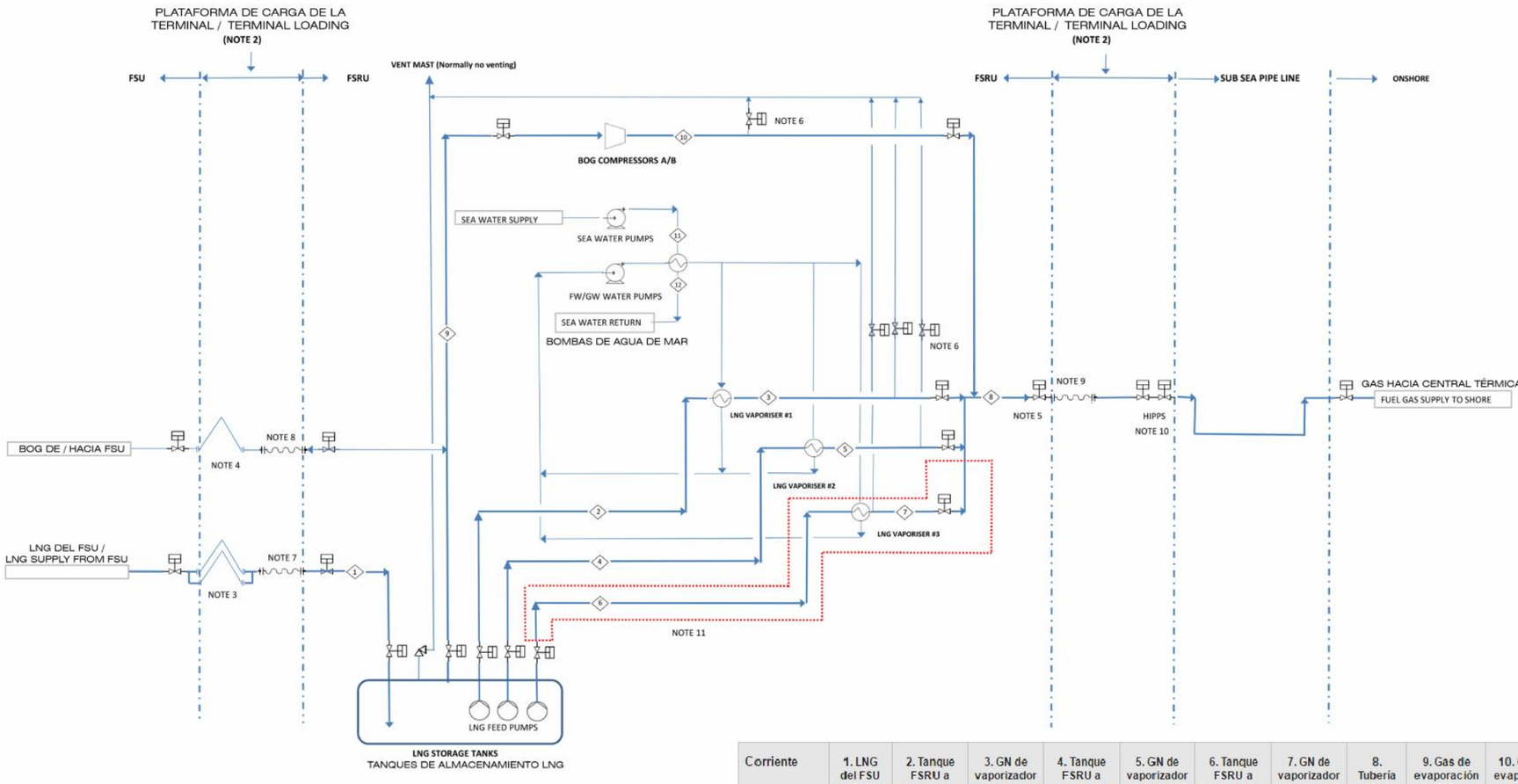
Figure 4.31 – Simplified Regasification and Fuel Delivery Diagram



Source: M&N, 2016

Table 4.22 – LNG and NG currents in Regasification Process and Delivery of NG												
Current	**1. LNG From FSU to FSRU**	**2. FSRU Tank to Vaporizer 1**	**3. NG from Vaporizer to plant 1**	**4. FSRU Tank to Vaporizer 2**	**5. NG from Vaporizer to plant 2**	**6. FSRU Tank to Vaporizer 3**	**7. NG from Vaporizer to plant 3**	**8. NG pipeline to plant**	**9. Evaporation gas from FSRU to pumps**	**10. Evaporation gas from pumps to NG pipeline**	**11. Sea water for regasification entrance**	**12. Sea water for regasification output**
Flow (m3/h)	3,000	177		177		177					10,000	10,000
Flow (MMSPCD)			93.3		93.3		93.3	280	12	12		
Phase	Liquid	Liquid	Gas	Liquid	Gas	Liquid	Gas	Gas	Gas	Gas	Liquid	Liquid
Density (kg/m^3)	460	460	9	460	9	460	9	8	1	8	1,000	1,000
Pressure (BAR)	2	13	12	13	12	13	12	11	1.1	1	5	5
Temperature (oC)	-163	-163	5	-163	5	-163	5	5	-140	5	28	23
Diameter (inches)	16	6	14	6	14	6	14	24	10	8		
Length (m)	100	50	50	100	50	100	50	50	50	100	40	40
Volume (m^3)	13.0	0.9	0.5	1.8	0.5	1.8	0.5	14.6	2.5	3.2		
Mass (kg)	5967	420	45	83	45	839	45	117	3	26		

Source: M&N, 2016



GENERAL NOTES:

A) THIS DRAWING HAS BEEN PREPARED ON PRELIMINARY INFORMATION FROM THE VENDOR AND IS INTENDED TO BE USED AS BASIC INFORMATION FOR PRELIMINARY SAFETY/QRA STUDIES. THIS DRAWING SHALL BE UPDATED BY THE FSRU CONTRACTOR.

B) BATTERY LIMITS AND SCOPE OF SUPPLY OF THE FSRU PROVIDER IS PRELIMINARY.

C) DESIGN OF THE SYSTEMS FOR LNG TRANSFERS BETWEEN FSU AND FSRU AND GAS TRANSFER BETWEEN FSRU AND ONSHORE TO BE RE-ASSESSED ONCE SELECTION OF GROUNDING/FLOATING IS DEFINED.

NOTES:

1. HYDROCARBON INVENTORY REFER TO VOLUME BETWEEN TWO ISOLATION VALVES.
2. PLEASE REFER TO MOFFAT & NICHOL MECHANICAL DRAWING S-107.
3. TWO (2) LIQUID LOADING ARMS (1 IN OPERATION).
4. ONE (1) VAPOUR LOADING ARM.
5. TWO GAS FLEXIBLE PIPES OF 70 MMSCFD EACH. PROVIDE SPACE ALLOCATION/CONNECTIONS FOR FUTURE THIRD AND FOURTH FLEXIBLE.
6. BLOW DOWN VALVES TO VENT MAST FOR ESD.
7. 3 (+1) LIQUID HOSES, ONE SPARE FOR LIQUID OR VAPOR TRANSFER.
8. ONE VAPOUR HOSE LINE TO LOADING ARM.
9. 2 HOSE CONNECTIONS FOR GAS TRANSFER.
10. HIPPS SYSTEM TO BE CONFIRMED DURING HAZOP.
11. FOR FUTURE EXPANSION TO 280 MMSCFD

Corriente	1. LNG del FSU al FSRU	2. Tanque FSRU a Vaporizador 1	3. GN de vaporizador a la planta 1	4. Tanque FSRU a Vaporizador 2	5. GN de vaporizador a la planta 2	6. Tanque FSRU a Vaporizador 3	7. GN de vaporizador a la planta 3	8. Tubería GN hacia la planta	9. Gas de evaporación de FSRU a bombas	10. Gas de evaporación de bombas a Tubería GN	11. Agua de mar para regasificación entrada	12. Agua de mar para regasificación salida
Flujo (m3/h)	3,000	177		177		177					10,000	10,000
Flujo (MMSPCD)			93.3		93.3		93.3	280	12	12		
FASE	Liquido	Liquido	Gas	Liquido	Gas	Liquido	Gas	Gas	Gas	Gas	Liquido	Liquido
DENSIDAD (kg/m^3)	460	460	9	460	9	460	9	8	1	8	1,000	1,000
Presión (BAR)	2	13	12	13	12	13	12	11	1.1	1	5	5
Temperatura (oC)	-163	-163	5	-163	5	-163	5	5	-140	5	28	23
Diámetro (pulgadas)	16	6	14	6	14	6	14	24	10	8		
Longitud (m)	100	50	50	100	50	100	50	50	50	100	40	40
Volumen (m^3)	13.0	0.9	0.5	1.8	0.5	1.8	0.5	14.6	2.5	3.2		
Masa (kg)	5967	420	45	83	45	839	45	117	3	26		

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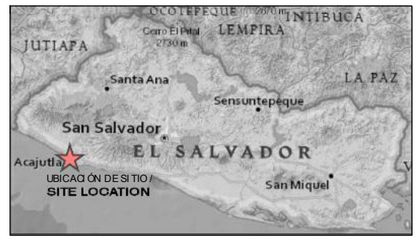
BALANCE DE MASA DE LA TERMINAL MARÍTIMA / MASS BALANCE OF THE MARINE TERMINAL

FIGURA 4.32 / FIGURE 4.32



FUENTE / SOURCE:
WARTSILA / WARTSILA

MAPA CREADO POR / MAP CREATED BY: WARTSILA
MAPA REVISADO POR / MAP CHECKED BY: WARTSILA
PROYECCIÓN DE MAPA / MAP PROJECTION :
UTM ZONA 16 WGS84 / UTM ZONE 16 WGS84

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PROYECTO / PROJECT: 14-9114
ESTADO / STATUS : FINAL / FINAL
FECHA / DATE: 9/16/2014

DILLON CONSULTING

ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

4.9.2.1 Sea Water Intake

Regasification requires a seawater flow of ten thousand cubic meters per hour. To be returned, after being used for regasification. It has been taken as the base temperature for water intake of 28 C, with the water being returned 5 C colder, i.e. at 23 C.

To protect the process equipment and piping system, a marine growth protection system (MGPS) is installed in the marine water system (SW). For the FSRU, a small amount of seawater is taken from the water intake and enters an electro-chlorination system, equipped with electrodes energized under direct anodic and cathode current. In this condition, the aqueous solution of sodium chloride (NaCl) will be transformed into sodium hypochlorite (NaOCl).

NaOCl is the active agent that will protect the system. The natural NaOCl will decay after a few minutes to recombine in NaCl and H2O. For the FSU, a similar system can be used or copper anode system.

4.9.2.2 Regasification Process

There will be three regasification equipment in the FSRU, one of operation and two of backup with the objective of guaranteeing the delivery of natural gas of permanent form to the plant.

The FSU will deliver the LNG to the FSRU, with a flow of 3,000m3 / h to be stored in the FSRU tanks. This delivery is not carried out permanently, if not when it is necessary to fill the tanks. A 16" to 2 bar pressure line will be used.

From the FSRU tanks, the LNG is delivered to -163 C to the regasification equipment, through a 6 to 13 bar pressure line; the re-gasified NG is delivered at 5 C to the 14" pipe that will bring the gas to the plant at 12 bars of pressure. This operation will be carried out permanently, when the plant is operating.

4.9.2.3 Boil off Gas (BOG)

The evaporative gas to be generated in the storage tanks of the FSRU and FSU or the LNGC vessel will be used partially for the power generation plant. The evaporation gas, if the maximum pressure in the tanks is reached, will be sent to the plant or, alternatively, to the gas combustion unit in case there is no consumption in the plant.

The evacuation of excess BOG is strictly an emergency measure to control the pressure of the cargo tank. The International Gas Code requires two means for the disposal of BOG. The main one is the burning in the engines. The use of gas burning units is the second means to remove excess BOG, which is to be used.

With low gas emissions (4-12MMSCFD), the cargo pumps in the tank are stopped and BOG is sent directly to the plant with 10 barg in the manifold through redundant compressors. The same compressors are used to supply fuel gas to the FSRU engines and to control the pressure in the cargo tank. The latter is done by sending the excess BOG (from FSRU and FSU) directly to land as part of the regasification shipment. The combination of LNG vaporizers and BOG compressors will be provided to deliver natural gas to offshore facilities.

The evaporation gas exits the tanks at -140 C, at 1.1 bar pressure, and is taken to the compressors to take it to 1 bar and 5 C, to be delivered.

4.9.3 Floating Storage Unit (FSU) Operation

The FSU will have a boiler with cooling system using sea water. 10,000m3 / h of sea water will be used. The water will return to the ocean 5 C warmer. Further details are given in Chapter 7.

The FSU will have two 120,000 lb/h superheated steam boilers that will run on natural gas. The capacity of each boiler is detailed:

- Generation of superheated steam: 120.000 pounds / h;
- Overheated steam pressure: 90 bar;
- Overheated steam temperature: 600 ^{o}C;
- The fuel consumption of each boiler, tied to the Marine Terminal, producing 26,000 pounds of steam will be 750 pounds/hour of natural gas

As an alternative energy source for cargo and general power pumps on the ship, the FSU will have an internal combustion engine (IC) of 2MW. The engine will consume approximately 130 pounds / hour of natural gas. This IC engine will also have the capability to operate on diesel fuel during emergencies only.

For the steam plant, a cooling system will be installed, consisting of hull and tube heat exchangers using sea water as the cooling medium. The seawater inlet for cooling will be 2.78 m3 / h while it is tied to the Marine Terminal.

The FSU will have a fresh water generator of approximately 40 ton / day for boiler needs and 5 tons / day for personnel needs.

4.9.3.1 Docking Equipment

The FSU will be permanently moored, using conventional mooring lines and quick-release hooks located at the mooring posts and in the cellular cofferdam itself. The idea is that the FSU can be easily freed from the moorings and leave the berth in the event of extreme weather events.

The LNG cargo ship that will be unloaded at the FSU will dock at one side of the FSU supported by air defenses that will be placed at the side of the FSU. Conventional mooring systems tied to the bow and stern of the freighter will be secured to mooring posts, also on easy release hooks with the other lines connecting with the FSU.

The FSRU shall be held in place using catenary chains anchored within the protected space of the breakwater.

4.9.3.2 LNG Discharge

FSRU Charge

To fill the FSRU tank, LNG is more likely to be transferred from the FSU by using LNG loading arms to be installed on the transfer platform; the final decision regarding the use of load arms and/or transfer hoses will be evaluated at the detailed design stage.

The design indicates that piping is required on the Transfer Platform to transport the LNG to two (2) LNG transfer hoses which will be connected to the FSRU manifold to allow transfer to the FSRU storage tank.

A steam loading arm and two (2) steam hoses will also be installed in the platform and connected to the FSU and FSRU vessel collectors, respectively, to allow bidirectional steam flow through the platform during the following conditions:

- Vapor flows from the FSRU to the FSU during the filling of the FSRU storage tank;
- Steam flows from the FSU to the FSRU during filling of the FSU by the LNGC; and
- Evaporation gas (BOG) from the inactive FSU LNG tanks would be consumed internally by the FSU to control the tank pressures, but with the steam line connected, any excess BOG can be transferred to the FSRU for compression and transfer on land.

Drainage and Purge after Transfer

Once the transfer to the FSRU storage tank is completed, the pumps will be closed in the FSU tank and the LNG valves of both collectors will be closed. Steam lines will remain open to both the FSRU and FSU tank vapor spaces. Nitrogen will be injected into the injection port at the highest point of the loading arm, which will push the LNG in both directions to the FSU and FSRU storage tanks through a bypass around the manifold isolation valves. LNG in the transfer pipeline will drain to the lowest point in the piping system and begin to vaporize, to the pressure.

The drain connections will then be opened in the transfer pipeline to allow the LNG to flow to the LNG drain drum. From the LNG drain drum, a vapor line will be attached to the vapor transfer duct to allow the vaporized LNG to flow back into one of the vapor spaces of the container storage tanks.

Standby mode

The transfer line is drained and purged. The steam hose / hose will remain connected to allow the transfer of steam from the liquid pipe as well as between the steam spaces of the FSU and FSRU tank.

4.9.3.3 Selection and Calibration of Equipment

NG Drain Drum Size

The LNG drain drum will be dimensioned to contain the volume of liquid in the hose and liquid transfer piping, plus a working damping volume. Although the LNG can be purged out of the liquid lines and into the storage tanks of the vessel before draining the lines into the drain drum.

Dimensioning of the LNG reservoir basin

A containment basin shall be provided on the breakwater in a cell adjacent to the transfer platform. The basin will collect any LNG spills occurring on the transfer platform. The dimensioning of the containment basin will be based on the closing time of the ESD valves.

Load Weapons and Transfer Hoses

Both the hoses and the load arms are capable of transfer between the FSU and the Transfer Platform, as well as between the Transfer Platform and the FSRU. They will continue to be analyzed during the detailed design phases of the project.

The loading arms come with a higher initial investment and maintenance costs and are a bit easier to handle. When they are handled to proper operating procedures and supplied with suitable emergency break couplings, hoses are also an option viable. Hoses would have to be routinely inspected and are usually replaced on average for two years as they are more susceptible to tampering and damage in service, a series of spare hoses would be kept at the Marine Terminal for quick replacement.

4.9.3.4 Floating Storage Unit Description

EDP is considering two options for the Floating Storage Unit (FSU), both of which are similar in terms of design and age. The options are the ships that include Hispania Spirit and Gemmata, although it could be another one different.

4.9.3.5 FSU Description

Appendix 4H presents the detailed specifications of the HISPANIA SPIRIT and GEMMATA CRAFT. HISPANIA SPIRIT was built in 2002 and has membrane type tanks (GT 96) with a total capacity of 140,678 m3. The GEMMATA was built in 2004 and has Moss Rosenberg spherical tanks with a total capacity of 138,000m3 (see Photo 4.8 and Photo 4.9).

Table 4.23 shows the main characteristics of the abovementioned vessels.

Table 4.23 – Possible FSUs to Use for Floating Storage		
Characteristic	**HISPANIA SPIRIT**	**GEMMATA**
Flag	Spain	Singapur
Kind	Tanker boat	Tanker Boat
Gross tonnage	94822	111459
Displacement	79363	72727
Length x sleeve	279.8m x 43.4m	290m x 46.28m
Year of construction	2002	2004
State	Active	Active

Photo 4.11 – GEMMATA Images

Source: vesseltracker.com

Photo 4.12 – HISPANIA SPIRIT Images

Source: vesseltracker.com

Detailed information on the Hispania Spirit ship is presented in Appendix 4I, which is the preferred option to use as FSU for the Project. The general data of the ship are as follows:

SHIP NAME: HISPANIA SPIRIT
DISTINCTIVE CALL: EBZZ
MANUFACTURER NAME: NAVIERA TEKKAY SHIPPING SPAIN, S.A.
MANUFACTURER ADDRESS: C/Musgo Nº 5, 2ª PL. La Florida 28023 MADRID ESPAÑA
GROSS TONNAGE: 94822
NET TONNAGE: 28446
GROSS TONNAGE SUEZ CANAL: 98212.61
NET TONNAGE SUEZ CANAL: 84218.92
SHIP TYPE: LNG CARRIER TYPE 2G
REGISTRY NUMBER: 12-02
IMO NUMBER: 9230048
FLAG: SPANISH (CANARIAS)
PORT OF REGISTRATION: STA. CRUZ DE TENERIFE
DATE OF DELIVERY: 30-09-02
CLASSIFYING SOCIETY: BUREAU VERITAS
MAXIMUM LENGTH: 279.8 m.

LENGTH BETWEEN PP:268.8 m.
SLEEVE: 43.40 m.
TRUNK DECK: 26.0 m
DRAFT DESIGN: 11.4 m.
SCANTILLED DRAFT: 12.1 m.
LOAD TQS CAPACITY: 140,500 m^3.
DESIGNATED SPEED: 19.5'.
CONSUME OF F.O.: 168 TONS/Day.
BRIDGE DISTANCE TO PR: 220.1 m
BRIDGE DISTANCE TO PP: 59.7 m
BRIDGE DISTANCE TO MANIFOLD: 78.3 m
MANIFOLD DISTANCE TO PR: 141.8 m
GINDOLA: 53.93 m.
GINDOLA (Antenna down):50.53 m.
TYPE MAIN MACHINE: STEAM TURBINE
CONTINUOUS MAXIMUM RATE: 36000 PS X 88 RPM
NOMINAL MAXIMUM RATE: 32400 PS X 85 RPM
SHIPYARD BUILDER: DAEWO SHIPPING & MARINE ENGINEERING CO., LTD.

At present, only gas carriers are built with membrane or gas tankers with spherical tanks. Hispania Spirit is a gas tanker with membrane.

The tanks are doubly insulated attached to the inner hull of the ship aligned in a bow-stern direction. The containment system is based on a thin layer (primary barrier), the membrane, above the insulation. In addition, there is a second barrier, to ensure the integrity of the load in case of leakage.

The spaces between the inner hull of the ship and the outer hull are used to ballast the ship and as protection of cargo tanks in emergency situations such as a collision or a strand.

The cargo tanks are separated from other compartments and between themselves by five transversal cofferdams [5], which are dry compartments.

The ballast spaces around the cargo tanks are divided into two double-bottom side tanks, port and starboard, in each cargo tank.

[5]Cofferdams are spaces that are not used to store anything. They simply serve as an empty security space.

This vessel has Gaz Transport membranes, which is the dominant system in most membrane gas carriers. The primary and secondary barriers are identical and are made with invar plates of a thickness of 0.7mm. This material is characterized by its small coefficient of thermal expansion. It is so fine that when walking over it flexes.

The insulation of the invar plates is formed by boxes of plywood filled with perlite. The space between the barriers is inert with Nitrogen to eliminate the risk of explosion in case of leakage of the tanks. It is inert with Nitrogen and not with inert gas because the dew point is much lower than that of the inert gas. At -150 ° C with inert gas frost or harmful dust is created for the barriers. Nitrogen is generated with the on-board Nitrogen Generating Plant.

The capacity of the tanks in the ship Hispania Spirit has the following capacity:

- Tank 1: 21,944.10 m^3;
- Tank 2: 40,431.80 m^3;
- Tank 3: 40,447.40 m^3; y
- Tank 4: 37,854.60 m^3.

For a total capacity of: 140,678.90 m^3. The tanks are filled up to 98.5% of their capacity and the filling is carried out at a rate of 12,468 m^3/h.

The LNG liquid is charged and discharged by means of the two manifolds, and this is sent to and from the liquid dome of the cargo tank through the liquid line, which extends from bow to stern along the entire cover of load. Each manifold line is separated into two loading / unloading ports, port and starboard, making a total of four loading / unloading connections to each band.

The steam domes of the cargo tanks are kept in contact with the vapor line from the bow to the stern by the cargo deck. The steam line also has a manifold connection, which is used to regulate tank pressure when loading or unloading. When charging, the manifold steam line, in conjunction with HD compressors, is used to return the gas from the tanks to the terminal. When discharged, the vapor line is used with the vapor manifold, or vaporizer, to supply gas to the tanks to replace the liquid of the outgoing charge.

Steam line and stripping lines entering the steam dome
The stripping line can be connected to the liquid line of the manifolds and can also be used to reach or to cool each tank of charge, and also to spray / disperse (spray) during the discharge if the return of steam is insufficient.

Steam line and stripping lines entering the steam dome
The stripping line can be connected to the liquid line of the manifolds and can also be used to reach or to cool each tank of charge, and to spray / disperse (spray) during the discharge if the return of steam is insufficient.

The steam line is connected to each steam dome to vent the boil-off gas, which is discharged into the atmosphere through the venting no.1. The main steam line also carries boil-off gas to the machine to burn through LD compressors and gas heaters.

The entire load line is welded without any joints where a spill may occur. In the rest of the lines, where there are union flanges, expansions, valves or other equipment are installed plates that ensure the continuity of these lines avoiding potential differences, due to static electricity, between the load lines and the rest Of lines.

Both the liquid and the vapor systems have been designed in such a way that shrinkage and expansion is absorbed by the line configuration. This is done by the expansions in the vapor line, and by the distribution of the liquid line, so that it has play to absorb the contractions and expansions. In addition, there are fixed and mobile line supports to ensure that the line stresses are maintained within acceptable limits.

Expansion
All sections of the liquid lines can be insulated, so if there is any liquid trapped between the valves, this is avoided by installing relief valves that relieve excess steam. This is an added safety measure, although the normal practice is for any remaining trapped liquid to become hot and evaporate before closing any valve. All main valves, such as manifolds, also called ESD valves, and separate loading and unloading valves are handled remotely from the IAS, so all normal loading operations can be carried out from the control room of load (CCR).

When an ESD occurs, the manifold valves close automatically, stopping loading or unloading operations. There is a non return valve in the discharge of each pump, which avoids the reflux of the liquid towards the tank. In addition, it has a 6mm drain hole in the valve disc to allow the discharge lines of the tank to drain and degasify. Non-return valves are also installed in the discharge flanges of the compressors, the discharge lines of the disassembly pumps and the emergency discharge pump have non-return valves located just after the hydraulic discharge valves.

Inside the tank, in each pump tower arm is placed a small sprayer (above each discharge line of each pump) to keep it at low temperature throughout the discharge.

The system of liquid of the tower of the pumps will count on a line of liquid; the liquid line system consists of cryogenic stainless steel lines connected to the four cargo tanks and the manifolds of both belts. In each liquid dome of each tank there is a manifold that connects to the main lines for loading or unloading, this manifold in the liquid dome connects to the discharge lines of the pumps of each port and starboard tank, the line of Load, the emergency well pump and the spray line.

It will also have a steam line that will be formed of stainless steel lines, connecting each of the four cargo tanks to a line common to the port manifold, the compressor room and the bow vent (No. 1).

The line going to the compressor room allows us to use this steam as follows:
Ship it to the Marine Terminal during loading using the HD compressors to control the pressure of the tanks;
During the ballast or loaded trips the gas that is evaporated is sent to the machine by the LD compressors and later to the heaters to be used as fuel in the boilers;
During periods of repairs the gas must be vaporized and used to purge and dry the cargo tanks; And
The line leading to the bow vent serves as a safety valve for all tanks to control tank pressure during normal operations.

Like the liquid line, at certain points along the vapor lines, we have flanges to facilitate the insertion and ventilation of the tanks during reconditioning operations.

All sections of the steam line outside the cargo tanks are insulated with rigid polyurethane foam to act as a water and vapor barrier.

4.9.3.6 Design and Mechanisms for LNG Vessel Mooring to FSU

The following is the method of mooring of vessels, which are based on the preliminary design of the Marine Terminal. The relevant modifications will be made in the final design.

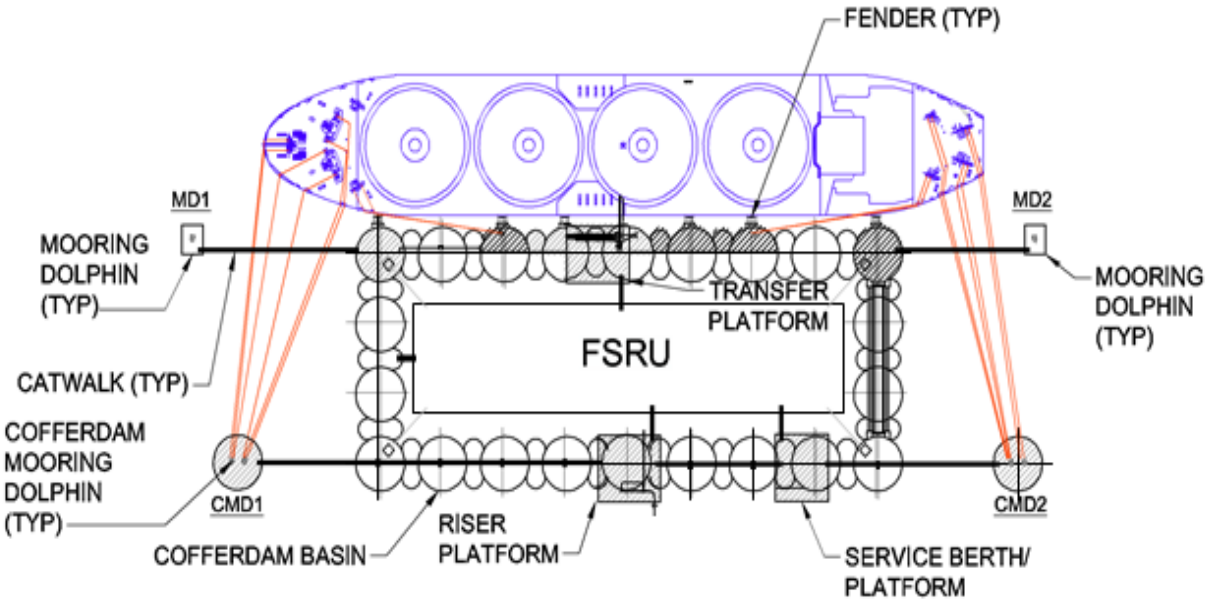
Case 1: Only the FSU Moored

The FSU will be anchored along the breakwater, it is expected to use six fenders and two sets of mooring hooks. Cofferdam mooring dolphins are considered (CMD), CMD1 on the bow and CMD2 on the stern; and mooring dolphins (MD) to be used by the tankers for delivery. The mooring system consists of twenty-two (22) mooring lines:

- Four (4) forward lines to CMD1;
- Four (4) lines type mooring dolphin to CMD1;
- Three forward and three lines of aft spring to the two sets of mooring hooks on the safe structure; and
- Eight (8) stern lines to CMD2.

The four defenses will serve to make contact with the parallel central body of the FSU. (See Figure 4.33)

Figure 4.33 – Anchorage Arrangement with Only the FSU



Fuente: M&N 2016

Case 2: FSU and LNG freighter moored

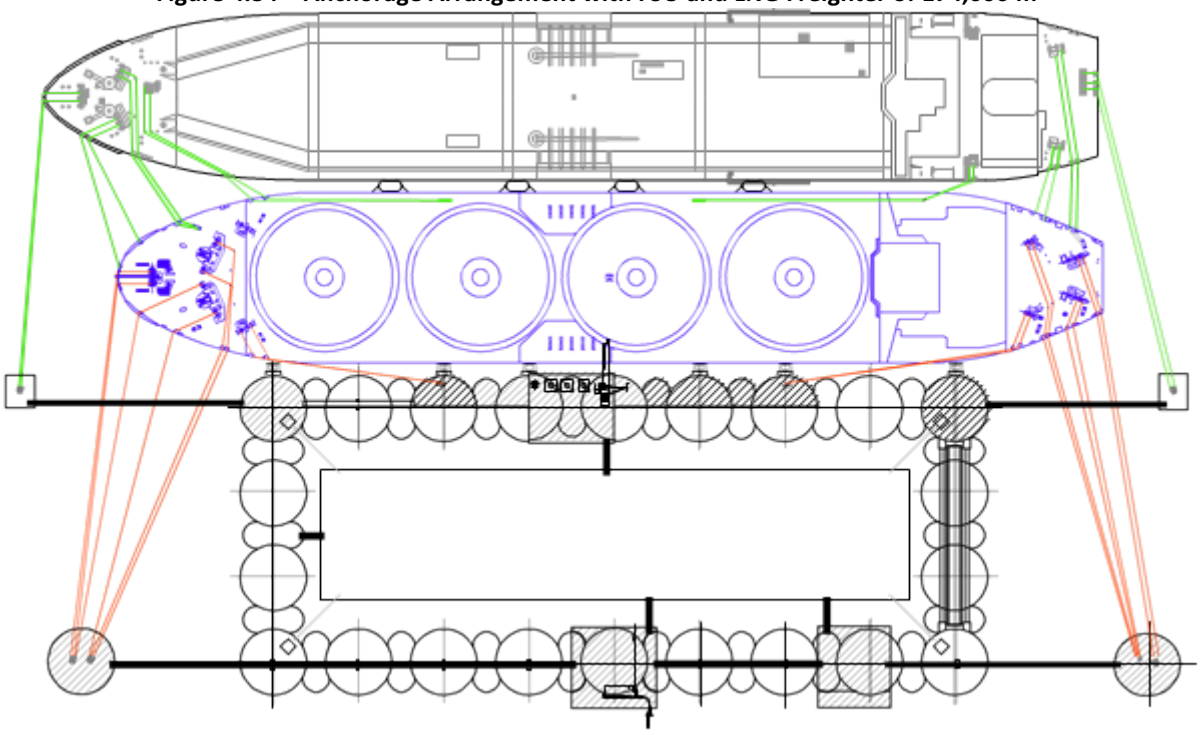
For all proposed mooring designs, with the LNGC moored, the mooring arrangement for the FSU will remain the same as that presented in the previous section. However, the proposed final design will be reviewed with the tsunami and operation conditions.

The mooring of the LNG freighter vessels of 174.000 m^3, 155,000 m^3 y 136,000m^3, use sixteen (16) lines as presented in Figures 4.34, 4.35 y 4.36 for each of the cases.

- Two lines from bow to MD1;
- Four lines alba duke type FSU;
- Two front and two stern spring lines to the FSU;
- Four stern lines to the FSU; Y
- Two stern lines to MD2.

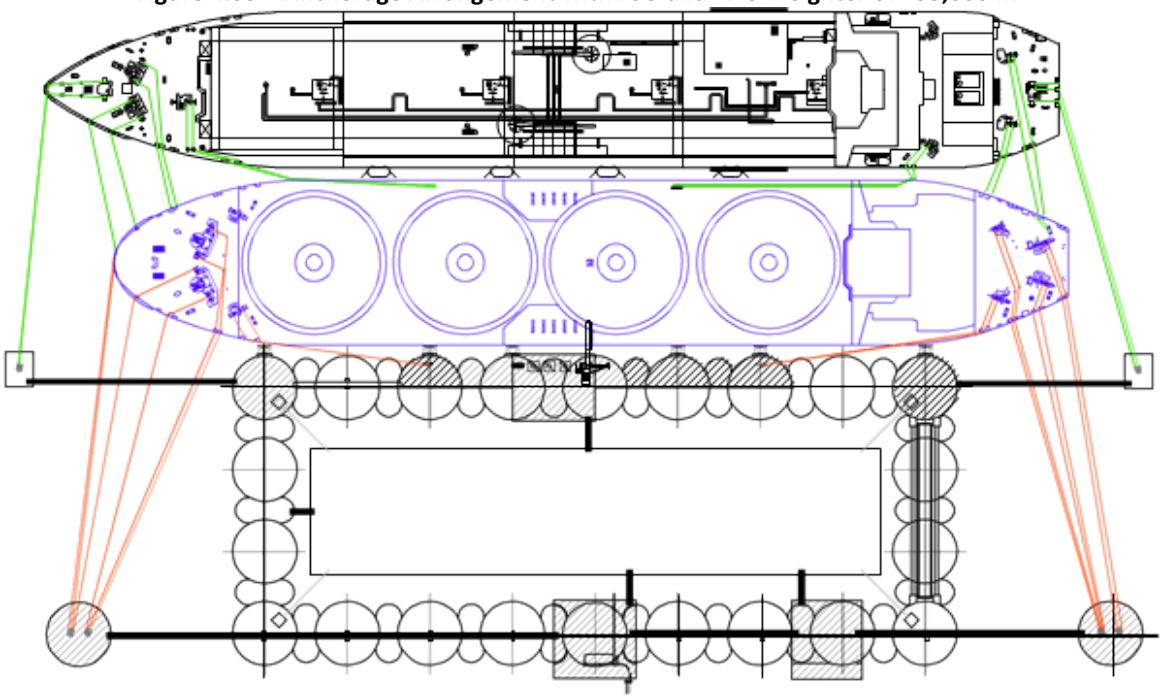
Four (4) floating fenders connected to the FSU shall be located between the freighter and the FSU, and shall contact with the body of both, placed in parallel. The fenders shall be positioned so that they are not below the hoses to be used for the transfer.

Figure 4.34 – Anchorage Arrangement with FSU and LNG Freighter of 174,000 m^3



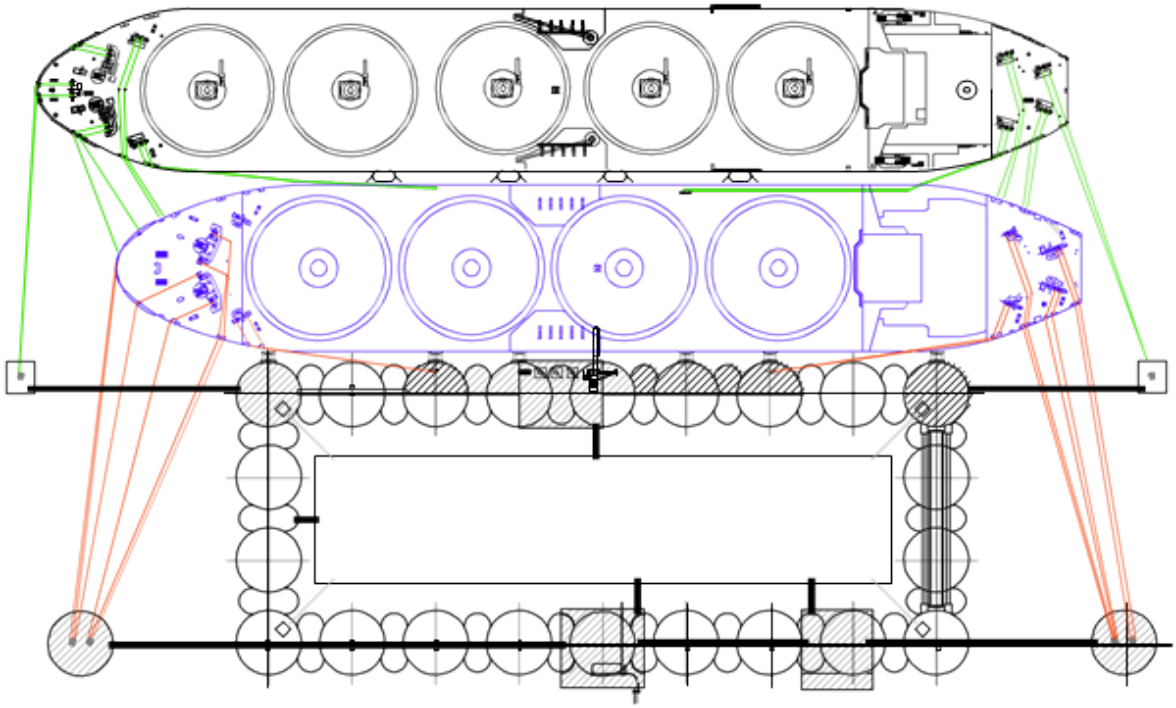
Source: M&N 2016

Figure 4.35 – Anchorage Arrangement with FSU and LNG Freighter of 155,000 m^3



Source: M&N 2016

Figure 4.36 – Anchorage Arrangement with FSU and LNG Freighter of 136,000 m^3



Source: M&N 2016

4.9.4 Description of the Floating Storage and Regasification Unit

The FSRU will be moored permanently inside the breakwater, tied by chains to it and on a bed of granular material.

For the FSRU requires a non-propelled barge with LNG storage and a flat surface to support a regasification plant, hereinafter the FSRU.

The FSRU storage system will have a capacity of approximately 100,000 m^3 of LNG.

The FSRU will have three 4.5MW internal combustion engines that will run on natural gas. It is expected that the three engines will be running at the maximum gas emission rate of 280 MMSCFD. Each IC engine will consume approximately 130 pounds / hour of natural gas. IC engines will also have the capability to operate on diesel fuel during emergencies only.

As an alternative energy source for load pumps and general energy consumption, the FSU will have an internal combustion engine (IC) of 2MW. The IC engine will consume approximately 130 pounds / hour of natural gas. This IC engine will also have the capability to operate with diesel fuel during emergencies only.

For the engine plant, a cooling system will be installed, consisting of hull and tube heat exchangers using seawater as the cooling medium. The intake of sea water for cooling will be 0.33 m3 / h while it is tied to the Marine Terminal.

The FSRU will have a fresh water generator of approximately 6 tons / day for the personnel needs.

Other general capabilities are detailed:

- Ballast water tanks, including peak tanks: Enough to maintain the keel even under all load conditions.
- Heavy fuel oil: Not required.
- Diesel fuel: Enough to power the FSRU in with its own fuel for 10 days.
- Fresh water tank: 400m³.
- Distilled water tanks: to the design of the builder.

Cargo tanks, water ballast tanks, fuel tanks, fresh water tanks and so on can be arranged on the FSU hull, to the manufacturer's design.

4.9.4.1 Cargo Tanks

It is expected to have membrane tanks to be installed in the FSRU hull with a total capacity of 100,000 m3. The primary membrane will be made of chrome-nickel stainless steel (SS304L) and the secondary membrane is composite membrane. Each membrane will be equipped with insulation to minimize the entry of heat into the system.

This membrane system has a complete secondary containment that is used in many tankers. If there is a primary membrane leak, the second membrane is designed to contain LNG for at least fifteen days in accordance with the International Gas Code (IGC).

This membrane system is also provided with leak detection; the two independent isolation zones of each tank are filled and emptied with nitrogen gas. The integrity of both membranes is monitored permanently by the detection of hydrocarbons in the nitrogen gas.

The general characteristics of the tanks are detailed:

- Number of cargo tanks: 2 is expected, but will be defined by the builder to maximize operational flexibility and minimize costs;
- Design temperature -163 ° C;
- Design pressure of at least 700 mbarg;
- The shape of the tank: IMO type C, Bi-lobe, or equivalent as recommended by the manufacturer;
- Diameter (internal), Length (internal) and material: to the manufacturer's recommendation.

- Internal piping: stainless steel AISI 304L; and
- Tank of insulation material: to the type of tank selected; with foam protection cover with polymer surface.

Equipment in the dome of the cargo tanks:

- Hydraulic actuation of quick-closing valves (ESD);
- Remote controlled valves;
- Manually operated valves;
- Tank safety valves (piloted);
- Maximum pressure alarm;
- Alarm of maximum level (95% and 98%);
- Level meter (floating type);
- Level gauge (radar type);
- Pressure gauge;
- Temperature gauge; Y
- Sampling tubes.

A rubber membrane connection will be provided between the cargo tank dome and the FSRU deck.

4.9.5 Provision of Basic Services to FSU/ FSRU

Access for maintenance and support to the FSU / FSRU will be made from land on a transfer and service platform, to be located on the breakwater.

The energy for the FSRU itself and the Marine Terminal will be provided from the FSRU, to be generated locally from stored LNG.

The energy for the FSU will be generated with steam boilers located in the FSU or internal combustion engines.

The Marine Terminal will include a diesel emergency generator system (in a fixed position), and a manual transfer switch to start the generator and perform the essential services on the generator platform in case the primary FSRU power cannot be operated.

The delivery of supplies and equipment to the FSRU and discharge of waste will be made by transfer to service barges, on the service platform, supported by cranes.

Drinking water supply to the FSRU and effluent discharge (garbage, bilge water, sludge, etc.) from the FSRU shall be carried out by transferring through the service platform through pipelines.

The delivery of supplies and equipment to the FSU will be done by the service barges docked directly to the starboard side of the FSU.

4.9.6 Zone of Restriction

There are two objectives for the safety zones of LNG vessels

- To minimize collision while the boat is running; and
- On the dock to protect surrounding property and personnel from hazards that could be associated with ignition

Regarding the risks, it is sought to avoid collision with commercial traffic that passes to the Port of Acajutla and collision with pleasure boats / fishing vessels / supply ships for anchoring and mooring in El Paso.

A restriction zone of 300 m diameter has been established for the passage of boats to/from the Port of Acajutla; and a safety area of 500 m diameter for other boats, which are not controlled by CEPA, like the boats of the fishermen. These distances will be reviewed in the final design stage and operations for optimization. See Figure 4.37.

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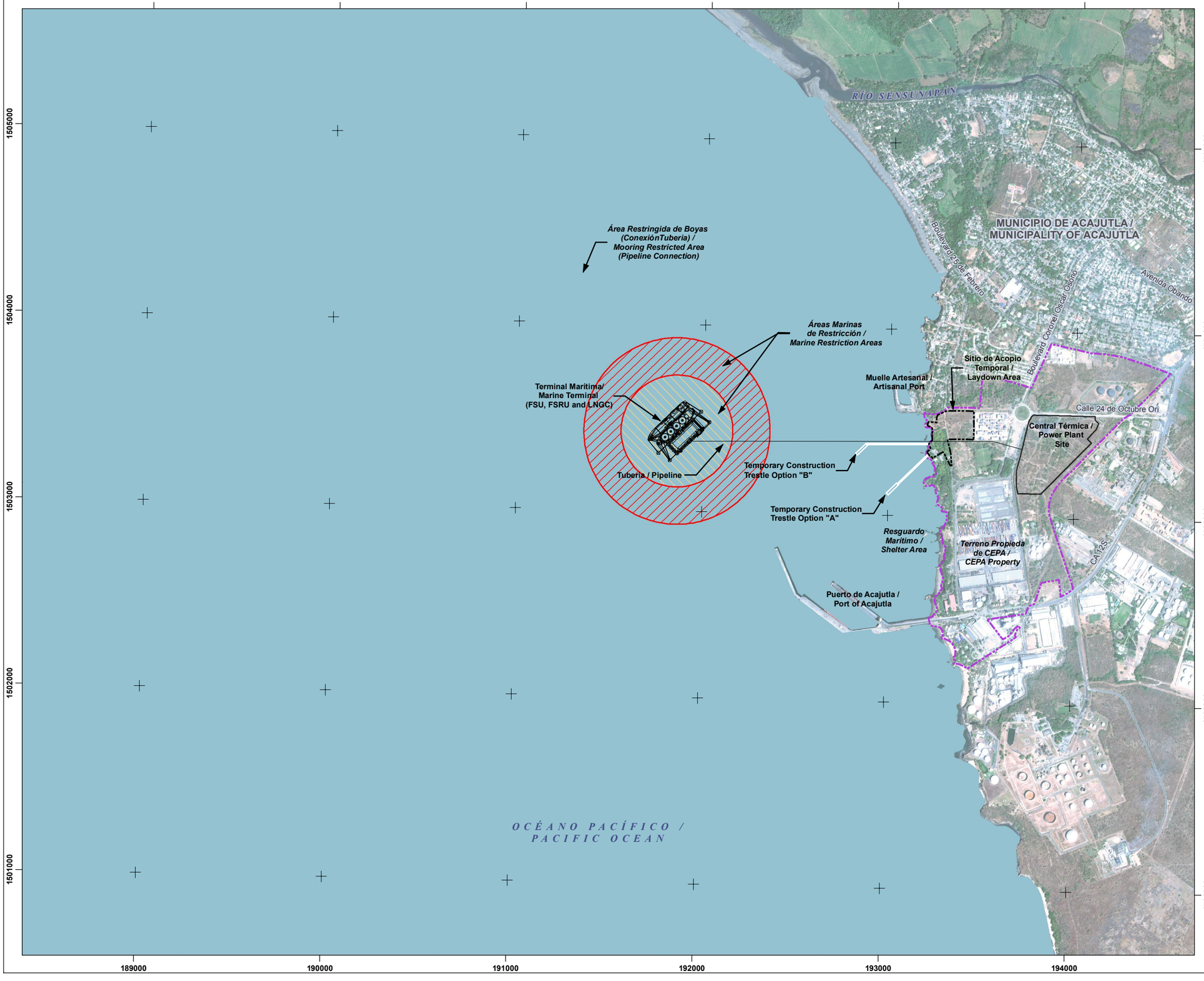
ÁREAS MARINAS DE RESTRICCIÓN (OPERACIONES) / MARINE RESTRICTION AREAS (OPERATIONS)

FIGURA 4.37 / FIGURE 4.37



SITIO DEL PROYECTO / PROJECT SITE

SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA

TERRENO PROPIEDAD DE CEPA / CEPA PROPERTY

ÁREAS MARINAS DE RESTRICCIÓN / MARINE RESTRICTION AREAS

ZONA DE RESTRICCIÓN DE PASO DE BARCOS (300 M)/ MARINE VESSEL RESTRICTION ZONE (300 M)

ZONA DE RESTRICCIÓN DE PASO DE BARCOS (SOLO BARCOS CONTROLADOS POR CEPA, 500 M) / MARINE VESSEL RESTRICTION ZONE (CONTROLLED CEPA TRAFFIC PERMITTED, 500 M)

0 100 200 400 m

1:20,000

N W E S

FUENTE / REFERENCE
VISIÓN DEL MUNDO 2 IMÁGENES DE ALTA RESOLUCIÓN / WORLDVIEW 2 HIGH RESOLUTION IMAGERY (2014-02-12)

MAPA CREADO POR / MAP CREATED BY: PFM
MAPA REVISADO POR / MAP CHECKED BY: MW
PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONE 16 WGS84

ARCHIVO / FILE:
I:\GIS\163489 Acajutla\GIS\MXDs\Reporting - 2016\5-XX - Maritime Elements.mxd

PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL / FINAL
FECHA / DATE: 12/8/2016

DILLON CONSULTING

ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

4.10 Fuel Transport Pipelines

The detail of the pipeline is presented in Table 4.24.

Table 4.24 – Technical Information of the Pipeline

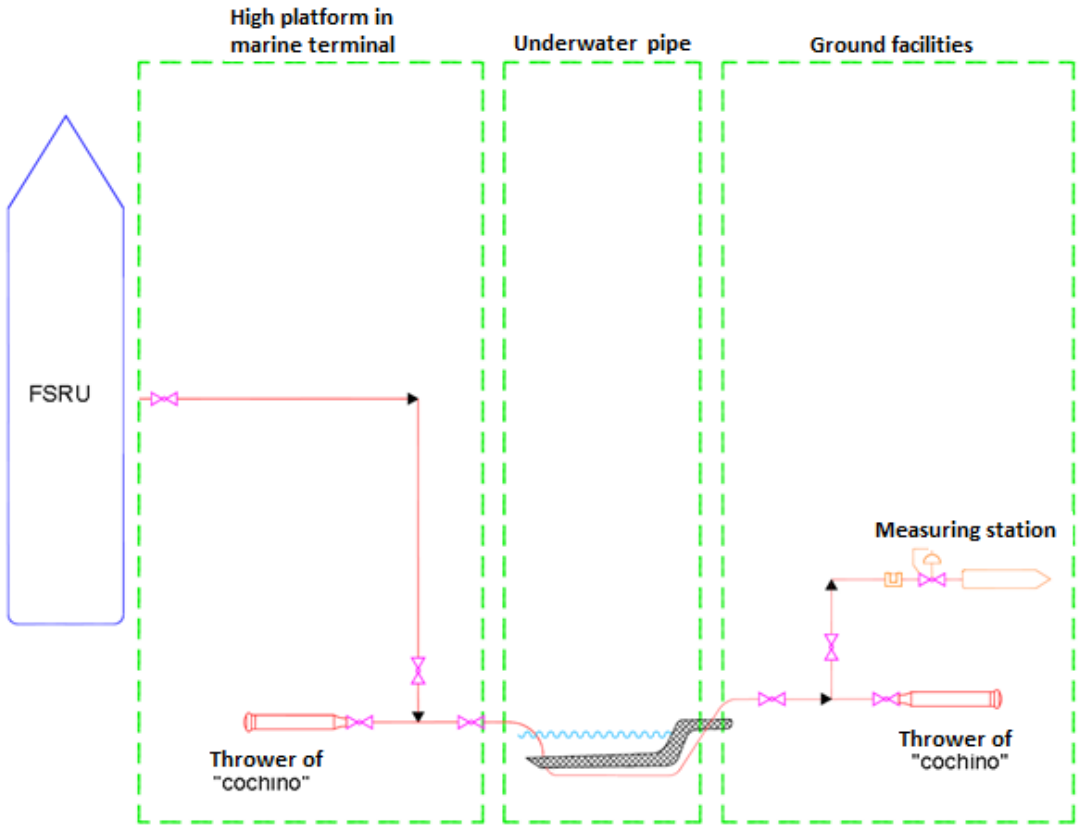
Pipeline Type	Beginning	Ending	Material	Diameter (inches)	Intake operation pressure (Bar)	Input Operating Pressure (Bar)	Transfer rate	
							Value	Unit
GNL	FSU	FSRU	Stainless Steel	16	2	-163	3,000	m^3/h
GN	FSRU	POWER PLANT	Coal Steel	24	11	5	280	MMCFPD

Source: M&N 2016

The flow, pressure and temperature of the pipeline will be monitored through an instrumented measuring station that will be in the vicinity of the Thermal Power Plant. The data will be received and monitored using a monitoring and data acquisition (SCADA) system that will evaluate the operational status of the pipeline.

Once installed, the integrity of the pipeline will be guaranteed by periodic hydrostatic or pneumatic pressure tests, as well as by a smart pig system, which will measure the thickness of the pipe wall and the integrity of the pipe. Same in all its extension. Figure 4.38 presents a schematic diagram of the pipeline elements.

Figure 4.38 – Main Elements Scheme and NG Pipe Configuration



Source: M&N, 2016

4.10.1 Construction Process of the Pipeline On-land

Construction will begin with cleaning the pipeline corridor. The soil, including organic soil, will be collected in a certain area for use in the trench-filling activities, once the pipeline is placed.

The trench is expected to be approximately 4 to 6 feet wide and about 2 to 5 feet deep to the top of the pipe. The excavation will include the use of excavators and loaders. Where rock is found, blasting techniques will be used.

The project will comply with internationally accepted erosion control procedures to control the discharge of sediments into the area's watercourses.

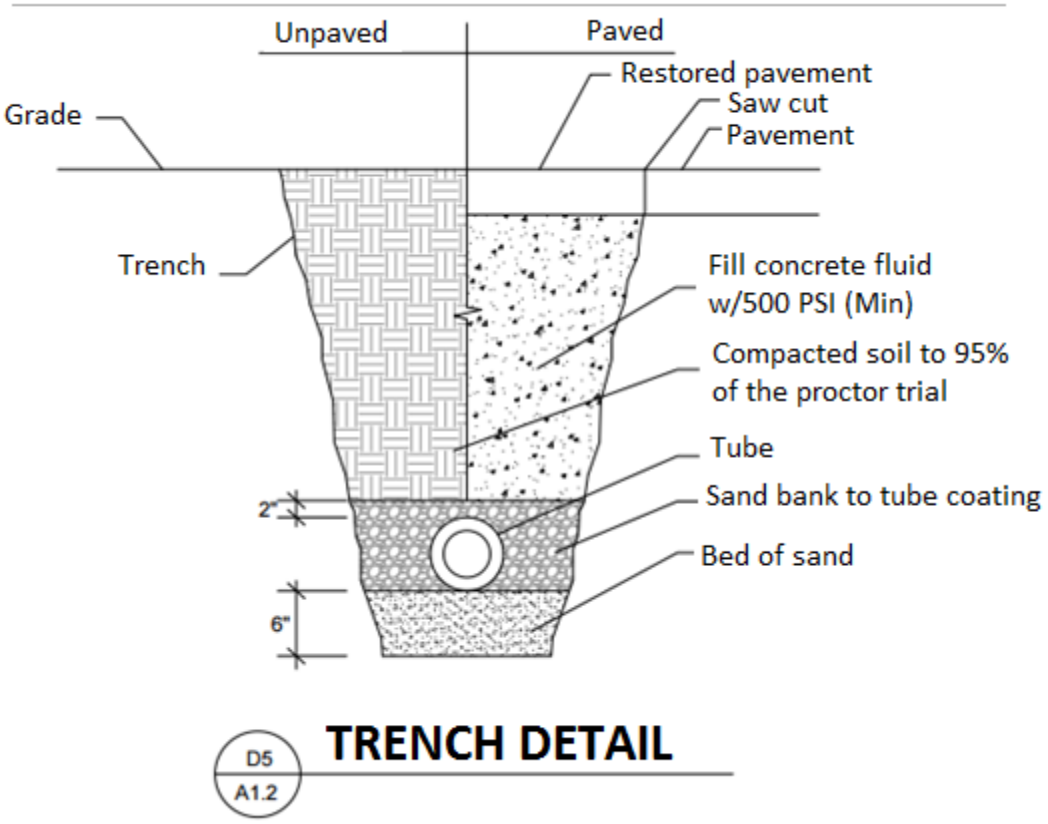
Typically, the pipeline is buried by trench construction, with a minimum depth of 2 feet. The project will comply with internationally accepted erosion control procedures to control the discharge of sediments into the area's watercourses.

The passage of the pipeline under streets or under zones with live loads can be placed to a greater depth and if necessary, will be placed inside a steel "box" that is installed by means of drilling and excavation method. This protects the pipeline from live loads such as vehicle passage.

In all cases, the appropriate distance from facilities of other utilities and infrastructure in general will be maintained.

Construction of the pipeline will require excavation of existing earth material. This activity will include the use of excavators, loaders and excavators. Where very hard rock is found, blasting techniques will be used, complying with all required Salvadoran standards, permits and safety requirements. The excavated materials will be stored next to the trench for later use in the filling activities. Prior to any excavation, the contractor will determine the location of existing services, either below or above ground, and must follow local procedures so as not to affect any existing pipeline or power line. The pipeline will be installed as "settle and cover". Figure 4.39 shows a detail:

Figure 4.39 – Ditch detail for pipe installation



Source M&N, 2016

4.10.2 Construction Process of Pipeline in Seabed

In the case of marine pipeline, the pipeline could be fully mount and then pulled into its final position on the seabed. The pipeline may be pulled on the seabed or on water or in a combination of both, and then put over the seabed. For this project, a horizontal installation by directed drilling is also to be considered.

An estimated 1,300 m of pipeline will be buried in the seabed; the trench will be approximately 2 m wide by 3 m deep, with an approximate 3H: 1V lateral slope. The excavated trench material will be deposited next to the trench to be used for filling after placement of the pipe. If rock material is found, explosives will be used for installation. The pipeline will be protected from tsunami currents with a cushion of articulated concrete blocks or stone base. Approximately 45,000 m3 of material will be excavated offshore to install the pipeline.

If favorable geotechnical conditions are found, the pipe can be constructed using horizontal directional drilling (HDD). This method will require an inlet well to be dug for the drilling rig and an outlet well on the seabed near the Marine Terminal. Excavation may require the use of explosive if rock is found. Installation of the pipeline from the HDD outlet well to the platform shall be performed using the cutting and cover method described above.

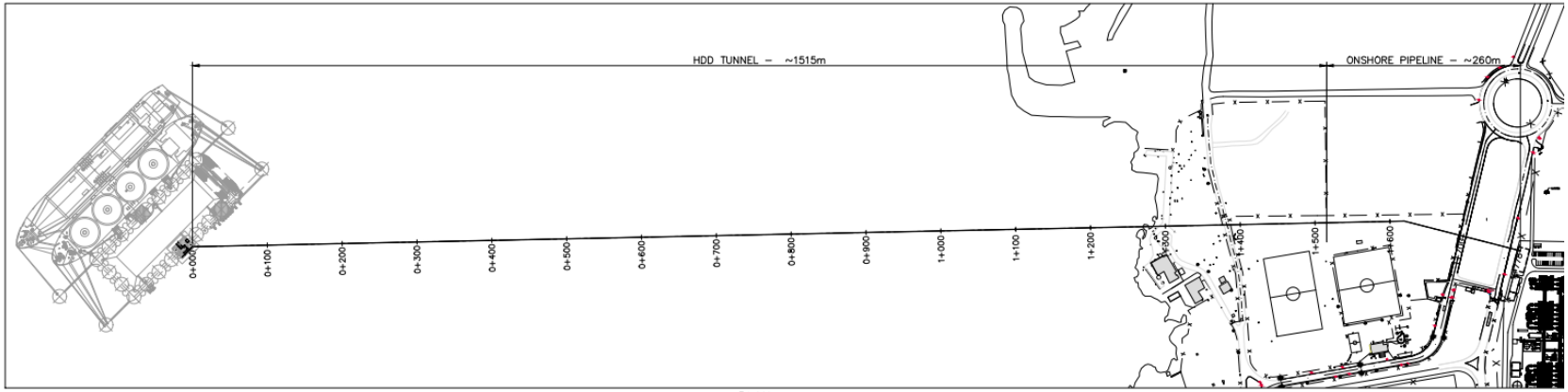
When the pipe is in place, the end toward the sea will be welded to the riser which will then be secured to the riser structure. One of the lifting platforms will facilitate the installation of the riser on the lifting platform. After installing the riser, open trench and HDD wells (if used) can be refilled.

Construction of the offshore pipeline will be completed using jack-up barges and / or floating barges.

Possible options for placing the pipe in the risk zone for grounding have been evaluated. These options are presented in Figures 4.40 to 4.43. The options are:

- HDD Tunnel.
- A section Buried and a section on HDD tunnel.
- A section buried and a section on a trestle spring type.
- Excavated, being the last section protected with rock.

Figure 4.40 – Submarine pipeline, HDD Tunnel Option



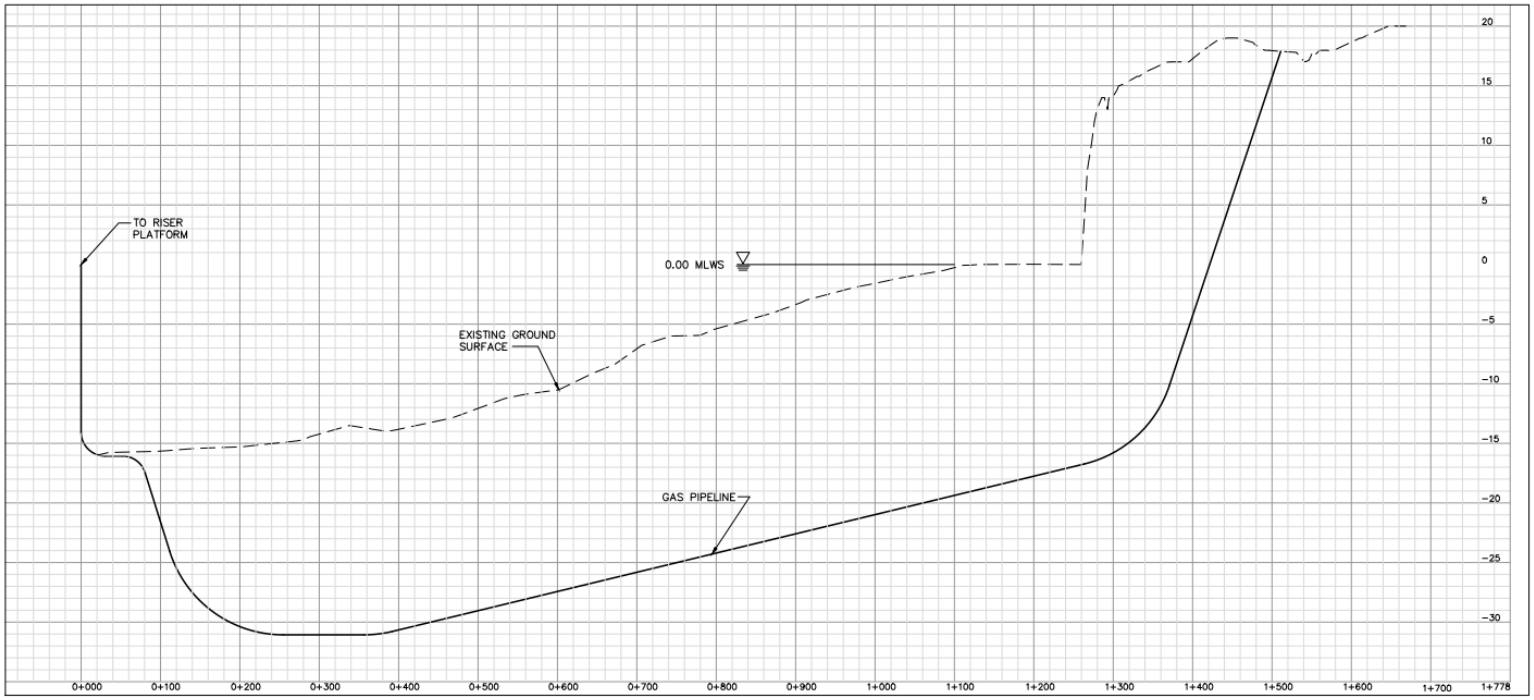


Figure 4.41 – Submarine pipeline, a section Buried and a section on HDD tunnel option

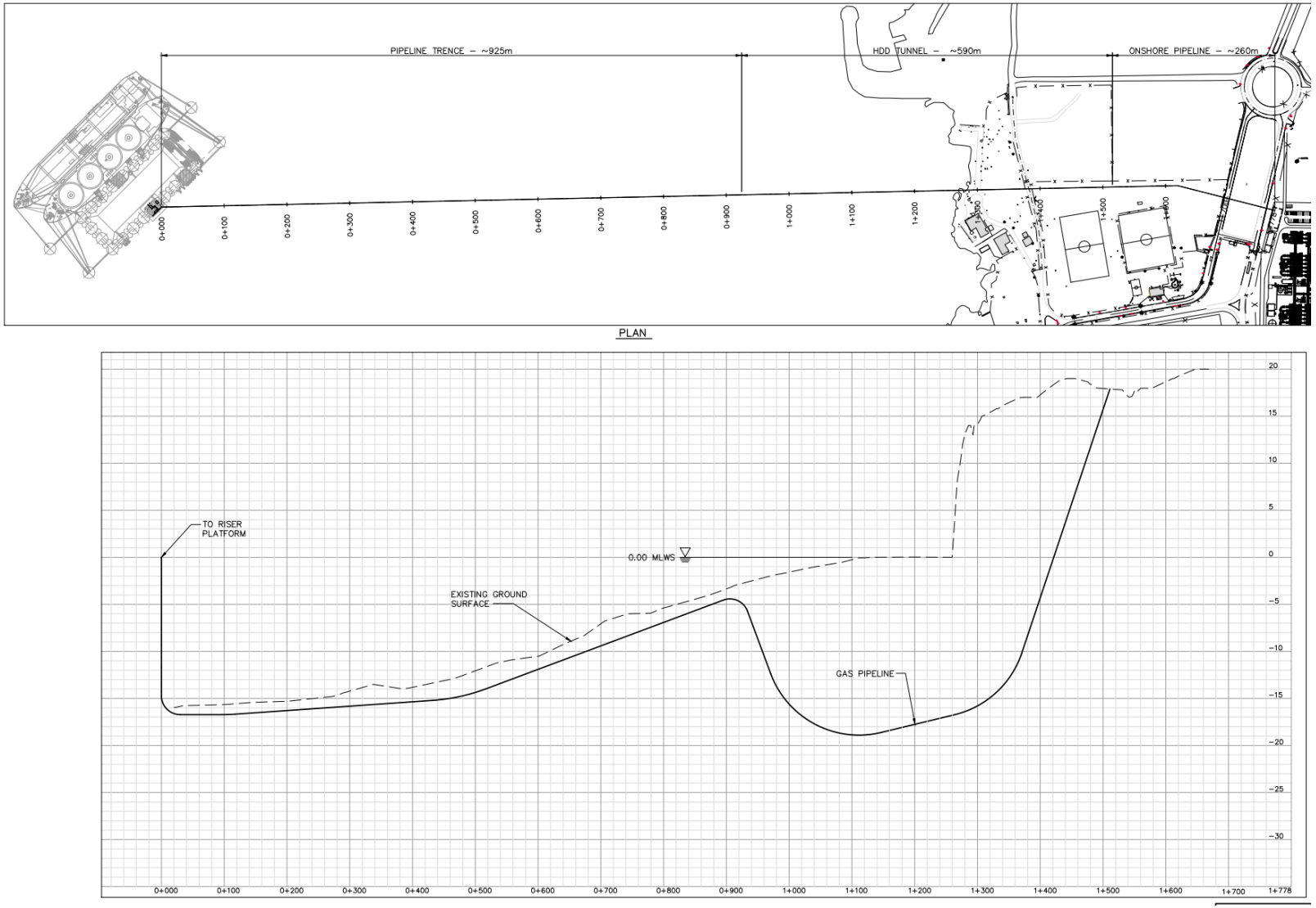


Figure 4.42 – Submarine pipeline, a section buried and a section on a trestle spring type option

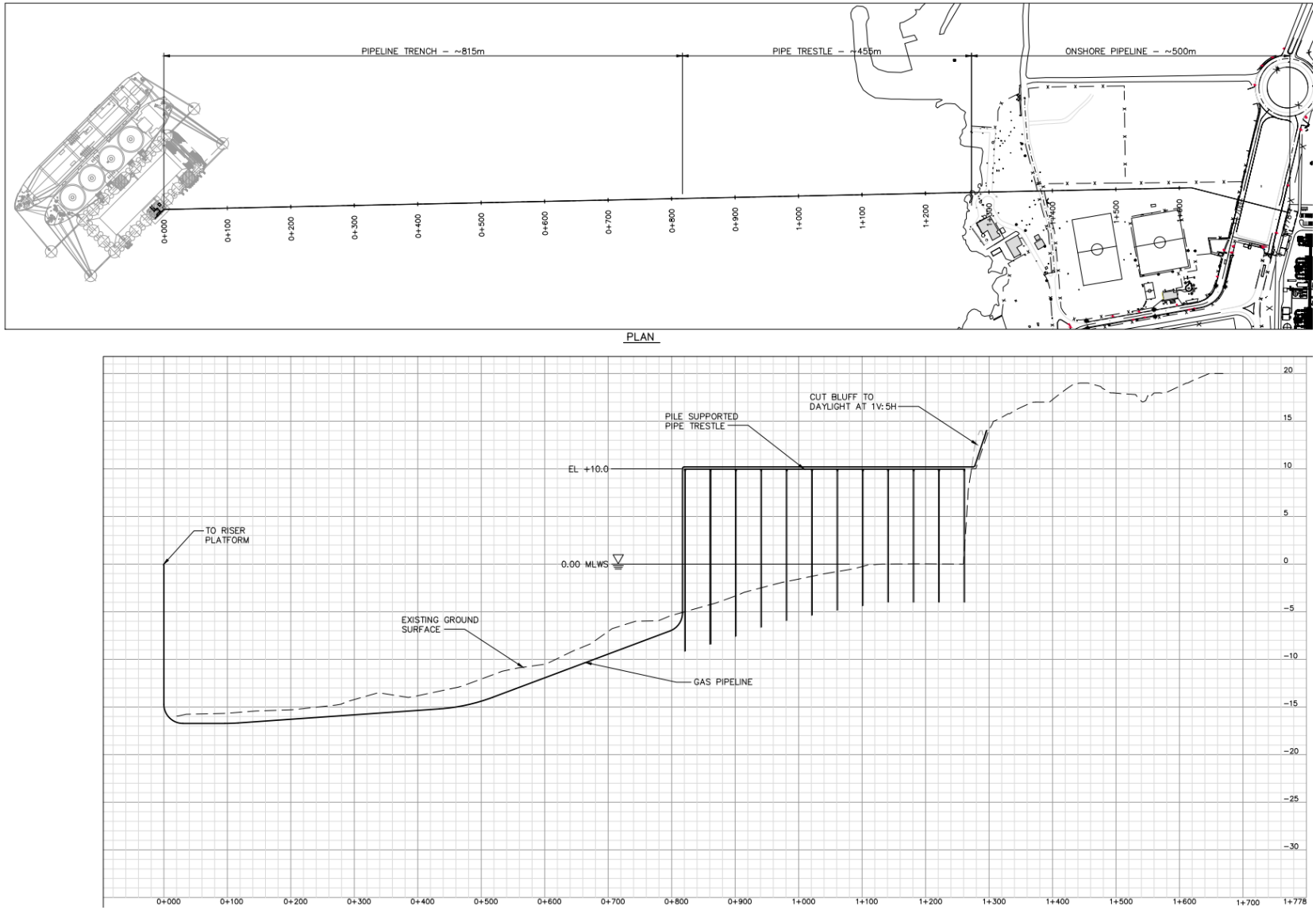
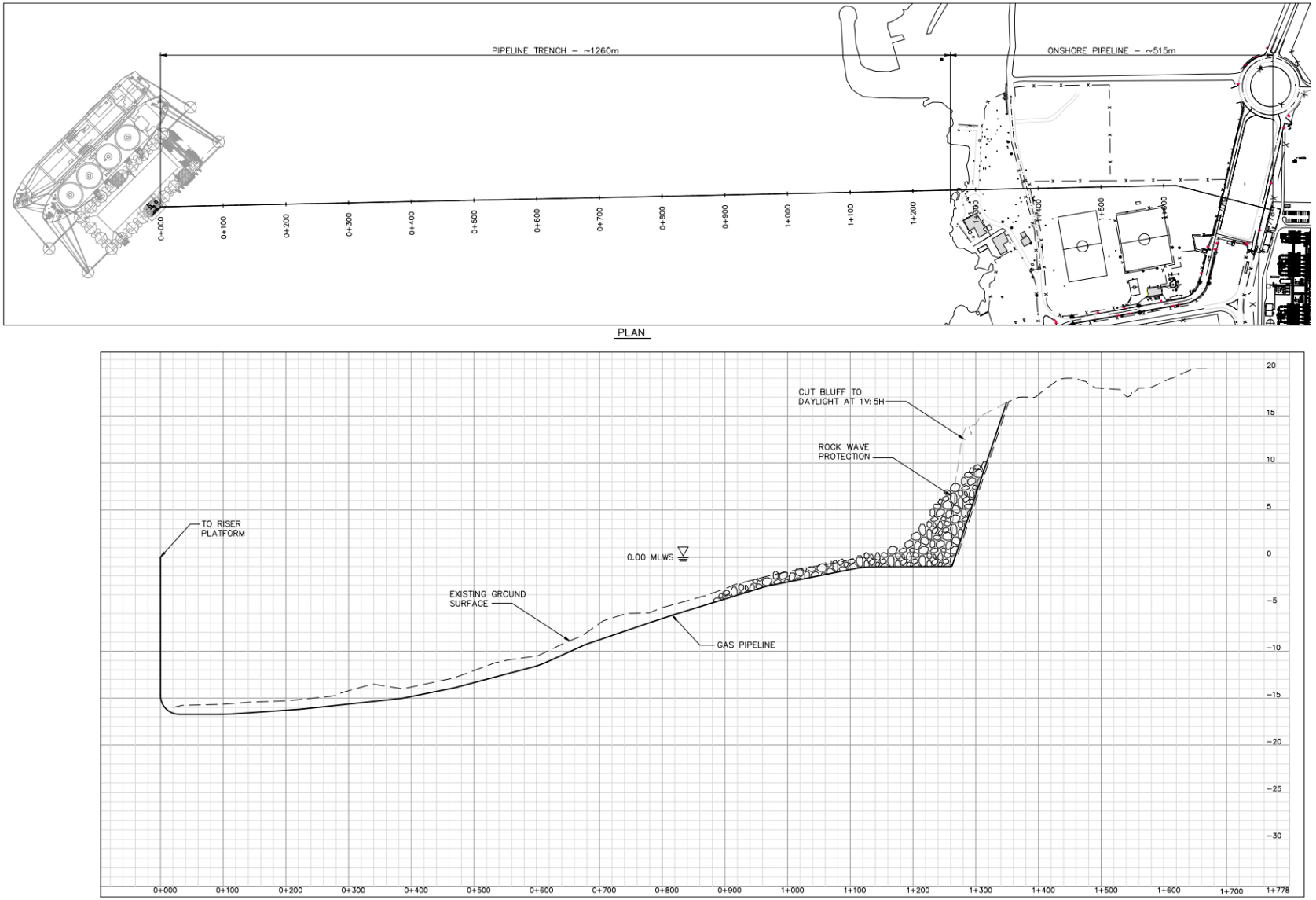


Figure 4.43 – Submarine pipeline, excavated, being the last section protected with rock, option



4.11 Handling of Hazardous Substances, Hazardous Residues and Hazardous Waste in the Operation Stage

Tables 4.25, 4.26 and 4.27, show the main hazardous materials, liquid, solid and gaseous, respectively, indicating the name, hazards, use in the plant, quantity to be stored. Tables also include if hazardous waste is generated from the same material or from the container where it is stored and final disposal.

The main hazardous materials are detailed:

- Natural Gas and Liquefied Natural Gas;
- Nitrogen;
- Lubricant oils;
- Dielectric oil for the transformer;
- Chemicals to keep the water boiler water clean and cooling systems, such as descales and algaecides;
- Chemicals for the water purification system;
- Chemical for the oily water treatment system;
- Diesel fuel for the diesel compressor and the diesel engine firefighting; and
- Cleaners for the maintenance shop.

Except for NG, LNG and lubricating oils, these materials shall be used and stored in relatively small quantities, as indicated in Tables 4.25, 4.26 and 4.27. Material Safety Data Sheets are included in Appendix 4F.

Table 4.25 – Inventory and management of liquid materials, waste and residues from the Thermal Power Plant

Material	MARN regulated	CAS Number	Description	Amount allowed by MARN	Hazard	Hazard Characteristic	Site of Use	Estimated Release Amount	Estimated Amount of Containers	Internal Leakage Management	Estimated Amount Of Full Storage	Method Of Final Disposal
LIQUID NATURAL GAS (GNL) (METHANE OR R50)	YES	74-82-8	METHANO, COMPRESSED OR NATURAL GAS, COMPRESSED WITH HIGH METHANE CONTENT	1Kg	GAS FLAMMABLE	It is highly flammable and may form explosive mixtures with air. It may cause personnel to be displaced by oxygen displacement.	Marine Terminal: Floating storage unit (FSU), LNG storage tank on shore, Dock	NONE-POSSIBLE LEAKAGE	NOT APPLICABLE - tank and pipeline transport	IF NECESSARY, USE FUEL GAS DETECTOR (EXPLOSIMETER). ESTABLISH A PERIMETRODE SAFETY. CLOSE VALVES IN PIPES OR LIQUID NATURAL GAS TANKS. DO NOT USE CO2, LOW EXPANSION SOAP OR SPRAY WATER APPLIED WITH STRONG PRESSURE DIRECTLY ON LIQUID GAS	Approximately 100,000 m^3 in the LNG tank on land and 140,000 m^3 in the floating storage unit	BEFORE A LEAK: REFRIGERATE THE EXPOSED CONTENT AND HELP DISPERSE GAS CLOUD WITH WATER IN SPRAY
			METHANE, REFRIGERATED LIQUID OR NATURAL GAS, LIQUID REFRIGERATED WITH HIGH METHANE CONTENT	25 g								
LIQUID NITROGEN	NO	7727-37-9	NITROGEN	N/A	TOXIC LIQUID	Causes rapid frostbite and suffocation in addition to cryogenic burns and damage to the lungs.	Marine Terminal: LNG storage tank on land, regasification room, LNG truck loading area	NONE-POSSIBLE LEAKAGE	NOT APPLICABLE - pipe transport	USE THE PERSONAL PROTECTIVE EQUIPMENT RECOMMENDED FOR THE MANUFACTURER, CLOSE SUPPLY VALVES. APPLY AN EXTINGUISHING AGENT TO SAFE UNDERSTANDING, PROTECT THE SURROUNDING AREA	Nitrogen generator, capacity 2,000 Nm^3 / hr	APPLY AN EXTINGUISHING AGENT TO A SAFE DISTANCE, PROTECT THE SURROUNDING AREA
MOBIL DTE OIL MEDIUM	NO	68649-42-3	PHOSPHORODITHOIC ACID, O, O-DI C1-14-ALKYL ESTERS, ZINC SALTS (2:1) (ZDDP)	N/A	WASTE OIL	The hydrocarbons are Eco-toxic, they can cause adverse effects in the aquatic environment	GENERATOR BEARINGS (Without Oil recirculation)	2,200 Liters / year	2 BARRELS of 55 gal. per year, used to transport used oil	CONTAINING AND COLLECTING USED OIL IN BARRELS	2 Barrels (55 Gal. c/u)	INCINERATION OR OTHER DEFINED BY ENERGIA DEL PACIFICO
MOBILDELVAC MX 15W40	NO	68649-42-3	ZINC DITHIOPHOSPHATE	N/A	WASTE OIL	The hydrocarbons are Eco-toxic, they can cause adverse effects in the aquatic environment	DIESEL ENGINE STARTER AIR COMPRESSOR	50 Liters / month	2 BARRELS of 55 gal. per year, used to transport used oil	CONTAINING AND COLLECTING USED OIL IN BARRELS	1 Barrel (55 Gal)	INCINERATION OR OTHER DEFINED BY ENERGIA DEL PACIFICO
Mobil Pegasus 805	NO	125643-61-0	BENZENE PROPANOIC ACID, 3,5-BIS (1,1-DIMETHYLETHYL)-4-HYDROXY-,C7-9 BRANCHED ALKYL ESTERS	N/A	WASTE OIL	The hydrocarbons are Eco-toxic, they can cause adverse effects in the aquatic environment	CARTER ENGINE W18V50SG	NONE-POSSIBLE LEAKAGE	NOT APPLICABLE-Transport in bulk	CONTAINING AND COLLECTING USED OIL IN BARRELS	80 m^3	INCINERATION OR OTHER DEFINED BY ENERGIA DEL PACIFICO
MOBIL RARUS 827	NO	119-06-2	1,2-BENZENEDICARBOXYLIC ACID, DITRIDECYL	N/A	WASTE OIL	The hydrocarbons are Eco-toxic, they can cause adverse effects in the aquatic environment	CARTER COMPRESSOR AIR START	60 Liters / month	The container is cleaned and sent with scrap	CONTAINING AND COLLECTING USED OIL IN BARRELS	1 container (5 Gal)	INCINERATION OR OTHER DEFINED BY ENERGIA DEL PACIFICO
MOBIL RARUS SHC 1026	NO	No reportable hazardous substance(s) or complex substance(s)	This material is not considered to be hazardous according to regulatory guidelines	N/A	WASTE OIL	The hydrocarbons are Eco-toxic, they can cause adverse effects in the aquatic environment	CARTER COMPRESSOR OF INSTRUMENTS	40 Liters / month	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING USED OIL IN BARRELS	1 container (5 Gal)	INCINERATION OR OTHER DEFINED BY ENERGIA DEL PACIFICO

Table 4.25 – Inventory and management of liquid materials, waste and residues from the Thermal Power Plant

Material	MARN regulated	CAS Number	Description	Amount allowed by MARN	Hazard	Hazard Characteristic	Site of Use	Estimated Release Amount	Estimated Amount of Containers	Internal Leakage Management	Estimated Amount Of Full Storage	Method Of Final Disposal
MOBIL SHC 634	NO	No reportable hazardous substance(s) or complex substance(s)		N/A	WASTE OIL	The hydrocarbons are Eco-toxic, they can cause adverse effects in the aquatic environment	MECHANISM SLOW TURN OF THE ENGINE W18V50SG	100 Liters / year	The container is cleaned and sent with scrap	CONTAINING AND COLLECTING USED OIL IN BARRELS	1 container (5 Gal)	INCINERATION OR OTHER DEFINED BY ENERGIA DEL PACIFICO
ACEITE MOBIL AUTOMATIC TRANSMISSION FLUID	NO	64742-55-8	HYDROTREATED LIGHT PARAFFINIC DISTILLATES,PETROLEUM	N/A	WASTE OIL	The hydrocarbons are Eco-toxic, they can cause adverse effects in the aquatic environment	BEARINGS	10 Liters / year	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING USED OIL IN BARRELS	1 container (2 Gal)	INCINERATION OR OTHER DEFINED BY ENERGIA DEL PACIFICO
		72623-86-0	LUBRICATING OILS (PETROLEUM), HYDROTREATED NEUTRAL OIL-BASED									
DIELECTRIC OIL	NO	64742-53-6	Naphthenic Oil Petroleum Distillates	N/A	WASTE OIL	The hydrocarbons are Eco-toxic, they can cause adverse effects in the aquatic environment	TRANSFORMER	NONE-POSSIBLE LEAKAGE	NOT APPLICABLE-Unique equipment	CONTAINING AND COLLECTING USED OIL IN BARRELS	NOT APPLICABLE - Based on demand	IF A LEAK: COLLECTION IN BARREL
CORROSION INHIBITOR SP- 400	NO	64742-49-0/ 107-83-5	Isomers of hexane	N/A	FLAMMABLE LIQUID	Irritating to eyes and skin. It also has hydrocarbons that cause adverse effects on the aquatic environment	MAINTENANCE WORKSHOP	NONE-POSSIBLE LEAKAGE	The aerosol is discharged and sent with scrap	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	5 containers (16 Ounces each)	INCINERATION IN CONTROLLED OVEN
		110-54-3	N-Hexane									
		8052-41-3	Stoddard Solvent									
		propietario	Additive Blend									
		34590-94-8	Dipropylene glycol monomethyl ether									
		68476-86-8	Liquefied petroleum gas									
COAGULANTE S- MIX-2040	UNIDENTIFIED			N/A	TOXIC LIQUID	The associated health hazard is that its contact causes burns on the skin, nasal mucous membranes and eyes	OILY WATER TREATMENT SYSTEM	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	6 containers (5 Gal each)	IF A LEAK: COLLECTION IN BARREL

Table 4.25 – Inventory and management of liquid materials, waste and residues from the Thermal Power Plant

Material	MARN regulated	CAS Number	Description	Amount allowed by MARN	Hazard	Hazard Characteristic	Site of Use	Estimated Release Amount	Estimated Amount of Containers	Internal Leakage Management	Estimated Amount Of Full Storage	Method Of Final Disposal
FLOCULANT-POL4040	UNIDENTIFIED			N/A	TOXIC LIQUID	The associated health hazard is that its contact causes burns on the skin, nasal mucous membranes and eyes	OILY WATER TREATMENT SYSTEM	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	6 containers (5 Gal each)	IF A LEAK: COLLECTION IN BARREL
CAUSTIC SODA	YES	1310-58-3	SOLID SODIUM HYDROXIDE	25 Kg	TOXIC LIQUID	The associated health hazard is that its contact causes burns on the skin, nasal mucous membranes and eyes	OILY WATER TREATMENT SYSTEM	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	6 containers (5 Gal each)	IF A LEAK: COLLECTION IN BARREL
			SOLUTION OF SODIUM HYDROXIDE	25 L								
TRASAR-22141 PHOSPHATE	UNIDENTIFIED			N/A	TOXIC LIQUID	The associated health hazard is that its contact causes burns on the skin, nasal mucous membranes and eyes	COMBUSTION GAS HEAT RECOVERY SYSTEM	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste.	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	6 containers (5 Gal each)	IF A LEAK: COLLECTION IN BARREL
NALCOEG-5010 ALKALINITY CONTROL	UNIDENTIFIED			N/A	TOXIC LIQUID	The associated health hazard is that its contact causes burns on the skin, nasal mucous membranes and eyes	COMBUSTION GAS HEAT RECOVERY SYSTEM	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	6 containers (5 Gal each)	IF A LEAK: COLLECTION IN BARREL
Tri-ACT-1820 CORROSION INHIBITOR	NO	108-91-8	CYCLOHEXYLAMINE (SARA 302)	N/A	TOXIC LIQUID	The associated health hazard is that its contact causes burns on the skin, nasal mucous membranes and eyes	COMBUSTION GAS HEAT RECOVERY SYSTEM	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	6 containers (5 Gal each)	IF A LEAK: COLLECTION IN BARREL
		100-37-8	ETHANOL	N/A								
		110-91-8	MORPHOLINE	N/A								
PH STABILIZER 8735	NO	1310-73-2	SODIUM HYDROXIDE (CERCLA)	N/A	TOXIC LIQUID	The associated health hazard is that its contact causes burns	COMBUSTION GAS HEAT RECOVERY	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	6 containers (5 Gal each)	IF A LEAK: COLLECTION IN BARREL
		1310-58-3	POTASSIUM HYDROXIDE (CERCLA)	N/A								

Table 4.25 – Inventory and management of liquid materials, waste and residues from the Thermal Power Plant

Material	MARN regulated	CAS Number	Description	Amount allowed by MARN	Hazard	Hazard Characteristic	Site of Use	Estimated Release Amount	Estimated Amount of Containers	Internal Leakage Management	Estimated Amount Of Full Storage	Method Of Final Disposal
		7732-18-5	WATER	N/A		on the skin, nasal mucous membranes and eyes	SYSTEM		plastic waste			
PLURON ACI M	UNIDENTIF IED			N/A	TOXIC LIQUID	The associated health hazard is that its contact causes burns on the skin, nasal mucous membranes and eyes	INVERSE OSMOSIS TREATMENT SYSTEM	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	2 containers (5 Gal each)	DILUTION WITH WATER IN WASTE WATER TANK
PLURON SEK M	UNIDENTI FIED			N/A	TOXIC LIQUID	The associated health hazard is that its contact causes burns on the skin, nasal mucous membranes and eyes	INVERSE OSMOSIS TREATMENT SYSTEM	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	2 containers (5 Gal each)	DILUTION WITH WATER IN WASTE WATER TANK

Table 4.25 – Inventory and management of liquid materials, waste and residues from the Thermal Power Plant

Material	MARN regulated	CAS Number	Description	Amount allowed by MARN	Hazard	Hazard Characteristic	Site of Use	Estimated Release Amount	Estimated Amount of Containers	Internal Leakage Management	Estimated Amount Of Full Storage	Method Of Final Disposal
PLURON CE 800 B	UNIDENTIFIED			N/A	TOXIC LIQUID	The associated health hazard is that its contact causes burns on the skin, nasal mucous membranes and eyes	INVERSE OSMOSIS TREATMENT SYSTEM	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	1 Container (1 Kg)	DILUTION WITH WATER IN WASTE WATER TANK
SALT TABLETS	UNIDENTIFIED	7647-14-5	Sodium Chloride	N/A	TOXIC SUBSTANCE	The associated health hazard is that its contact causes burns on the skin, nasal mucous membranes and eyes	INVERSE OSMOSIS TREATMENT SYSTEM	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	1 Container (50 Kg)	DILUTION WITH WATER IN WASTE WATER TANK
DREWGARD 4109	UNIDENTIFIED	7775-19-1	SODIUM METABORATE TETRAHYDRATE	N/A	TOXIC LIQUID	Irritating to eyes and skin. It also has hydrocarbons that cause adverse effects on the aquatic environment	MOTOR COOLING WATER TREATMENT TANK	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	NOT APPLICABLE - Based on demand, stored by the supplier	DILUTION WITH WATER IN WASTE WATER TANK
		1303-96-4	SODIUM TETRABORATE, DECAHYDRATE									
		7631-99-4	SODIUM NITRATE									
		7632-00-0	SODIUM NITRATE (SARA III)									
		6834-92-0	SODIUM METASILICATE (ANHYDROUS)									
		64665-57-2	SODIUM TOLYLTRIAZOLE									
BELT DRESSING	UNIDENTIFIED	107-83-5/64742-49-0	HEXANE ISOMERS	N/A	FLAMMABLE LIQUID	Irritating to eyes and skin. It also has hydrocarbons that cause adverse effects on the aquatic environment	MAINTENANCE WORKSHOP	NONE-POSSIBLE LEAKAGE	The aerosol is discharged and sent with scrap	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	2 containers(16 ounces each)	INCINERATION IN CONTROLLED OVEN
		110-54-3	N-HEXANE									
		9003-29-6	POLYSISOBUTENE									
		68476-86-8	LIQUEFIED PETROLEUM GAS									
SOLVE-ELECTRIWELL	UNIDENTIFIED		SOLVENT DIELECTRIC	N/A	FLAMMABLE LIQUID	It consists of hydrocarbons that cause irritation and adverse effects on the aquatic environment	TRANSFORMER	NONE-POSSIBLE LEAKAGE	The aerosol is discharged and sent with scrap	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	NOT APPLICABLE - Based on demand	INCINERATION IN CONTROLLED OVEN

Table 4.25 – Inventory and management of liquid materials, waste and residues from the Thermal Power Plant

Material	MARN regulated	CAS Number	Description	Amount allowed by MARN	Hazard	Hazard Characteristic	Site of Use	Estimated Release Amount	Estimated Amount of Containers	Internal Leakage Management	Estimated Amount Of Full Storage	Method Of Final Disposal
MAGNAFLUX PENETRANT, DEVELOPER, REMOVER		PENETRANT		N/A	FLAMMABLE LIQUID	It consists of hydrocarbons that cause irritation and adverse effects on the aquatic environment	MAINTENANCE WORKSHOP - MACHINES ROOM	NONE-POSSIBLE LEAKAGE	The aerosol is discharged and sent with scrap	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	Box of 9 Containers (16 Ounces each) that includes: Cleaner, Penetrant and Developer	INCINERATION IN CONTROLLED OVEN
		8042-47-5/ 64742-47-8	WHITE MINERAL OIL (petroleum)									
		71888-89-6	PHTHALIC ESTERS									
		68476-86-8	LIQUEFIED PETROLEUM GASSES									
		DEVELOPER										
		67-63-0	2-PROPANOL									
		67-64-1	2-PROPANONE									
		75-28-5	ISOBUTANA (PROPELLANT)									
		REMOVER										
		64742-89-8	LIGHT ALIPHATIC SOLVENT NAPHTHA									
		124-38-9	CARBON DIOXIDE (propellant)									
PAINTINGS	UNIDENTIFIED			N/A	FLAMMABLE LIQUID	It consists of hydrocarbons that cause irritation and adverse effects on the aquatic environment	MAINTENANCE WORKSHOP	NONE-EXPIRED PAINT	The container is cleaned and sent with scrap	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	NOT APPLICABLE - Based on demand	INCINERATION IN CONTROLLED OVEN
THT (TETRAHIDROTIO FENO)	NO	110-01-0	TETRAMETHYLENE, TOLANO SULFIDE, THT C4H8S	N/A	FLAMMABLE LIQUID	It is highly flammable and may form explosive mixtures with air and is harmful to aquatic organisms	CITYGATE	NONE-POSSIBLE LEAKAGE	NOT APPLICABLE - transport by compressed bottle	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	NOT APPLICABLE - Based on demand, stored by the supplier	INCINERATION IN CONTROLLED OVEN
THINNER	NO	64742-89-3	SLIMMER	N/A	COMBUSTIBLE LIQUID	The hydrocarbons are Eco-toxic, they can cause adverse effects in the aquatic environment	MAINTENANCE WORKSHOP	30 Litters/month	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	1 Container (5 Gal)	INCINERATION IN CONTROLLED OVEN
PENETRATING HOLDER	NO	8032-32-4	DISOLVENTE	N/A	COMBUSTIBLE LIQUID	Irritating to eyes and skin. It also has hydrocarbons that cause adverse effects on the aquatic environment	MAINTENANCE WORKSHOP	NONE-POSSIBLE LEAKAGE	The aerosol is discharged and sent with scrap	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	12 Containers (10 Ounces each)	INCINERATION IN CONTROLLED OVEN
		119345-04-9	PETRONATE									
		8012-95-1	MINERAL OIL									
		A-70	NOT ESTABLISHED									
VARSOL	NO	64742-47-8	ALPHATIC DISTILLATES	N/A	COMBUSTIBLE LIQUID	The hydrocarbons are Eco-toxic, they can cause adverse effects in the aquatic environment	MAINTENANCE WORKSHOP	48 Litters/month	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	2 Container (5 Gal each)	INCINERATION IN CONTROLLED OVEN

Table 4.25 – Inventory and management of liquid materials, waste and residues from the Thermal Power Plant

Material	MARN regulated	CAS Number	Description	Amount allowed by MARN	Hazard	Hazard Characteristic	Site of Use	Estimated Release Amount	Estimated Amount of Containers	Internal Leakage Management	Estimated Amount Of Full Storage	Method Of Final Disposal
ACPM (DIESEL)	NO	68334-30-5	HYDROCARBONS AND ADDITIVES.	N/A	COMBUSTIBLE LIQUID	The hydrocarbons are Eco-toxic, they can cause adverse effects in the aquatic environment	DIESEL ENGINE AGAINST FIRE AND DIESEL COMPRESSOR	NONE-POSSIBLE LEAKAGE	NOT APPLY - transport in BARREL of 55 gallons every 3 months.	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	1 container (55 Gal)	INCINERATION IN CONTROLLED OVEN
QUIM	NO	7647-01-0	HYDROCHLORIC ACID	N/A	TOXIC LIQUID	Contact causes burns to the skin, nasal mucous membranes and eyes. And it is toxic to aquatic organisms and plants.	MAINTENANCE WORKSHOP	48 Litters/ month	1 plastic BARREL of 5 gal. per month, washed and stored, for re-use.	WASHING THE AREA WITH PLEINTY OF WATER	2 containers (5 Gal each)	DILUTION WITH WATER IN WASTE WATER TANK
CAPTANMASK	UNIDENTIFIED			N/A	TOXIC LIQUID	Irritating to eyes. It also has hydrocarbons that cause adverse effects on the aquatic environment	CITYGATE	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	1 container 5 Gal	INCINERATION IN CONTROLLED OVEN
CONTACT CLEANER CRC	NO	811-97-2	1,1,1,2-TETRAFLUOROETHANE (HFC-134a)	N/A	TOXIC LIQUID	Irritating to eyes. It also has polymers that cause adverse effects on the aquatic environment	MAINTENANCE WORKSHOP	NONE-POSSIBLE LEAKAGE	The aerosol is discharged and sent with scrap	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	10 containers (16 Ounces each)	INCINERATION IN CONTROLLED OVEN
		138495-42-8	1,1,1,2,2,3,4,5,5,5-DECLAFLUOROPENTA									
		163702-07-6	METHYL NONAFLUOROBUTIL ETHER									
		163702-08-7	METHYL NONAFLUOROISOBUTIL ETHER									
GASKET LOCTITE 5699	NO	70131-67-8	SILOXANES AND SILICONES, DI-ME, HYDROXY-TERMINATED	N/A	TOXIC LIQUID	Irritating to eyes. It also has polymers that cause adverse effects on the aquatic environment	MAINTENANCE WORKSHOP-MACHINES	NONE-POSSIBLE LEAKAGE	The aerosol is discharged and sent with scrap	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	20 Tubes (32 Ounces each)	INCINERATION IN CONTROLLED OVEN
		471-34-1	CALCIUM CARBONATE									
		2224-33-1	BUTAN-2ONE O,'O,O"-(vinylsilylidyne) TRIOXIME									
		68909-20-6	SILICA, AMORPHOUS, TEATED									
		96-29-7	BUTANONE OXIME									

Table 4.25 – Inventory and management of liquid materials, waste and residues from the Thermal Power Plant

Material	MARN regulated	CAS Number	Description	Amount allowed by MARN	Hazard	Hazard Characteristic	Site of Use	Estimated Release Amount	Estimated Amount of Containers	Internal Leakage Management	Estimated Amount Of Full Storage	Method Of Final Disposal
		7429-90-5	ALUMINIUM									
COIL CLEANER (COIL)	NO	1310-73-2	SODIUM HYDROXIDE	N/A	CORROSIVE LIQUID	The associated health hazard is that its contact causes burns on the skin, nasal mucous membranes and eyes.	MAINTENANCE WORKSHOP	30 Litters/month	1 plastic BARREL of 5 gal. per month, washed and stored, for re-use.	WASHING THE AREA WITH PLEINTY OF WATER	2 Containers (5 Gal each)	DILUTION WITH WATER IN WASTE WATER TANK
		110615-47-9	ALKYL POLYGLYCOSIDE									
BACTROL	NO	64-17-5	ETHANOL	N/A	CORROSIVE LIQUID	The associated health hazard is that its contact causes burns on the skin, nasal mucous membranes and eyes.	MAINTENANCE WATER TANK	NONE-POSSIBLE LEAKAGE	1 plastic BARREL of 5 gal per month, washed and stored, for re-use.	WASHING THE AREA WITH PLEINTY OF WATER	4 Containers (5 Gal each)	DILUTION WITH WATER IN WASTE WATER TANK
		7732-18-5	WATER									
		67-63-0	ISOPROPYL ALCOHOL									
FRIXON	NO	81406-37-3	FLUROXYPYR-MEPTYL	N/A	ALKALIN LIQUID	The associated health hazard is that its contact causes burns on the skin, nasal mucous membranes and eyes.	MAINTENANCE WATER TANK	NONE-POSSIBLE LEAKAGE	Reused every month with the provider	WASHING THE AREA WITH PLEINTY OF WATER	4 Containers (5 each)	DILUTION WITH WATER IN WASTE WATER TANK
		19432-41-6	ALKYLPHENOL ETHOXYLATES									
		64742-94-5	SOLVESSO 150#									
GASKET LOCTITE515	NO	79-10-7	ACRYLIC ACID	N/A	ANAEROBIC LIQUID	Irritating to eyes. It also has polymers that cause adverse effects on the aquatic environment	MAINTENANCE WORKSHOP-MACHINES	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	20 Tubes (32 Ounces each)	INCINERATION IN CONTROLLED OVEN
		80-15-9	CUMENE HYDROPEROXYDE									
		868-77-9	2-HYDROXYETHYL METHACRYLATE									
		98-82-8	CUMENE									
LOCTITE 567 SEALANT	NO	39382-25-7	BISPHENOL A FUMARATE RESIN	N/A	ANAEROBIC LIQUID	Irritating to eyes. It also has polymers that cause adverse effects on the aquatic environment	MAINTENANCE WORKSHOP-MACHINES	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	20 Tubes (32 Ounces each)	INCINERATION IN CONTROLLED OVEN
		25852-47-5	POLYGLYCOL DIMETHACRYLATE									
		9004-81-3	POLYGLYCOL LAURATE									
		61791-29-5	POLYETHYLENE GLYCOL MONOCOCOATE									
		13463-67-7	TITANIUM DIOXIDE									
		112945-52-5	SILICA, AMORPHOUS, FUMED, CRYSTAL-FREE									
		81-07-2	SACCHARIN									
		25068-38-6	EPICHLOROHYDRIN-4,4'-ISOPROPYLIDENE DIPHENOL RESIN									

Table 4.25 – Inventory and management of liquid materials, waste and residues from the Thermal Power Plant

Material	MARN regulated	CAS Number	Description	Amount allowed by MARN	Hazard	Hazard Characteristic	Site of Use	Estimated Release Amount	Estimated Amount of Containers	Internal Leakage Management	Estimated Amount Of Full Storage	Method Of Final Disposal
		107-21-1	ETHYLENE GLYCOL									
LOCTITE 242	NO	80-15-9	CUMENE HYDROPEROXIDE	N/A	ANAEROBIC LIQUID	Irritating to eyes. It also has polymers that cause adverse effects on the aquatic environment	MAINTENANCE WORKSHOP-MACHINES	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	20 Tubes (32 Ounces each)	INCINERATION IN CONTROLLED OVEN
		11294-5-52-5	SILICA AMORPHOUS, SMOKED, FREE OF CRYSTALS									
		25852-47-5	POLYMETHYL DIMETHACRYLATE									
		9004-96-0	POLYETHYLIC OLEATE									
		81-07-2	SACCHARIN									
		57-55-6	PROPYLENE GLYCOL									
LOCTITE 545 SEALANT	NO	18268-70-7	POLYGLYCOL DIOCTANOATE	N/A	ANAEROBIC LIQUID	Irritating to eyes. It also has polymers that cause adverse effects on the aquatic environment	MAINTENANCE WORKSHOP-MACHINES	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	20 Tubes (32 Ounces each)	INCINERATION IN CONTROLLED OVEN
		109-16-0	POLYMETHYL DIMETHACRYLATE									
		868-77-9	2-HYDROXYETHYL METHACRYLATE									
		112945-52-5	SMOKED SILICE									
		114-83-0	1-ACETYL-2-PHENYLHYDRAZINE									
		98-82-8	CUMENE									
		79-41-4	METACRYLIC ACID									
		80-15-9	HYDROGEN PEROXIDE CUMENE									
KLEN	UNIDENTIFIED	111-76-2	BUTIL CELLOSOLVE	N/A	BIODEGRADABLE LIQUID	The associated health hazard is that its contact causes burns on the skin, nasal mucous membranes and eyes.	MAINTENANCE WORKSHOP	240 Litters/ month	2 plastic BARREL of 5 gal per month, washed and stored, for re-use.	WASHING THE AREA WITH PLEINTY OF WATER	2 containers (5 Gal each)	DILUTION WITH WATER IN WASTE WATER TANK
		6834-92-0	SODIUM METASILICATE									

Table 4.25 – Inventory and management of liquid materials, waste and residues from the Thermal Power Plant												
Material	**MARN regulated**	**CAS Number**	**Description**	**Amount allowed by MARN**	**Hazard**	**Hazard Characteristic**	**Site of Use**	**Estimated Release Amount**	**Estimated Amount of Containers**	**Internal Leakage Management**	**Estimated Amount Of Full Storage**	**Method Of Final Disposal**
SKIN	UNIDENTIFIED			N/A	BIODEGRADABLE LIQUID	The associated health hazard is that its contact causes burns on the skin, nasal mucous membranes and eyes.	MAINTENANCE WORKSHOP	48 Litters/ month	1 plastic BARREL of 5 gal per month, washed and stored, for re-use.	WASHING THE AREA WITH PLEINTY OF WATER	2 containers (5 Gal each)	DILUTION WITH WATER IN WASTE WATER TANK

Source: Wärtsilä 2014.

Table 4.26 – Inventory and management of solid materials, waste and residues from the Thermal Power Plant

MATERIAL	MARN regulated	Cas Number	Description	Waste Hazard	Hazard	Site OF Use	Estimated Release Amount Of The Waste	Estimated Amount Of Containers	Internal Leakage Management	Estimated Amount Of Storage On Site	Method Of Final Disposal
WIPES AND FILTERS WITH HYDROCARBONS	UNIDENTIFIED			INFLAMMABLE SOLID	The hydrocarbons are Eco-toxic, they can cause adverse effects in the aquatic environment	MAINTENANCE WORKSHOP-MACHINES	100 kg / month	NOT APPLY	COLLECTION IN RED BAGS AND CONTAINERS	200 Kg	INCINERATION IN CONTROLLED OVEN
FLUORESCENT TUBES	UNIDENTIFIED			MERCURY	Mercury is a heavy metal that is introduced into the food chain through the soil and affects human health.	ALL GENERATION PLANT	60 kg / year	NOT APPLY	COLLECTION OF COMPONENTS IN CARDBOARD BOX	50 units	RECOVERY OF THE COMPONENTS
BATTERIES	UNIDENTIFIED			LEAD	Lead is a heavy metal that is introduced into the food chain through the soil and affects human health.	LOW VOLTAGE SUBSTATION - OFFICES	20 kg / year	NOT APPLY unique equipment	RECOLECTION IN WOOD BOX	NOT APPLICABLE Use devices with rechargeable battery	RECOVERY OF THE COMPONENTS
PRINTING TAPES AND TONER	UNIDENTIFIED			COLORING INKS	It is a chemical that causes adverse effects in the aquatic environment and in the subsoil.	OFICINAS	20 kg / year	NOT APPLY unique equipment	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	NOT APPLICABLE - Based on demand	PLASTIC RECOVERY
BALLAS AND ELECTRONIC CARDS	UNIDENTIFIED			HEAVY METALS	Heavy metal are introduced into the food chain through the soil and affects human health.	MAINTENANCE WORKSHOP-MACHINES	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste.	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	Base on demand	RECOVERY OF HEAVY METALS
PLASTIC OIL AND FAT CONTAINERS	UNIDENTIFIED			FLAMMABLE SOLID	The hydrocarbons are Eco-toxic, they can cause adverse effects in the aquatic environment	MAINTENANCE WORKSHOP-MACHINES	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste	COLLECTING WITH WIPE	Approximately 20 Containers Between 2 Gal, 5 Gal and 55 Gal	INCINERATION IN CONTROLLED OVEN
FUMIGATION CONTAINERS	UNIDENTIFIED			PERMANENT ORGANIC COMPOUNDS	Persistent organic compounds are introduced into the food chain through soil and affect human health.	GENERATION PLANT	NONE-POSSIBLE LEAKAGE	The container is delivered to the supplier	COLLECTING WITH SAND OR EARTH	NOT APPLICABLE Supplier charge	RECOVERY OF RAW MATERIAL
PLASTIC CHEMICAL CONTAINERS	UNIDENTIFIED			SOLID WITH TOXIC LIQUID	The associated health hazard is that its contact causes burns on the skin, nasal mucous membranes and eyes	MAINTENANCE WORKSHOP-MACHINES	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	Approximately 40 Containers Between 2 Gal, 5 Gal and 55 Gal	DIRECT REUSE AS WORKSHOP CONTAINERS
LOCTITE SUPERFLEX RED	No	7631-86-9	SILICON DIOXIDE	TOXIC SILICONE	Irritating to eyes and skin. In addition, it has polymers that cause adverse effects on the aquatic environment	MAINTENANCE WORKSHOP-MACHINES	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	20 Tubes (32 Ounces each)	INCINERATION OF THE WIPE IN CONTROLLED OVEN
		64742-46-7	DISTILLATES (petroleum), HYDROTREATED MIDDLE								
		17689-77-9	TRIACETOXYETHYLSILANE								
		4253-34-3	METHYLSILANETRIYL TRIACETATE								

Table 4.26 – Inventory and management of solid materials, waste and residues from the Thermal Power Plant

MATERIAL	MARN regulated	Cas Number	Description	Waste Hazard	Hazard	Site OF Use	Estimated Release Amount Of The Waste	Estimated Amount Of Containers	Internal Leakage Management	Estimated Amount Of Storage On Site	Method Of Final Disposal
		64-19-7	ACETIC ACID								
LOCTITE SILVER GRADE	UNIDENTIFIED	6474-52-5	MINERAL OIL	USED GREASE	Irritating to eyes and skin. In addition, it has hydrocarbons that cause adverse effects in the aquatic environment	MAINTENANCE WORKSHOP-MACHINES	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste.	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	20 Tubes (32 Ounces each)	INCINERATION OF THE WIPE IN CONTROLLED OVEN
		7782-42-5	GRAPHITE								
		1305-78-8	CALCIUM OXIDE								
		7429-90-5	ALUMINIUM								
		64741-44-2	PETROLEUM DISTILLATE								
		8001-78-3	CASTOR IL, HYDROGENERATED								
		61789-97-7	TALLOW								
		14808-60-7	SILICA,QUARTZ								
LOCTITE SUPERFLEX CLEAR	UNIDENTIFIED	7631-86-9	SILICA, AMORPHOUS (fumed)	TOXIC SILICONE	Irritating to eyes and skin. In addition, it has polymers that cause adverse effects on the aquatic environment	MAINTENANCE WORKSHOP-MACHINES	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste.	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	20 Tubes (32 Ounces each)	INCINERATION OF THE WIPE IN CONTROLLED OVEN
		17689-77-9	ETHYLTRIACETOXYSILANE								
		4253-34-3	METHYLTRIACETOXYSILANE								
MOBILITH SHC 220	UNIDENTIFIED	94270-86-7	1H-BENZOTRIAZOLE-1-METHANAMINE,N,N-BIS(2-ETHYLYLHEXYL)-NETHYL-	USED GREASE	The hydrocarbons are Eco-toxic, they can cause adverse effects in the aquatic environment	BEARINGS UNIT DECENGER AIR VENTILATION	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste.	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	1 container (5 Gal)	INCINERATION OF THE WIPE IN CONTROLLED OVEN
		68411-46-1	BENZENAMINE, N-PHENYL-,REACTION PRODUCTS WITH 2,4,4-TRIMETHYLPENTENE								
		1310-66-3	LITHIUM HYDROXIDE MONOHYDRATE								
		Confidencial	LITHIUM SALT OF ALIPHATIC ACID								
		10254-57-6	METHYLENE BIS (DIBUTYLDITHIOCARBAMATE)								
		68649-42-3	ZINC DITHIOPHOSPHATE								
MOBILITH SHC 100	UNIDENTIFIED	68649-42-3	ZINC DITHIOPHOSPHATE	USED GREASE	The hydrocarbons are Eco-toxic, they can cause adverse effects in the aquatic environment	BEARINGS MOTOR PRELUBRICATION PUMP	NONE-POSSIBLE LEAKAGE	The container is discharged and sent with scrap	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	1 Container (5 Gal)	INCINERATION OF THE WIPE IN CONTROLLED OVEN
ACTIVATED CARBON	UNIDENTIFIED	7440-44-0	CARBON AMORPHOUS	SOLID WITH TOXIC LIQUID	The associated health hazard is that its contact causes burns on the skin, nasal mucous membranes and eyes.	OILY WATER TREATMENT SYSTEM	NONE-POSSIBLE LEAKAGE	The container is cleaned and sent with plastic waste.	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	NO APLICA - Con base en demanda	INCINERATION OF THE WIPE IN CONTROLLED OVEN

Table 4.26 – Inventory and management of solid materials, waste and residues from the Thermal Power Plant											
MATERIAL	**MARN regulated**	**Cas Number**	**Description**	**Waste Hazard**	**Hazard**	**Site OF Use**	**Estimated Release Amount Of The Waste**	**Estimated Amount Of Containers**	**Internal Leakage Management**	**Estimated Amount Of Storage On Site**	**Method Of Final Disposal**
SHELLALVANIA GREASE	UNIDENTIFIED	CLASSIFICATION TYPE 3: NON-HAZARDOUS PRODUCT. THE COMPONENTS OF THIS MIXTURE DO NOT IMPARATE HAZARDOUS PROPERTIES OF THE PRODUCT	LUBRICANT FAT CONTAINING HIGHLY REFINED MINERAL OILS AND ADDITIVES	USED GREASE	The hydrocarbons are Eco-toxic, they can cause adverse effects in the aquatic environment	BEARINGS MOTOR AIR STARTING	24 Litters / year	The container is cleaned and sent with plastic waste.	CONTAINING AND COLLECTING AND APPLICATION WITH WIPE	1 Container (5 Gal)	INCINERATION OF THE WIPE IN CONTROLLED OVEN

Source: Wärtsilä 2014.

Table 4.27 – Inventory and management of gas materials, waste and residues from the Thermal Power Plant

MATERIAL	MARN regulated	Cas Number	Description	Waste Hazard	Hazard	Site OF Use	Estimated Release Amount Of The Waste	Estimated Amount Of Containers	Internal Leakage Management	Estimated Amount Of Storage On Site	Method Of Final Disposal
NATURAL GAS	UNIDENTIFIED	74-82-8 74-84-0 74-98-6 106-97-8	METHANE ETANO PROPANE BUTANE	FLAMMABLE GAS	It is highly flammable and can form explosive mixtures with air. It can cause suffocation to personnel by displacement of oxygen.	MACHINE ROOM, REGISTRATION AREA	NONE-POSSIBLE LEAKAGE	NOT APPLICABLE-Pipeline transportation	CORRECT LEAKAGE, VENTILATION OF THE AREA AND REMOVAL OF SOURCES OF IGNITION.	NOT APPLICABLE - Based on demand	IF A LEAK: NATURAL OR FORCED AIR-VENTURE
SULFUR HEXAFLUORIDE (SF6)	UNIDENTIFIED	2551-62-4	SULFUR HEXAFLUORIDE	SUFFOCATING GAS	The danger associated with leaks from this gas is asphyxiation due to oxygen displacement.	SWITCHES IN MEDIUM VOLTAGE SUBSTATION	NONE-POSSIBLE LEAKAGE	NOT APPLICABLE – Unique equipment	CORRECT LEAKAGE, VENTILATION OF THE AREA AND REMOVAL OF SOURCES OF IGNITION.	NOT APPLICABLE - Based on demand	IF A LEAK: NATURAL OR FORCED AIR-VENTURE
OXYGEN	UNIDENTIFIED	7782-44-7	GAS	NON TOXIC GAS	The health hazard associated with gas leaks is dizziness, lightheadedness and loss of consciousness.	MAINTENANCE WORKSHOP	NONE-POSSIBLE LEAKAGE	NOT APPLICABLE-Compressed bottle transport	CORRECT LEAKAGE, VENTILATION OF THE AREA AND REMOVAL OF SOURCES OF IGNITION.	2 Bottles (50 Kg)	RECOVERY OF REMAINER IN NEW LOAD
ACETYLENE	UNIDENTIFIED	74-86-2	GAS	GAS INFLAMABLE	The health hazard associated with leaks from this gas is that at high pressures the vessels cause blows and suffocation.	MAINTENANCE WORKSHOP	NONE-POSSIBLE LEAKAGE	NOT APPLICABLE-Compressed bottle transport	CORRECT LEAKAGE, VENTILATION OF THE AREA AND REMOVAL OF SOURCES OF IGNITION..	2 Bottles (50 Kg)	RECOVERY OF REMAINER IN NEW LOAD
NITROGEN	UNIDENTIFIED	7727-37-9	GAS	FREEZING GAS	The danger associated with leaks from this liquefied gas is contact freezing.	MAINTENANCE WORKSHOP	NONE-POSSIBLE LEAKAGE	NOT APPLICABLE-Compressed bottle transport	CORRECT LEAKAGE, VENTILATION OF THE AREA.	NOT APPLICABLE - Based on demand	RECOVERY OF REMAINER IN NEW LOAD
HELIUM	UNIDENTIFIED	7440-59-7	GAS	SUFFOCATING GAS	The danger associated with leaks from this gas is asphyxiation due to oxygen displacement.	ANALYZER IN THE CITYGATE	NONE-POSSIBLE LEAKAGE	NOT APPLICABLE-Compressed bottle transport	CORRECT LEAKAGE, VENTILATION OF THE AREA.	NOT APPLICABLE - Based on demand	RECUPERACION DEL REMANENTE EN NUEVO CARGUE
R22 (REFRIGERANT GAS)	UNIDENTIFIED	75-45-6	CHLORODIFLUOMETHANE	GREEN HOUSE EFFECT GAS	The danger associated with leaks from this gas is that it affects the ozone layer.	AIR CONDITIONING SYSTEMS	NONE-POSSIBLE LEAKAGE	NOT APPLICABLE-Compressed bottle transport	CORRECT LEAKAGE, VENTILATION OF THE AREA.	NOT APPLICABLE - Based on demand	RECOVERY OF REMAINER IN NEW LOAD

Source: Wärtsilä 2014.

The main residues and waste in the FSRU are:

Materials:
Lubricating oil of the machinery
The hydraulic oil for the emergency generator, Hydraulic systems and actuators

Solid waste
The elements of filters, cartridges
Non-toxic spent absorbents
Waste maintenance form

Liquid waste
oil waste
oily water
sanitary waste, waste water.

Ordinary and Hazardous waste will be periodically sent to the plant on land for proper final disposal as described in the previous tables.

The design of the on-board FSRU and HSE management system will be such as to comply with IMO regulations, specially MARPOL.

Under MARPOL (International Convention for the Prevention of Pollution from Ships), a waste management plan has to be in place during operations in order to handle all types of food, household and operational waste including chemical waste. Monitoring the proper execution of this plan is guaranteed by the correct maintenance of the Garbage Record Book that will record the collection, processing, storage and disposal of the garbage.

As in the Waste Log book, a Hydrocarbon Log Book will also be maintained to handle any oil / water sludge in the engine room according to the MARPOL requirement.

The FSRU will be provided with a wastewater treatment unit with 14 days of wastewater storage. The treated water will comply with the wastewater discharge standard of El Salvador, prior to its discharge into the ocean.

4.11.1 Oil Storage and Containment Structures

Lubricating oil and sludge tanks will have protective berms sized for a volume 10% greater than the larger tank volume within the enclosure. The floor of the containment berms will be waterproofed.

The foundations of the tank will be made of rings of reinforced concrete beams, in strips at the base, alternated with a load bearing slab on them. The tanks shall be installed within the containment area. To prevent contamination, the compact polished concrete earthenware will be installed.

The containment area will slope to an open concrete trench to collect rainwater. For the containment of a possible spill, water and hydrocarbon valves will be installed at the exit of the trench and will be operated manually. Rainwater is driven into the rainwater system by opening the rainwater valve. Water with possible oil content will be carried by opening the oil water valve to the separator and the sludge tank.

4.11.2 Wastewater management

In the Thermal Power Plant the following waste water is produced:

- Reject water from the drinking water treatment plant.
- Domestic wastewater from bathrooms and kitchens.
- Water with possible content of oils: of workshops, berms of tank containment and washing of boilers; the latter is done twice a year.
- Boiler purge water.

Reject water from the rainwater treatment plant will be discharged directly. This water will comply with the parameters established in the wastewater standard.

The wash water of the boilers contains a mixture of ash, hydrocarbon residues and water. The ash content depends on the fuel used. The purge water will be neutralized in a wash water collection tank prior to being pumped to the oily water treatment system.

The water from the boiler purge is expected to meet the parameters of the Salvadoran standard. The parameters that could be elevated are the phosphates and the iron, related to the control of the corrosion. In a well maintained plant the parameters are met.

The treatment that will be given to water with possible content of oils and domestic wastewater is described below.

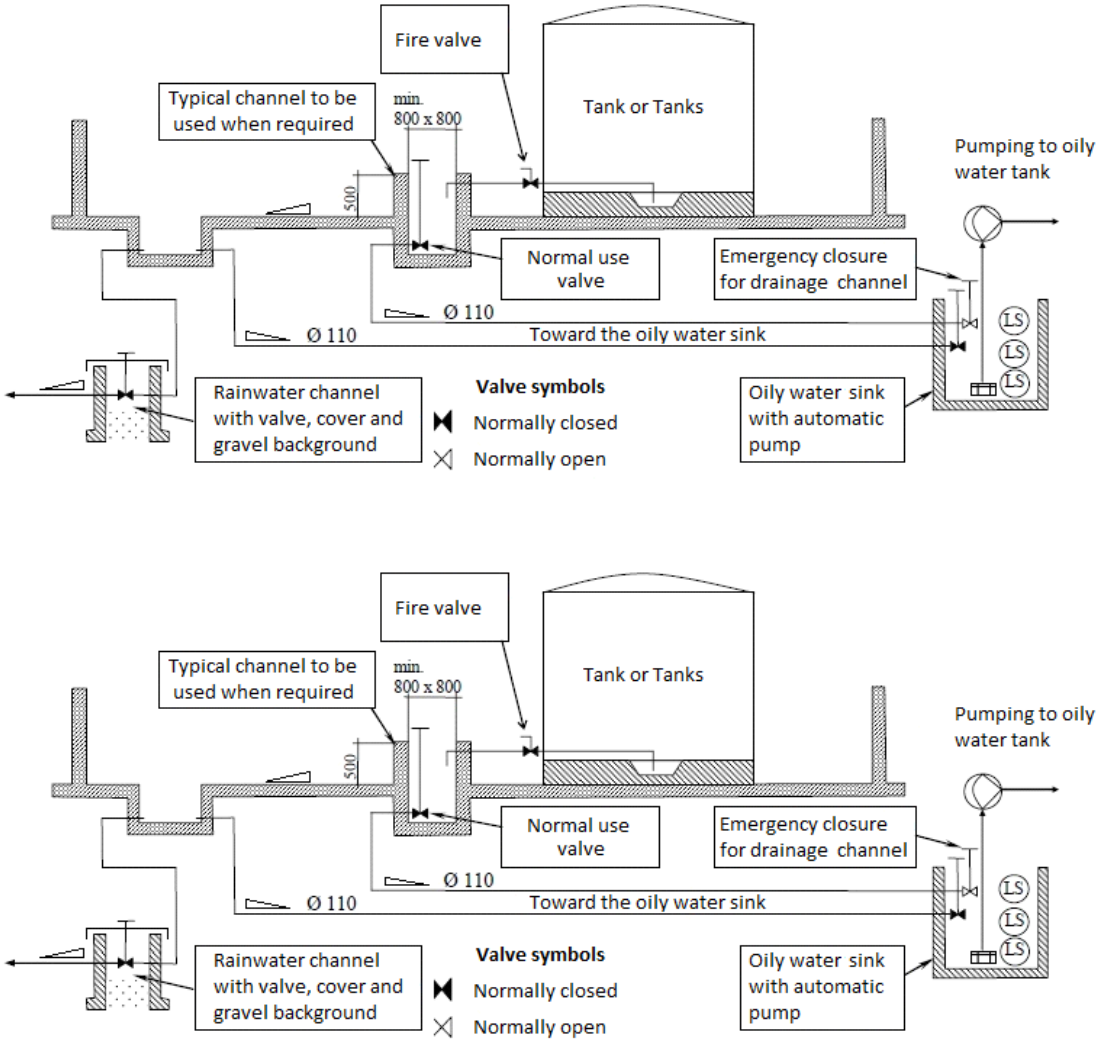
4.11.3 Handling and Treatment of Oily Waters

All tanks with oil content will have a drainage system. The main purpose is to perform the collection of water and cleaning of the tank areas, resulting in a lower risk of rainwater contamination.

The typical problem in drainage designs has been that oily water from the bottom of the fuel oil tank containment area (or other hydrocarbon) has also entered the area from which the rainwater is collected. During a very strong storm, the water can flood a drainage channel too low and result in oily water spreading over the area. This is the reason why the drainage channels are designed with walls half a meter high.

The main scheme is shown in Figure 4.44 below.

Figure 4.44 – Scheme of oily water treatment system



Source Wärtsila 2016

The philosophy and the most important rules that prevent spills are the following.

- Normally closed valves must only be opened under supervision.

- All tanks containing hydrocarbons (oily water, sludge, lubricating oil, fuel, etc.) will have an equivalent drainage system. The nearby tanks will use the same drainage channel. If

funnels are used after the drain valves (in small tank rows, for example) they will connect with a pipe to the common drain channel of the tank.

- Drainage channels will be constructed with walls about 0.5 meters high to keep pure rainwater and oily waters separate. Rain that falls directly into the drainage channel (in smaller amounts) will be brought to the oily water collector. The minimum area of the bottom of the channel will be 800 x 800 mm to maintain valves and the channel. The drain channel valve will be equipped with an extension arm for easy operation.

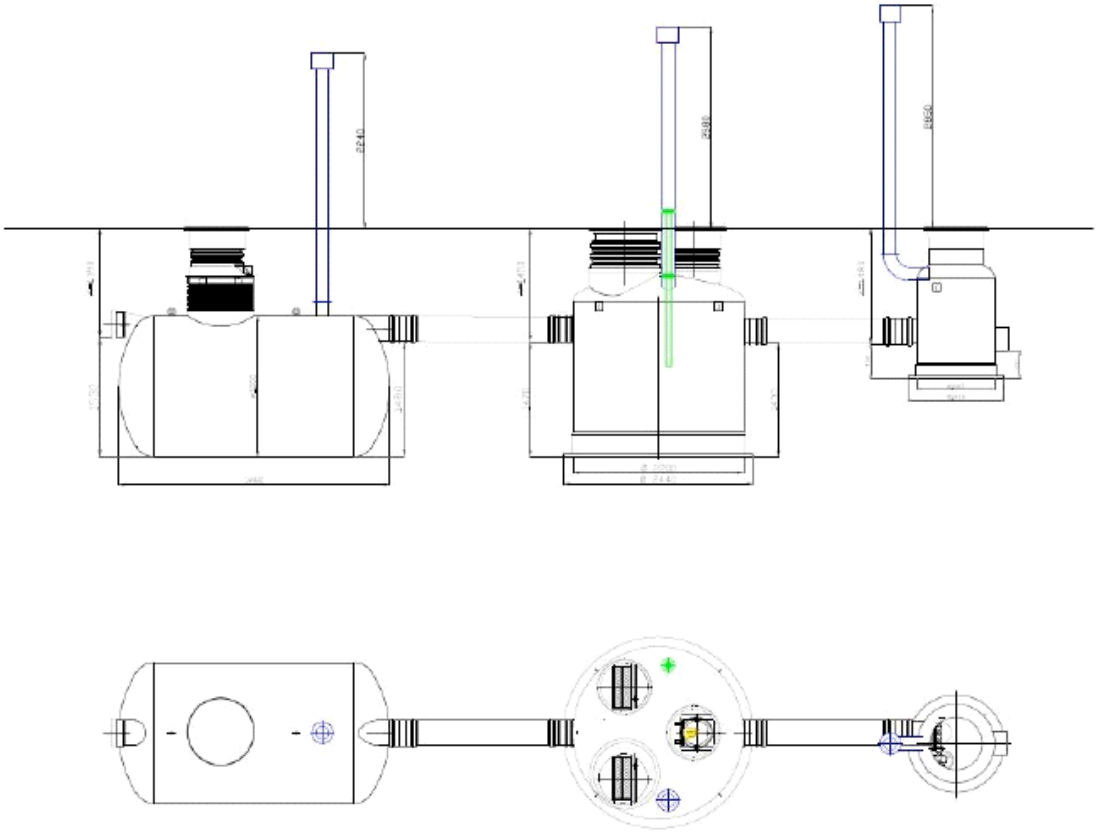
- All drain lines will normally be closed to prevent oil dripping out of the area in case the tank spills. The pipelines of the drainage channel of the tank and those of the rainwater channel will be separated to avoid direct spillage of the tank to the rainwater system.

The oily water management system will be responsible for collecting the oily waters and sludge produced in the plant to be stored in a tank for future disposal and transportation. The sludge will be delivered to a company that has environmental permission for its final provisions and withdrawals outside the plant.

Water separator systems will be used to drain the water that could have contact with the oils of the equipment.

Figure 4.45 shows the treatment system for rainwater potentially contaminated with oil. Rainwater passes through the sand trap where the particles settle. When they leave, the sand trap the water is taken to the oil trap where the oil content is separated with the help of a coalesce, which separates the oil from the water, the system also includes a sampling vessel from where the samples of the treated water can be taken.

Figure 4.45 – water-oil separator (oil pit)



Source Wärtsila 2016

During plant operation, potentially contaminated rainwater from oil will pass through the oil trap to prevent contamination. In general, contaminated cleaning water from the following areas will also be treated:

- Machines House;
- Fourth switch;
- Turbines;
- Heat recovery boilers;
- Fireplace;
- Water boiler washing;
- Heat recovery system;
- Building of compressed air; and
- Outdoor Tanks.

4.11.4 Transformer Containment

The foundations of the transformers will be made of reinforced concrete, with a containment area equivalent to 110% of the volume of oil in the transformer. The concrete slab will be covered with thick gravel supported with a concrete mesh or perforated concrete sheet.

For the management of a possible spill, there will also be two valves, one for water and one for oils, handled manually. The whole area of transformers will be surrounded.

4.11.5 Domestic Wastewater Treatment System

A treatment plant will be installed for wastewater from employees, cafeteria and cleaning, to treat the water prior to discharge and comply with the quality standard of waste water discharged to a receiving body.

The monitoring and monitoring of the plant is presented in section 10.1.24. The water to be discharged will comply with the Standard of "WASTEWATER DISCHARGE TO SURFACE WATER".

The treated effluent will be discharged to the CEPA drainage channel at the south-west corner of the site. The sludge from the domestic wastewater treatment plant will be sun dried and used as fertilizer in the green areas of the plant.

A SBR "Sequencing Batch Reactor" process system will be installed. This process is divided into the following stages:

During the initial loading phase (sludge damping and storage) the solids (sludge) settle and the slurry water from the upper layer is transferred to the second stage of the treatment (the bioreactor).

The draining water is aerated inside the bioreactor with fine bubbles of oxygen and this causes the microorganisms that consume the nutrients to increase. This can be seen in the aeration phase.

After aeration, which lasts for a relatively long time, there is a rest phase inside the bioreactor. During this phase the water rests completely and the rest of the sludge is set in the bottom of the tank and a zone of clear water is created.

The clear water is extracted for disinfection with Ultraviolet light, which kills E.Coli bacteria. The seated sludge returns from the bioreactor to "Cushioning and sludge storage". After this the cycle starts again from the beginning.

Figure 4.46 shows the different phases of the SBR process. In the proposed plant the operation is the same, but may be different tanks or cameras.

Figure 4.46 – Wastewater Treatment System

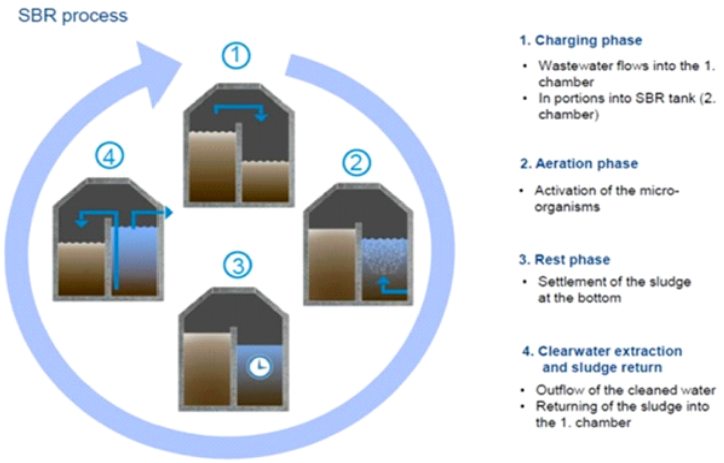


Figure 1 The different stages of the SBR process.

Source Wärtsila 2016

The monitoring and monitoring of the plant is presented in section 10.1.24. The water to be discharged will comply with the standard "WASTEWATER DISCHARGE TO SURFACE WATER".

4.12 Consumption of The Water Resource

4.12.1 Project Water Demand

The facilities of the Thermal Power Plant will operate in an approximate area of 126,431.09 m² and consists of areas for industrial use, which will use water as raw material, that why the demands have been calculated based on the use of water from a well to be drilled, for irrigation of green areas, work of cleaning in the facilities of the Thermal Plant, human consumption, for industrial use and firefight system. In Table 4.28 and Figure 4.47, the maximum water demands are described for each activity expected to be installed in the Thermal Plant.

Table 4.28 – Thermal Power Plant Water Demand			
Description	**Water demand (m^3/h)**	**Water demand (m^3/d)**	**Average flow (l/s)**
Reject water of treatment system	7.83	187.92	2.18
Cooling system maintenance	0.07	1.68	0.02
Water for employees	0.21	5.04	0.06
Workshops	0.07	1.68	0.02
Turbo wash	0.00	0.05	0.00
Boiler washing	0.04	0.96	0.01
Steam loss	0.75	18.00	0.21
Boiler Purging	4.53	108.72	1.26
TOTAL	13.50	324.05	3.75
Reuse of water for irrigation (Reject water of treatment system)	4.90	117.60	1.36
FOR 20 HOURS OF PUMPING	16.20	388.86	4.50

Source: Wärtsilä 2016.

Water consumption has been estimated based on maximum output. The average daily water demand of the Project is 3.75 L / s (13.50 GPM), equivalent to 324.05 m3 / d.

The water pumping rate (20 hours per day) to cover the demand of the project is obtained by multiplying the average daily flow rate by the factor 1.2, resulting in the following result:

Qmd = 324.05 x 1.2 = 388.86

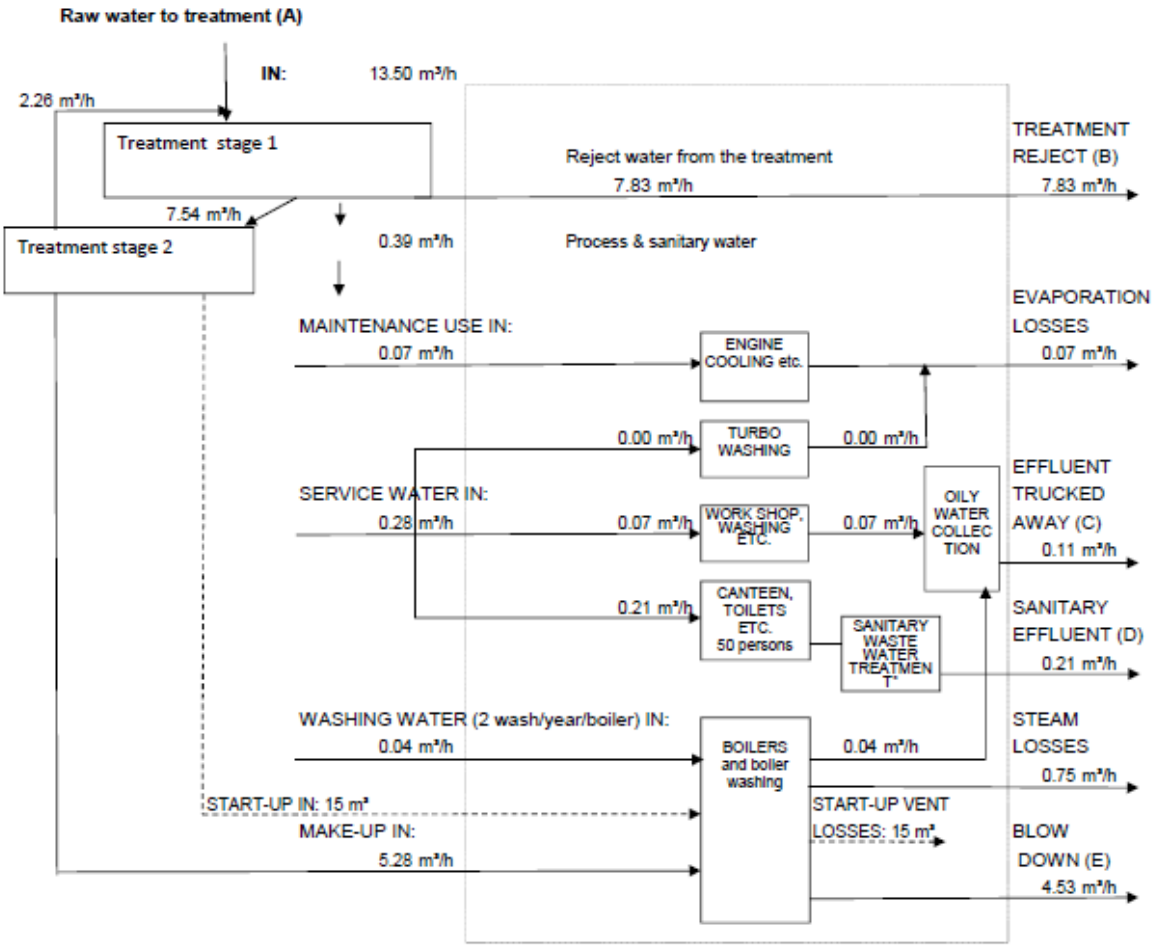
As a result, there is a pump flow rate of4.5 L/s (16.20 GPM), equivalent to 388.86 m3/d.

In the study area, wells of variable production are observed, from 1.26 to 66.24 L / s, depending on their depth, so it is feasible to obtain this flow through the drilling of a deep well in the zone of maximum production of the aquifer.

The flow approved in a letter of non-affectation dated June 2, 2015 is sufficient to cover the projected demand. (See Appendix 4J).

The technical information of the cooling system that supports the projected water consumption is given in Appendix 4K.

Figure 4.47 – Water Demand of the Thermal Power Plant



Source: Wärtsilä 2016

The systems will have the following amount of water in recirculation:
Cooling System (Radiators and Pipes): 270m3;
Water tank treated: 300m3; And
Boiler water tank: 200m3.

In Appendix 5I, the hydrogeological study is included, which evaluates the feasibility of wellbore supply, being feasible the exploitation.

4.12.2 Supply Source

To cover the water demands of the Project, several wells will be drilled within the project area to be developed, as detailed:

- Operation well
- Back-up well
- Monitoring wells (2) –

The characteristics and location of the same are described below.

- Production well
- Construction of a well that should have the following drilling characteristics:
- Location X = -89.827450 --- W and Y = 13.582900 ---- N
- Total Depth: 120 meters.
- Perforation Diameter: 12 inches.
- Coating Diameter: 8 inches
- Static level likely: 25 to 30 meters.
- The location of the recommended site for well drilling is shown in Map No. 8 (Alternatives Map).

- Backup well:
- Consideration has been given to the construction of a backup well, which will be drilled next to the production well, which will only operate when the main well is being maintained.
- The backup well should have the same characteristics as the production well:
- Location = -89.82745 --- W and Y = 13.58290 ---- N, are the same coordinates, but should be between 6 and 12 m apart, preferably to the northeast.
- Total Depth: 120 meters.
- Perforation Diameter: 12 inches.
- Coating Diameter: 8 inches
- Static level likely: 25 to 30 meters.
- Grid length: 1/3 of the wet thickness, approximately 30 m.
- Location: 14 m southwest of the production well (See Figure 4.4).

In alignment with the NFPA 850 guide that deals with the necessary flow to fill the fire water tank, in case of fire the production well will be used. According to the characteristics of the aquifer it is possible to extract a flow of 20.5 L/s from the proposed location, as it would only work for one

day, in case of fire, it does not affect at all the neighboring wells, it can be considered that catch zone it would only extend a few meters.

4.12.3 Water Storage

For the water storage, it will have a tank that will store the water from the process, from common uses and from the firefight system. The tank will be of 15 m of diameter, with capacity for 1,500 m3 and house for pumps of the firefight system.

4.12.4 Well and Aquifer Monitoring

For monitoring the well and the aquifer a 2 " water meter of flange and standard multi-jet pressure will be installed. It will keep a daily record of the well exploitation.

To do a continuous monitoring and verify that there is no risk of saline intrusion in the aquifer, it is proposed to construct two monitoring wells. The chemical change in water will be reflected by an increase in the value of Electrical Conductivity, Total Dissolved Solids and Temperature.

The wells will be drilled in the following coordinates (possible):

- Monitoring well N° 1 N 273,459.55 and E 410,261.13
- Monitoring well N° 2 N 273,809.29 and E 410,558.48

The characteristics of each drilling well are as follows:
Total Depth: 100 meters;
Perforation Diameter: 10 inches;
Coating Diameter: 6 inches; and
Static level likely: 25 to 30 meters.

Both wells will have daily recording equipment of Static Level (piezometric tube), Temperature, Conductivity and Total Solids Dissolved, known in the market as DATA LOGGER.

4.12.5 Water Quality

To update the information on groundwater quality in the study area, a recent sampling campaign was carried out on drilled wells in the Acajutla area. They were sampled DUKE ENERGY wells (2, 6, and 7) and CEPA well No. 1. In Acajutla, they were the only companies that agreed to conduct water sampling in their wells.

The hydrogeological study in Appendix 5I and 5J includes the complete analysis of the above-mentioned samples, the results of which are discussed below.

The analysis of the electro-neutrality indicates that the error of analysis in the samples obtained on July 9, 2014, oscillates between 9.5% and 17.4%, it is recommended that the results are below 15%, but all samples were analyzed, because their numbers are very limited.

The samples with the lowest ionic balance error are samples from DUKE N ° 6 and DUKE N ° 7, with values of 9.51% and 11.1%, respectively. Samples from DISAGRO No. 1 and DISAGRO No. 3, obtained on March 16, 2012, are 23.1% and 15.5% respectively.

The Piper, Stiff and Schoeller charts of the 4 recent samples and the 2 samples of DISAGRO, from year 2012, they are in the hydrogeological study. In Stiff's graphs, it can be seen that the closer the sea is to the water source, the more mineral-filled it is, as is the case with DISAGRO wells. The DUKE No. 2 well, on the other hand, being farther away, is the one whose waters present less mineralization.

Also, Piper's graph shows that the wells of DISAGRO have a very different chemical nature than the other wells analyzed. The same can be seen in the Schoeller diagram.

4.12.6 Drinking Water Treatment System

Water from the well will be stored in the tank, before being treated. The water will receive a first treatment to make it suitable for the basic processes: water for radiators, replacement of the steam system and for the auxiliary boiler.

The treated water of the first treatment (process water) will be stored in a tank of 200 m2 of vertical capacity, with its floodgates, level indicators, valves, switches, alarms, ladders, etc. The tank will be constructed of anti-corrosion material to prevent particles from entering the system.

There will be two modules of the water treatment system will consist of:

- Capacity 8 m3;
- 2 sand filters;
- 2 smoothing units (NaCl tanks);
- Safety cartridge with 5 micron mesh;
- High pressure centrifugal pump;
- A reverse osmosis system train;
- Chemical cleaning tank; And

- Control panel, pipes and valves.

The treated water from the first treatment is expected to have the following characteristics:

- PH at 21 ° C: 6-8;
- Dissolved solids total: <100mg / l;
- Total hardness Ca2 + + Mg2 + <0.2 ° dH;
- Silicates as SiO 2: <10mg / l;
- Iron Fe; and
- Suspended solids <0.5mg / l.

Part of the water from the first treatment will go to a second treatment in a reverse osmosis system, and then stored in a 100m3 tank. Water to produce steam in the combined cycle system will come from this tank.

4.12.7 Demineralizing Plant

The water demineralizer plant is designed for demineralization of treated water to be used in heat recovery boilers. The treated water must comply with the following characteristics:

- PH: 6-7;
- Conductivity: <1 mS / m;
- TDS: <5 mg / l;
- Total hardness: <0.01 dH;
- Alk. (HCO3): <1 mg / l;
- Fe + Cu: <0.02 mg / l;
- Silica SiO2: <0.1 mg / l;
- Chloride Cl: <1 mg / l; And
- Na + K: <2 mg / l.

The following chemicals will be used for water treatment:

- Amine 8030 A: 2 g / t; and
- KK-830: 3 g / t.

4.12.8 FSU/FSRU Fresh Water Consumption

On board the FSU and FSRU, a fresh water generator of approximately 45 ton / day is provided for personnel requirements and for engine boilers. In the FSRU and FSU will generate 6 t / day of fresh water for the needs of personnel.

4.12.9 Consumption of the Water Resource Construction Stage

During the construction phase, temporary water storage tanks will be used, which will be filled with water from the well, without exceeding the pumping rate, which is 4.5 L / s (for 20 hours of pumping)

If more water is required to be pumped, it will be supplied by tanker trucks, which come from sites authorized by ANDA and MARN.

Water uses during construction include:

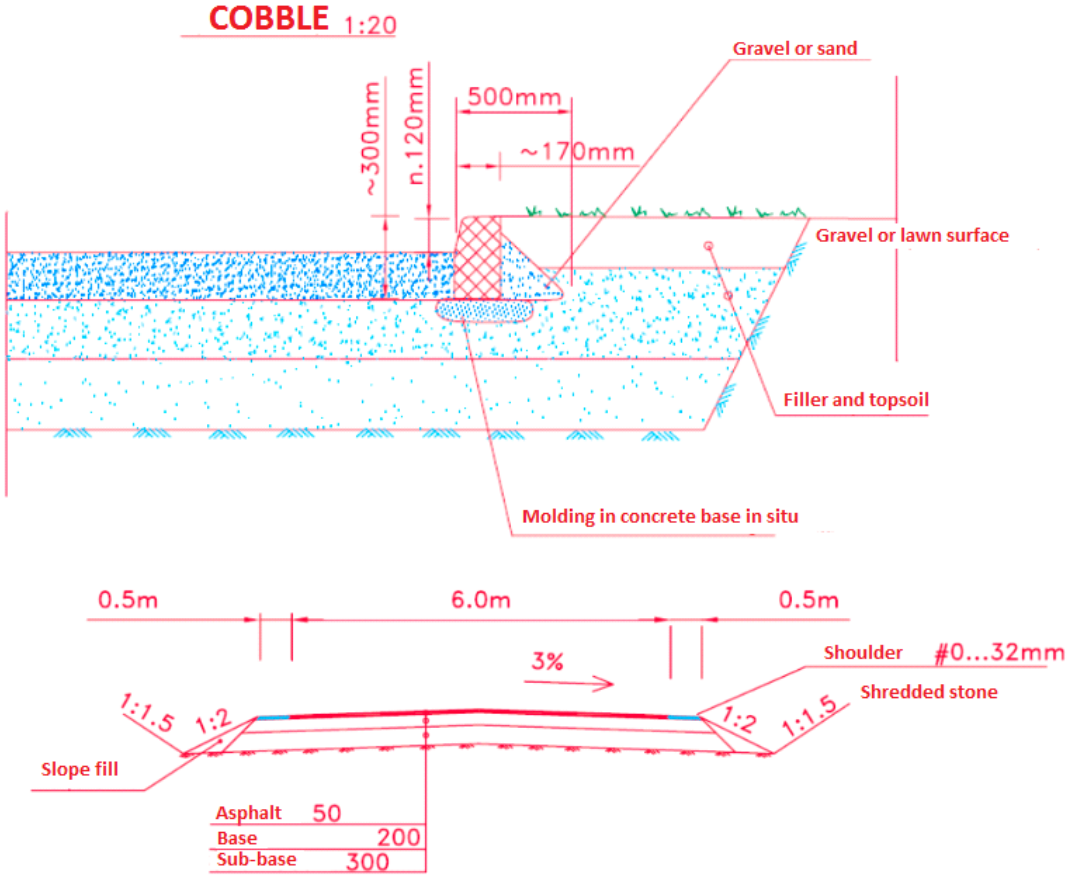
- Domestic consumption of employees, for washing and cafeteria. Human consumption will be supplied by bottled water and portable toilets will be used without water consumption.
- Consumption for the elaboration of concretes and mixtures of cement. For casting large volumes of concrete, this will be supplied to the premixed project.
- Cleaning of work areas.
- Irrigation for dust control during dry season landfill.
- Irrigation of green areas that are adapting.

4.12.10 Storm Drain

The Drainage System will consist primarily of open, concrete, rip-rap, or grass lining. Water from streets and other areas with impermeable pavement will be channeled out through open gutters or pipes, and gutter boxes.

Ditches around the engine room and workshops will be used for visual reasons and to channel drainage. See Figure 4.48.

Figure 4.48 – Arrangement of ditches and typical drainage system in streets



Source: Wärtsilä 2014

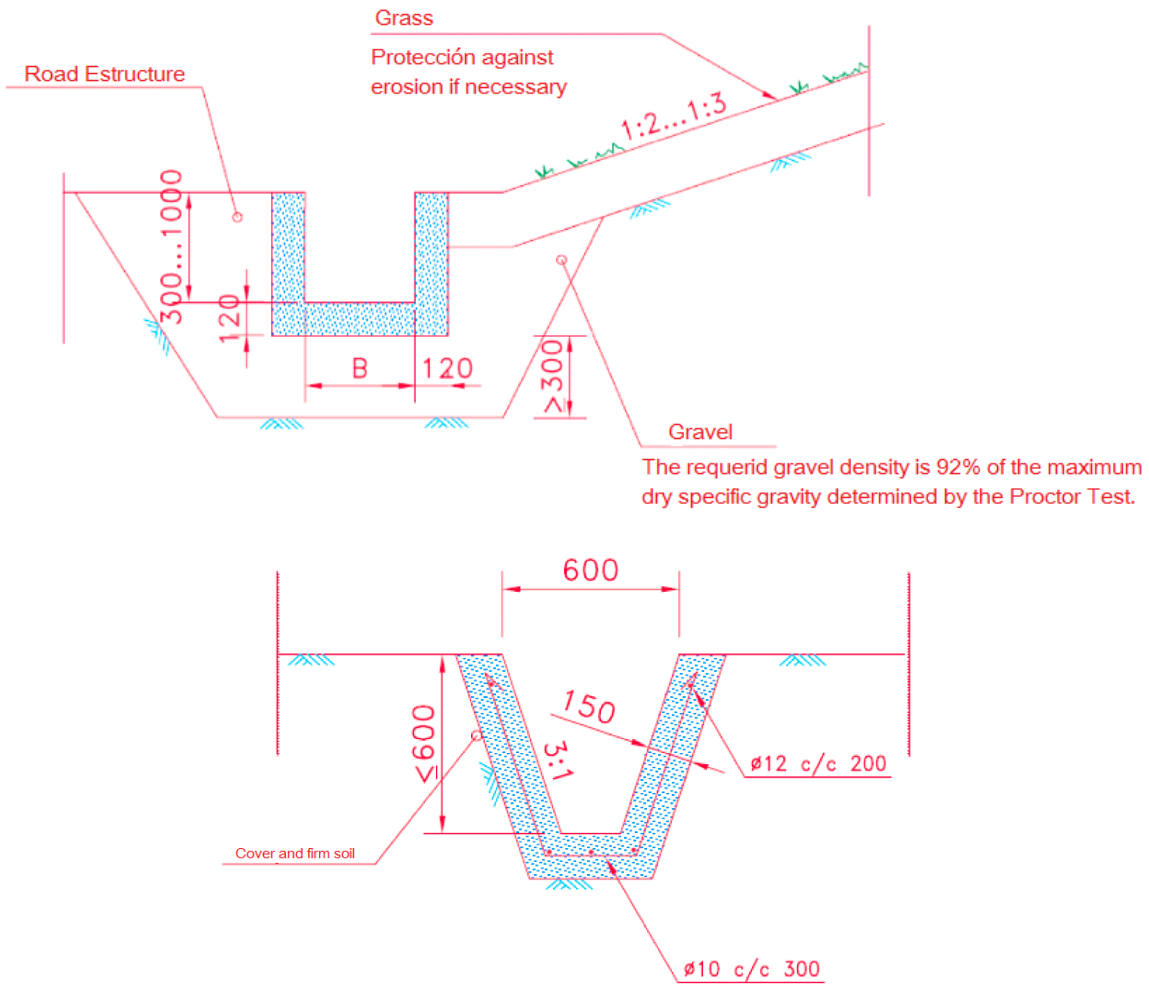
Works to channel water include:

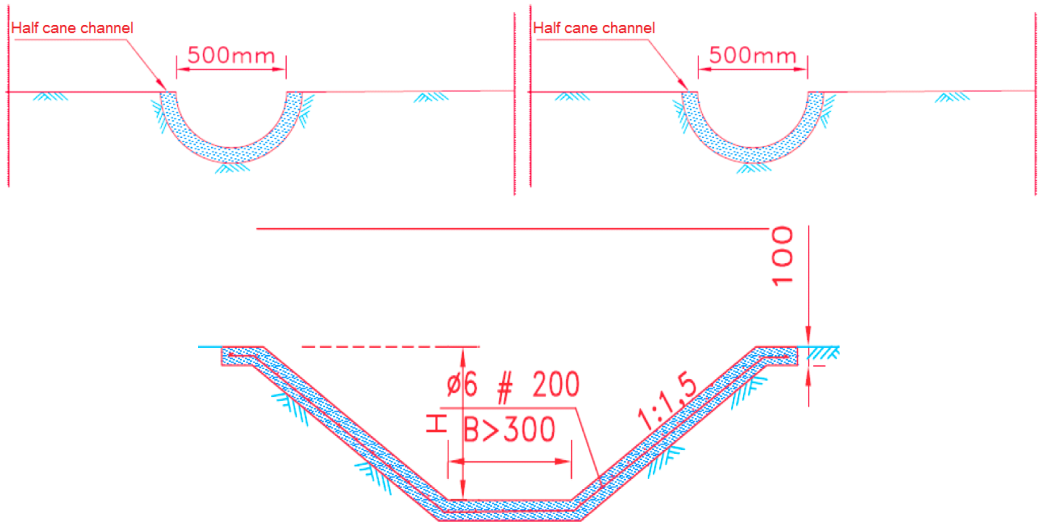
Trenches: Trapezoidal trenches will be used around the whole terrain (drawing in mm). The concrete will have a thickness of at least 5 cm with slopes from 0.5% to 1.0%. They will have a maximum depth of 1 m and a maximum width of 3m.

Half cane channels: Around the engine room and other buildings rectangular or half-cane drains will be used. The concrete will have a thickness of 11 to 15 cm, with reinforced steel. The drains will have a minimum slope of 0.5% and maximum of 3%. The depth will be between 30cm and 1m; and the width between 0.3cm and 1.2m. A concrete deck or metal grill will be used where people or vehicles pass. If drainage passes below streets, an underground pipeline will be used.

The ceilings will be drained through pipes and boxes to the aforementioned drains. See Figure 4.49.

Figure 4.49 – Typical Drain Details





Source: Wärtsilä 2014

Drains in tank areas: Rainwater areas of tank containment berms will be channeled to the water and oil separator and to the pond for oily water control.

4.12.11 Zero Hydrological Impact

In order to reduce the hydrological impact caused by the generation of flows in the project area, detention works will be constructed with the capacity to store the additional volume to the conditions without project.

The calculated flow rate for the projected terrain generated by the maximum rainfall intensity, 0.17mm / min, for a 100 years return period is 179L / s. The storm duration used is 24 hours. It was used for the design storm with return period of 100 years, according to United States regulations, at the request of the project owner.

Within the project area, a total flow of 210L / s with project is generated. The difference in flows between the conditions with and without project is 0.033m3 / sec for the substation area, and 0.16m3 / sec for the rest of the terrain. The maximum daily rainfall data used in this study correspond to the rainfall station Acajutla, are from the period 1971-2011 (41 years). No more recent data; However, the period analyzed includes catastrophic weather events, such as IDA (2009), AGHATA (2010) and 12E (2011).

Two detention ponds consisting of a lagoon and a pumping system are proposed, since the point of discharge is at an upper level, in the channel of CEPA, on the Boulevard Colonel Oscar Osorio.

The retention pond for the rest of the land without the electrical substation will have minimum dimensions of 24 x 60 meters in the base and 1.8 meters in height, having a capacity of 2,544.48 m3. The emptying time of the tank will be double filling, so that the criterion of zero hydrological impact is fulfilled.

The retention pond for the substation, will have dimensions of 15 x 10 meters of base and 1.8 meters of height, with capacity for 267.84m3.

The recommended pumping equipment is of submersible type, since it will be submerged inside the pond, Due to the low flow rate and the small hydraulic load that must overcome, a required power of 1.1 HP has been estimated, data to be confirmed in the final design stage. The water will be evacuated in 48 hours.

A solid trap will be installed in the entrance of the rainwater to the holding ponds, in order to prevent large solids from damaging the pump, it is recommended to use a submersible pump for wastewater, since these have the capacity to handle solid particles up to 2 inches in diameter.

The ponds will be periodically inspected to verify that there are no obstructions or excessive sedimentation in the pond. The inspection should be daily in the rainy season, and should be cleaned or removed and sediments when necessary.

4.13 Test Protocol

All components will be tested as required according to the standards and / or requirements and manufacturer's standards. A comprehensive test program will be prepared for the teams. Inspection reports or certificates will be presented according to the manufacturer's standard.

Below we present the protocol of environmental performance tests to be carried out for the verification of the operation of the technology for the thermoelectric generation proposed in the Project, as well as the systems to prevent and control the potential emission of pollutants, in a way that allows to evaluate low Controlled conditions, with the presence of representatives of the Ministry of Environment and Natural Resources, compliance with the maximum values allowed in the legal system, for the discharge of discharges and emissions, whether liquid, solid or gaseous. The tests will be carried out to obtain the ENVIRONMENTAL OPERATION PERMIT of the project.

The parameters to be monitored prior to commissioning include:

- Atmospheric emissions;

- Ambient air quality;
- Special waste water;
- Ordinary wastewater;
- Meteorology; and
- Tightness of NG transport pipelines

4.13.1 LNG Sampling

The protocol of these tests will be submitted to the approval of the MARN, whose personnel will be invited to witness their execution (see Table 4.29).

Table 4.29 – LNG Composition Testing	
Sampling site:	LNG
Parameters:	LNG Composition
Methods to be used:	Gas chromatography
Number of Tests:	One, the first LNG load received
Duration of sampling:	Simple sampling
Composition to comply (not applicable standard):	The supplied LNG will comply with the following specification (the "Specification", according to the supply agreement: Composition of hydrocarbons and Nitrogen content within the following range: Methane: 85.00 mol% minimum Ethane: 15.00 mol% max Propane: 5.00 mol% maximum Butanes: 2.50 mol% maximum Pentanes and heavier: 0.25 mol% maximum Nitrogen: 1.0 mol% maximum Impurities within the following range: Hydrogen Sulfide: 6.0 mg / SCM max Total sulfur: 30.0 mg / SCM max Mercury: 50.0 ng /SCM max

Source: Own elaboration

4.13.2 Well Water Monitoring

The protocol of these tests will be submitted to the approval of the MARN, whose personnel will be invited to witness their execution (see).

Table 4.30 – Well Exploitation Record	
Sampling site:	Water well
Parameters:	Volume extracted daily (day)
Methods to be used	Flow meter
Number of Tests	30 measurements (1 month for test protocol report), monitoring will be continuous during operations.
Duration of sampling:	Simple sampling
Extraction flow (not applicable):	4.5 l / s extraction (for 20 hours of pumping)

Source: Own elaboration

4.13.3 Atmospheric Emissions

Atmospheric emissions of combustion gases will be measured after the start-up of the engines. Sampling will be carried out by an independent laboratory selected by EDP and authorized by MARN. MARN staff will be invited to witness its execution.

Methods of measurement shall be US EPA reference methods and ASTM methods. The air emissions program is summarized in the following.
For the stack it is detailed:

Table 4.31 – Summary of Air Ambient Quality Program (Atmospheric Emissions) Acceptance Testing	
Sampling Site:	5-engine stacks
Parameters:	NOX; PTS; O2; CO; CO2; Gas flow; composition; Energy Production (MW)
Methods to be used:	NOx: US EPA Method 7, 7C, or 7E
	PTS *: US EPA Method 17E the EPA 201A
	O2: US EPA Method 3A or 3B
	CO2 emissions will be calculated based on the fuel analysis and the measured O2; Alternatively EPA Methods 3A or 3B may be used.
	Flow of gases: US EPA Method 2
	Humidity of gases: US EPA Method 4
	Fuel consumption: Load measurement

Table 4.31 – Summary of Air Ambient Quality Program (Atmospheric Emissions) Acceptance Testing	
Number of tests:	3 runs for each parameter
Sampling duration:	≥1 hour to ≥90% maximum continuous load
Standard to be fulfilled:	IFC Guidelines, 2007.

*Note: PTS: Total suspended particles

Source: Own elaboration ECO/DILLON

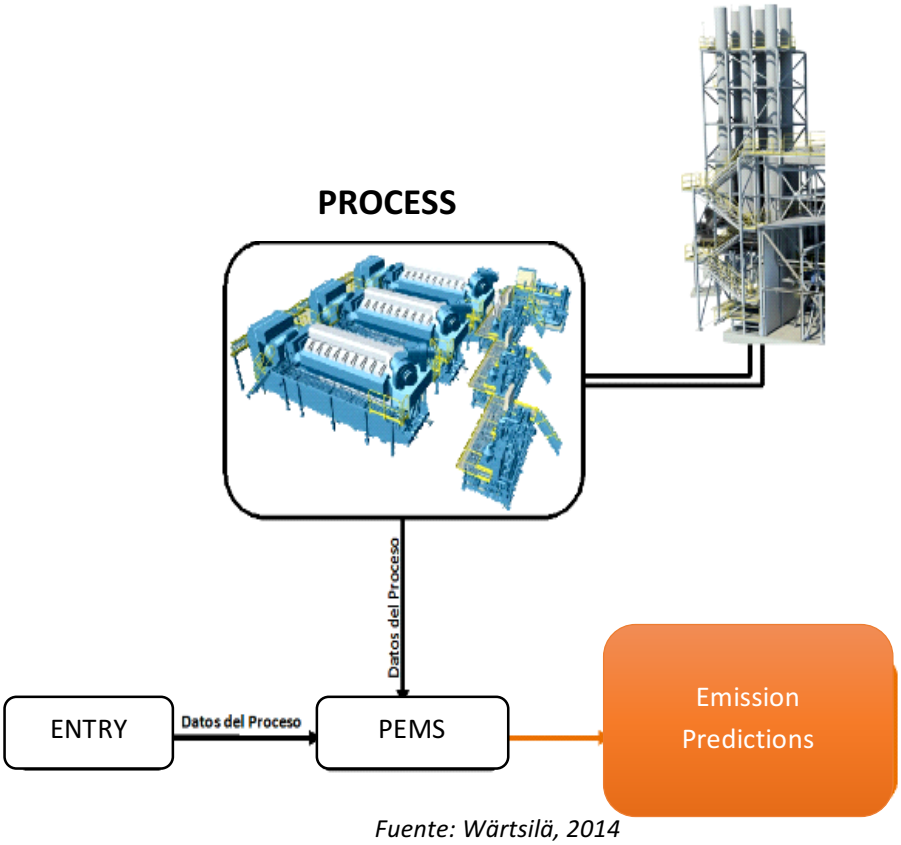
The detailed procedure for the atmospheric emissions test is included in Appendix 4L.

4.13.4 System Stop Mechanism in case of Detecting Non-Favorable Discharge Conditions

Since NOx is the main pollutant produced in the combustion of natural gas, the NOx gas detector allows the reading of the NOx levels in the chimney in real time, so when detecting non-standard levels during the tests will proceed with the Stop the system.

In addition, an PREDICTION EMISSION MONITORING SYSTEM (PEM) will be installed. These systems calculate emissions using models that use real data of different parameters, use robust instrumentation and can be verified by reference measurements. These systems have been tested in the United States and are used in more than one hundred facilities worldwide to report emissions. The USEPA No. 16 standard gives the requirements for this equipment. See Figure 4.50.

Figure 4.50 – Operating Scheme of Emissions Prediction Monitoring System



Fuente: Wärtsilä, 2014

4.13.5 Ambient Air Quality

The ambient air quality will be measured after the startup of the equipment. Sampling will be carried out by a laboratory selected by EDP. MARN staff will be invited to witness its execution.

Methods of measurement shall be US EPA reference methods and ASTM methods. The program of atmospheric emissions is summarized in the.

For ambient air details:

Table 4.32 – Summary of Air Ambient Quality Program (Atmospheric Inmissions)	
Sampling Site:	A point in the critical area determined in the dispersion modeling.
Parameters:	NOx; During the test period, calorific value, fuel consumption, energy production (MW)
Methods to be used:	Continuous measurement electrochemical continuous analyzer equipment to be acquired by the company like the one used for the baseline
Number of tests:	Number of tests: Continuous
Sampling duration:	20 continuous sampling days
Standard to be complied:	Standard to be complied with NSO 13.11.01: 01, table 1 Nitrogen dioxide: 150 µg / Nm3 for 24 hours.

Fuente: Elaboración propia ECO/DILLON con información Wärtsilä.

The results will be commented with the meteorological data obtained from the meteorological station to be installed.

4.13.6 Meteorology

A permanent meteorological station will be operated and maintained, with the purpose of:
Facilitate the interpretation of NO2 and PST monitoring data;
Evaluate air quality events (eg, possible odor observations); and
Build a local database for a more accurate application of dispersion models.

A meteorological station will be installed, to register the following parameters:
Wind direction (degrees, from the north = 0, from the east = 90);
Wind speed (m / s);
Relative Humidity (%, calculated dew point °C);
Temperature (°C);
Rain (mm total, mm / h); and
Solar radiation (W / m^2, currently not working).

The wind sensors will be located to comply with the following guidelines:

The standard height is 9-10 m on flat ground without obstacles;
Maintain a distance ≥10 times the height of the nearest buildings or trees;

If the sensor was installed on a building, do it on a mast of ≥ 6 m above the highest part of the building; and If the sensor is installed on a tower (e.g. stacks) on a horizontal support, it needs a length equal to twice the diameter of the tower, and installs this extension where the wind comes most of the time.

A summary of the local meteorological data will be included in the annual reports that EDP submits to MARN, where the results of the air quality measurements are reported. This summary shall include for each sampling period the number of hours in which the passive monitoring station was to the leeward of the PLANT (± 11.25 degrees), and the average wind speed. That is, if the monitor is located exactly to the west of the PLANT (270 degrees) it would count the time the wind direction was in the range (78.75 to 101.25 degrees). The production of this meteorological summary will be facilitated by the use of software or a spreadsheet to classify wind directions, with respect to the orientation of each of the air quality monitoring stations (see Table 4.33).

Table 4.33 – Meteorology	
Sampling site:	EDP Communications Office
Frequency:	Continuous, hourly data file
Parameters to be determined:	Direction and speed of the wind, solar radiation, temperature, humidity
Methods to be used	NOAA guidelines for meteorological stations. (NOAA, guidelines for meteorological station reconnaissance and meteorological sensors height measurements, April 2008).
Number of tests	Continuous
Duration of sampling	Continuous

Source: Own elaboration ECO/DILLON with information provided by Wärtsilä.

The data obtained from the meteorological station to be installed will be used to review the data in the future, since there would not be sufficient information during an hour that the sampling in chimney lasts, or 24 hours that the one of ambient air lasts. Atmospheric information will be recorded during the emission and immission tests, to comment on the results obtained.

4.13.7 Noise

The noise will be measured after the start of the equipment. Sampling will be carried out by an independent contractor selected by EDP. MARN staff will be invited to witness its execution.

Methods of measurement shall be US EPA reference methods and ASTM methods. The noise measurement to be performed is detailed (see Table 4.34).

Table 4.34 – Summary of the Noise Testing Program	
Sampling site:	4 points on sensitive receivers, sampled for the project baseline and at a point on the edge of the property
Frequency:	3 tests in a period of one month
Parameters to be determined:	dBA day and night
Methods to be used	Measurement with sound level meter
Number of tests	3 tests
Sampling time:	Spot
Standard to be met	Noise in the residential areas where the points are located should be no more than 3 dB (A) of the noise measured at the baseline

Source: Own elaboration ECO/DILLON with information provided by Wärtsilä.

Take a simple with the engines not operating.

4.13.8 Special Waste Waters

The protocol of these tests will be submitted to the approval of the MARN, whose personnel will be invited to witness their execution. Sampling will be carried out by an external laboratory selected by EDP.

Boiler bleed and rejection fluid from the well water treatment plant will be sampled weekly by the parameters listed on the chart for 4 consecutive weeks. The methods of sampling and analysis shall be those prescribed by NSO 13.49.01: 09. The test shall be considered satisfactory if the four samples of treated effluent result in concentrations below the limits of the standard.

Table 4.35 – Acceptance Testing for Special Wastewater Treatment	
Sampling site:	a) Reject water outlet of drinking water treatment plant. b) Boiler purge water
Stabilization:	1 month from commissioning
Parameters and frequency:	Weekly, for 4 weeks: BOD5, COD, pH, grease and oils, sedimentable solids, total suspended solids, Temperature, chlorides, flow (point "a" or "b")
Methods to be used:	Prescribed by NSO 13.49.01: 09
Number of Tests:	1 for each parameter and frequency
Sampling Duration:	Composite Sample
Standard to be met:	NSO 13.49.01:09, BOD5 60 mg / L, COD 60 mg / L, pH, grease and oils 20 mg / L, sedimentable solids 1 mg / L, total suspended solids 60 mg / L, Temperature 20-35 ºC,

Table 4.35 – Acceptance Testing for Special Wastewater Treatment	
	chlorides), Flow (point "a" or "b")

Source: Own elaboration ECO/DILLON with information provided by Wärtsilä.

4.13.9 Oily Waste Water (Separator Acceptance Testing)

The protocol of these tests will be submitted to the approval of the MARN, whose personnel will be invited to witness their execution. The sampling will be carried out by an external laboratory selected by EDP and the main contractor of the project, since its results will determine the acceptance or rejection of the oily water treatment plant.

The incoming and outgoing fluid of the plant will be sampled weekly by the parameters listed in the chart, for 4 consecutive weeks. The methods of sampling and analysis shall be those prescribed by NSO 13.49.01: 09. The test shall be considered satisfactory if the four samples of treated effluent result in concentrations below the limits of the standard.

Table 4.36 – Acceptance Testing for Oily Water Treatment System	
Sampling site:	a) Outflow of oily water treatment system b) Entry of oily water treatment system
Parameters and frequency	Weekly, for 4 weeks: temperature, pH, sedimentable solids, flow (point "a" or "b"), grease and oils, BOD5, COD, total suspended solids
Methods to be used:	Prescribed by NSO 13.49.01: 09
Number of tests	1 for each parameter and frequency
Sampling Duration	Composite Sample
Standard to be met	NSO 13.49.01:09, BOD5 60 mg / L, COD 60 mg / L, pH, fat and oils 20 mg / L, sedimentable solids 1 mg / L, total suspended solids 60 mg / L, Temperature 20-35 ºC, flow rate (point "a" or "b")

Source: Own elaboration ECO/DILLON with information provided by Wärtsilä.

4.13.10 Test Protocol Results

The results of the tests will be presented to the Ministry of Environment and Natural Resources in a technical report that will contain at least:

Goals;
Methodology;
Results;
Copy of laboratory records; and

Photographic record.

4.14 Closing Stage

The project will operate under the regulations and requirements as specified in the Power Purchase Agreement (PPA). The PPA for the project has an established term of 20 years, subject to revision and extension. The installed infrastructure has a viable physical life to extend in the coming decades and would remain in operation until the project is determined that it will no longer be viable; Over 50 years of life are estimated with adequate maintenance.

Therefore, the closure phase of the project would be carried out on the basis of factors related to current productivity and the sustainability of the project as an energy source for the area. Given the uncertainty about the final end point of project operations, at the time of closure in the future, an assessment will be conducted to determine the prevailing conditions in order to develop a detailed and specific environmental and social management context for this phase. The options for the final management of the infrastructure assets of the project will include, but would not be limited to:

Conversion of machinery facilities and operations to meet the needs of a future energy strategy;
Sale of the facilities to a third party;
Demolition and removal of the entire infrastructure of the project; or
Dismantling of facilities and infrastructure without demolition.

In any case the land will be left with the structures required for its future use and clean of contamination in soil and water.

Energía del Pacífico

Project: LNG to Power
Chapter 5: Description of the Environmental Conditions: of the Physical, Biological and Socio-Economic Area of Influence

December 2016 – 16-3489

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5.0 Description of the Environmental Conditions: of the Physical, Biological and Socio-Economic Area of Influence

5.1 Project's Study Area

The performance standards of the IFC (1 January 2012) specify that the risks and impacts associated with a project will be analyzed in the context of its area of influence. The IFC indicates that the area of influence is to cover:

A. The area most likely to be affected: (i) the Project and the client's activities and facilities directly owned, operated and managed (included by contractors) and which are components of the Project; (ii) Impacts of unforeseen developments caused by the Project that may occur later or in another location; or (iii) Indirect impacts of the Project on biodiversity or ecosystem services that may affect the lives of communities and dependencies.
B. Associated facilities, which are facilities that are not financed as part of the Project and which would not have been built or expanded if the Project did not exist and without which the Project would not be viable.
C. Cumulative impacts that result from the incremental impact in the areas or the resources used, or directly affected by the Project, other existing progress, planned or reasonably defined when the risk and impact identification process is carried out.

Table 5.1 summarizes the area of influence for the "LNG to Power" Project as defined by IFC.

The effects on the Project site, as well as indirect effects, cumulative impacts, and the effects of unforeseen but predictable developments, when relevant to the LNG to Power Project, in this EIA report. The effects associated with associated facilities are addressed in a separate EIA report that is being prepared for the LNG to Power Transmission Line Project.

Table 5.1 – Area of Influence of the LNG To Power Project
A(i) Activities and facilities of the Project
1. Areas at the sea, occupied permanently by the marine terminal/breakwater, the Floating Storage and Regasification Unit (FSRU) , the floating storage unit (FSU), and the sub sea NG pipeline Areas on land to be occupied by NG pipleine, power generation plant and electrical substation.
1. Area of land occupied temporarily for construction phase
2. Marine channels and areas to maneuver the LNG tankers and FSU (including the bottom of the sea areas potentially affected by the ship's propeller)
3. Offsite areas affected by air emissions, noise emissions, rainfall runoff , discharges of sewage, sediment releases and changes in coastal processes; as well as the areas potentially affected by major hazards such as spills, fires and explosions
4. Facilities and infrastructure off-site that will be used by the project (stockpiling of materials, areas for disposal of solid waste, waste disposal facilities, access facilities)
A(ii) Unforeseen developments, but predictable
1. No significant unforeseen but predictable developments are expected.
A(iii) Indirect impacts of the Project on biodiversity or ecosystem services
1. Potential effect of the marine terminal/breakwater, the FSRU, of the FSU and marine activities on local resources of the fishing industry (fish and crustaceans)
B. Associated Facilities
1. Area of influence of the transmission line incorporated in a separate EIA.
C. Cumulative Impacts
1. Cumulative effects on air quality and noise considering the existing power plant and other local sources of air emissions and noise.
2. Incremental effects on land, water, marine conditions previously considered, planned, and reasonably defined industrial development of the port and land of the port area

Source: Consulting team, 2016

5.1.1 Landscape and Views

5.1.1.1 Overview of Acajutla's Municipality Landscape

The four homogeneous rural areas that also constitute the four styles of landscape and of agricultural management of the municipality of Acajutla territory are:

1. **The Inland Plain:** The deep regional center, one of the most fertile areas of the country and with extraordinary water resources, with a magnificent geographic layout as a natural corridor between mountains, which opens at one end to San Salvador and on the other towards the Pacific Ocean. In this plain are, in central position, Sonsonate and Izalco. Despite their remarkable resources, they cannot be said to be optimally exploited.
2. **The Low Mountain**: It does not have the resources of the Middle-High Mountain and its landscape is that of the most typical Salvadoran subsistence economy, with an excess of rural

population that overexploits the slopes and feeds the symptoms of extreme poverty. However, its location is close to other active territories to which it traditionally provides human resources and diverse goods. The Lower Mountain is situated as a pre-coastal mountain range, interrupted by the Interior Plain and divided into two sectors. The most characteristic area is the West Sector (Low Western Mountain), which extends as foothills below the coffee mountain between the Sonsonate agglomeration and the border with Guatemala.

3. **The other Lower Mountain, the "Bálsamo Mountain" (Lower Bálsamo Mountain):** Presents serious problems of internal and external connectivity, but also the advantages of certain local peculiarity (the balsam tree itself with its associated culture), or enclaves of protected natural areas with an eco-tourism potential.
4. **The Coast and Coastal Plain:** "The other Great Plain" so open and so different from the interior plain, with great resources and a modern backbone such as the *Carretera del Litoral* that facilitate the existence and growth of a dense population in relatively recent settlements, but also with the condition of the risk of floods and with mangroves and various wetlands whose management is not always adequate.

The area where the Project will be developed belongs to the last homogeneous area, and landscape style, corresponding to the "Coast and Coastal Plain". The land where the Project is located is quite flat, having a wide visual, the inland views of the Power Plant, are a reflection of the industrial activity in the area, with predominating artificial landscapes; that is, spaces that have been already transformed by human activity. Likewise, the area where the marine terminal will be developed, belongs to the West coastal plain, which already has the port of Acajutla as part of its landscape, this means, the intervention of the landscape for the construction of the new terminal, would not greatly affect the existing scenery.

Within the main urban structural elements, the Project may be classified within the category of "Main Industrial Areas", which includes the Acajutla industrial port concentration, and is at the same time related to the structural element of the road network. For the aesthetic-landscaping description of the study area, two zones have been defined: Thermal Power Plant and Marine Terminal, with different characteristics, both of which are described below.

5.1.1.2 Thermal Power Plant

The visual resources evaluated in the field of the Thermal Power Plant are described below:

Predominant Vegetation Cover: Refers to the type of visually dominant vegetation cover in a given area. The predominant vegetation cover in the land of the Project is composed of shrubs and bushes, with some small scattered trees. Also, the vegetative environment has been altered by human intervention, in other surrounding industries.

Presence of Fauna: Refers to all animal population, exotic or native, that generate an interesting dynamic and which contribute to the scenic quality of the landscape. Some species of birds, reptiles, and mammals were identified in the site area. However, no endangered species, or which represent some scenic interest were identified.

Bodies of Water: Areas defined as bodies of water which have a visual significance in the observer. No bodies of water were identified in the site, that may contribute to the landscape.

Human Intervention: They are the various types of structures made by man, whether punctual, extensive or linear (such as roads, high voltage transmission lines, urbanizations, green areas, etc.). Human intervention works are identified inside the project site, as well as in the surrounding areas, due to the industrial use of the land. Boiler Stacks, thermal plants, steel structures, among others, are already part of the landscape of the site.

Areas of Historical Interest: These are all the areas that have a significant historical or heritage value for a country, region or city (areas where important battles, native settlements, or others, have been registered). The land of the Project, does not represent a site of historical interest, however, the pier of the Port of Acajutla represents certain interest for being part of the industrial development history of the country.

Areas of Scenic Interest: defined as areas or sectors that by their characteristics (shapes, lines, textures, colors, etc.) provide an important degree of aesthetic value to the landscape. In the Project area, no areas of scenic interest were identified.

Visual landmarks of interest: are specific elements that bring beauty to the landscape in a singular form, and that by their dominance in the scenic context, acquire significance to the observer. In the landscape of the Thermal Power Plant, there aren't any specific significant elements that bring beauty to the landscape. The area where the project is located is pretty flat, so it will have a wide visual. However, the area is not visited by people unrelated to the industrial activities developed within the port enclosure of CEPA.

Some views identified in the project area, are presented below, photos 5.1 to 5.3:

Photo 5.1 – Power Transmission Lines and Fuel Storage Tanks in the eastern zone of the site

Source: Pictures taken by the consulting team

Photo 5.2 – View of the western zone of the site, where the parking of trucks is seen

Source: Pictures taken by the consulting team

Photo 5.3 – Predominant Vegetation Cover at the Project's Site

Source: Pictures taken by the consulting team

5.1.1.3 Marine Terminal

The Port of Acajutla is one of the main ports of El Salvador, and one of its main attractions is the CEPA pier. During the twentieth century it was developed as a support for the oil industry, so the demand for this product favored the emplacement of refineries, especially near ports or other cities in the interior, and along with them emerged industrial centers, that took advantage from the proximity to the power source. On the other hand, the industries of consumer goods were located next to the markets, reason why in almost all the cities, industrial parks appeared for supplying. The new high technology industries were located far from the city, in suburban areas, looking for more attractive locations closer to the major transportation infrastructures that facilitate communication, creating a modern industrial landscape, as it is the case of the Port of Acajutla.

The construction of the Marine Terminal and Thermal Power Plant required for the Project, will not significantly modify the current visual or landscape in the area of the pier of CEPA. The Project will be seen by residents in the city and people who visit the beaches to the north and west of the project. See photo 5.4.

Photo 5.4 – Acajutla Pier

Source: mitierraacajutla.blogspot.co

5.1.1.4 Landscape Fragility

The landscape fragility refers to the degree of deterioration that the landscape would experience before the occurrence of certain actions. Determining fragility is a way of establishing the degree of vulnerability of a territory to intervention, land use changes, and occupations, that are intended to be developed in it. In general terms, the landscape identified in the project environment is predominantly industrial. With the implementation of the Project, the landscape of the site and existing scenic views, would not be greatly modified.

5.1.2 Administrative Limits

Acajutla is one of the 16 municipalities belonging to the southwestern department of Sonsonate (see Figure 5.1), located 19 km away from the departmental head, Sonsonate and 84 km from the capital city, San Salvador. Its municipal head is the city-port of Acajutla, located to a height of 20 meters above the sea level (msnm); Its coordinates are 13º 35' 30 "L.N. and 89º 50' 04" L.W.G.

It borders to the north with the municipalities of Guaymango, Santo Domingo de Guzmán and Sonsonate; to the east, with Sonsonate; to the west, with Jujutla; and to the south, with the Pacific Ocean (see Figure 5.1 - Administrative Limits Figure 5.2 Geographic Location of the Project). The

officially recognized municipal jurisdiction comprises a territorial area of 166.59 km. Of this, 4.5% is considered as an urban area, and the rest, as rural.

The political-administrative structure of the unit is divided into eight cantons (see Figure 5.3). They recognize the existence of at least 45 hamlets or human settlements distributed as follows: i) El Salamo, 2 hamlets; ii) El Suncita, 4 hamlets; iii) Metalío, 24 hamlets; iv) Morro Grande, 3 hamlets; v) Punta Remedios, 3 hamlets; vi) San Julián, 2 hamlets; Vii) Santa Rosa El Coyol, 5 hamlets; and, viii) Valle Nuevo, 2 hamlets.

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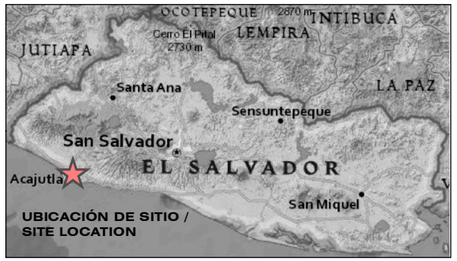
ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

LÍMITES ADMINISTRATIVOS / ADMINISTRATIVE BOUNDARIES

FIGURA 5.1 / FIGURE 5.1

- SITIO DEL PROYECTO / PROJECT SITE
- VIAS / ROADS
- LÍMITES MUNICIPALES / MUNICIPAL BOUNDARIES
- LÍMITES DEPARTAMENTALES / DEPARTMENT BOUNDARIES



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FUENTE / REFERENCE
MISIÓN DE MAPEO / MAPPING MISSION (SRTM)
LANDSAT-8 IMAGEN MOSAICO / LANDSAT-8 IMAGE MOSAIC (2014-01-30)

MAPA CREADO POR / MAP CREATED BY: PFM
MAPA REVISADO POR / MAP CHECKED BY: MW
PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONE 16 WGS84

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PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL / FINAL
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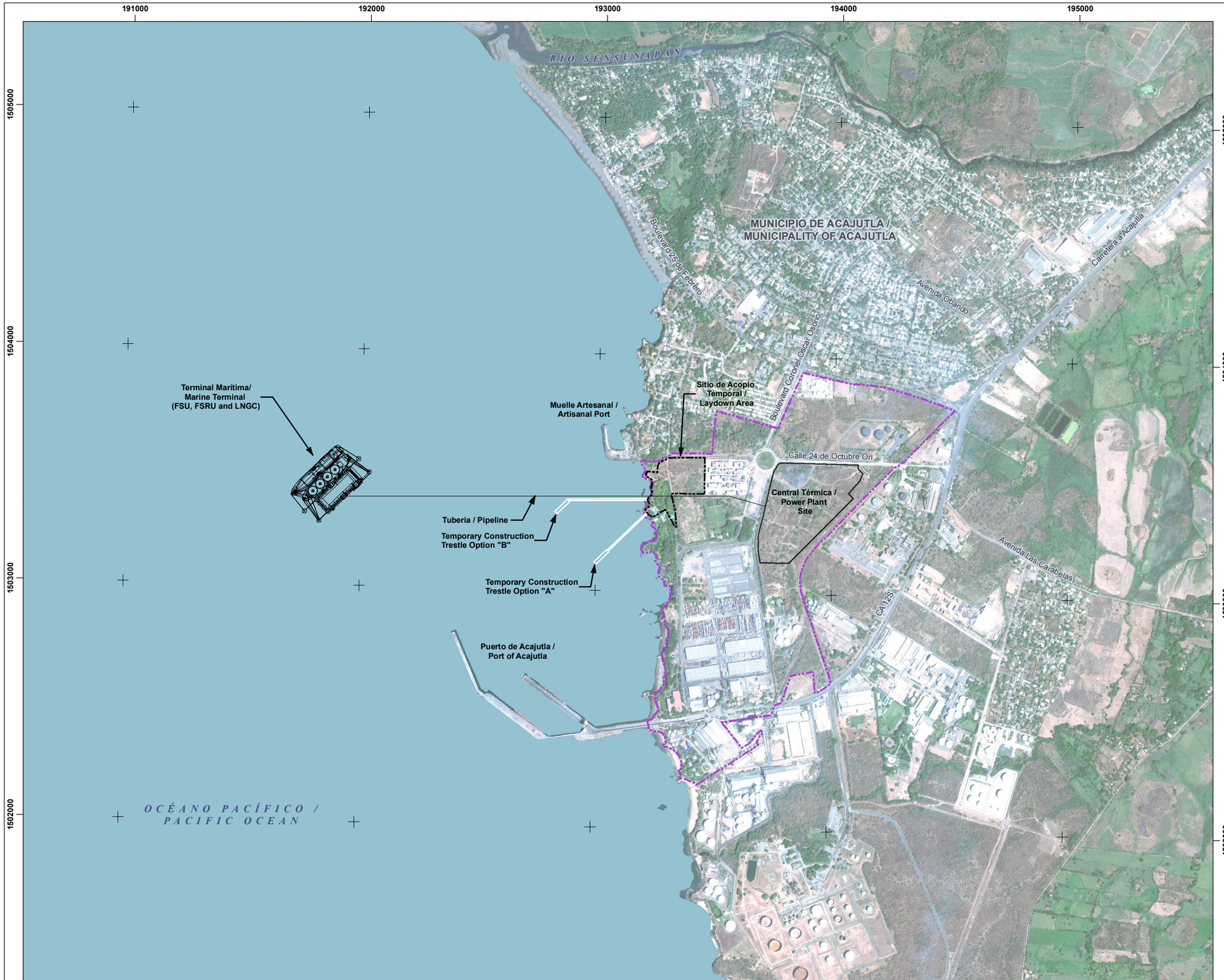

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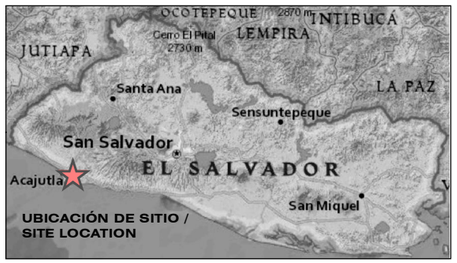
ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

UBICACIÓN GEOGRÁFICA DEL PROYECTO /PROJECT LOCATION

FIGURA 5.2 / FIGURE 5.2

- SITIO DEL PROYECTO / PROJECT SITE
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA
- TERRENO PROPIEDA DE CEPA / CEPA PROPERTY



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FUENTE / REFERENCE
VISIÓN DEL MUNDO 2 IMÁGENES DE ALTA RESOLUCIÓN /
WORLDVIEW 2 HIGH RESOLUTION IMAGERY (2014-02-12)

MAPA CREADO POR / MAP CREATED BY: PFM/SFG
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PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONE 16 WGS84

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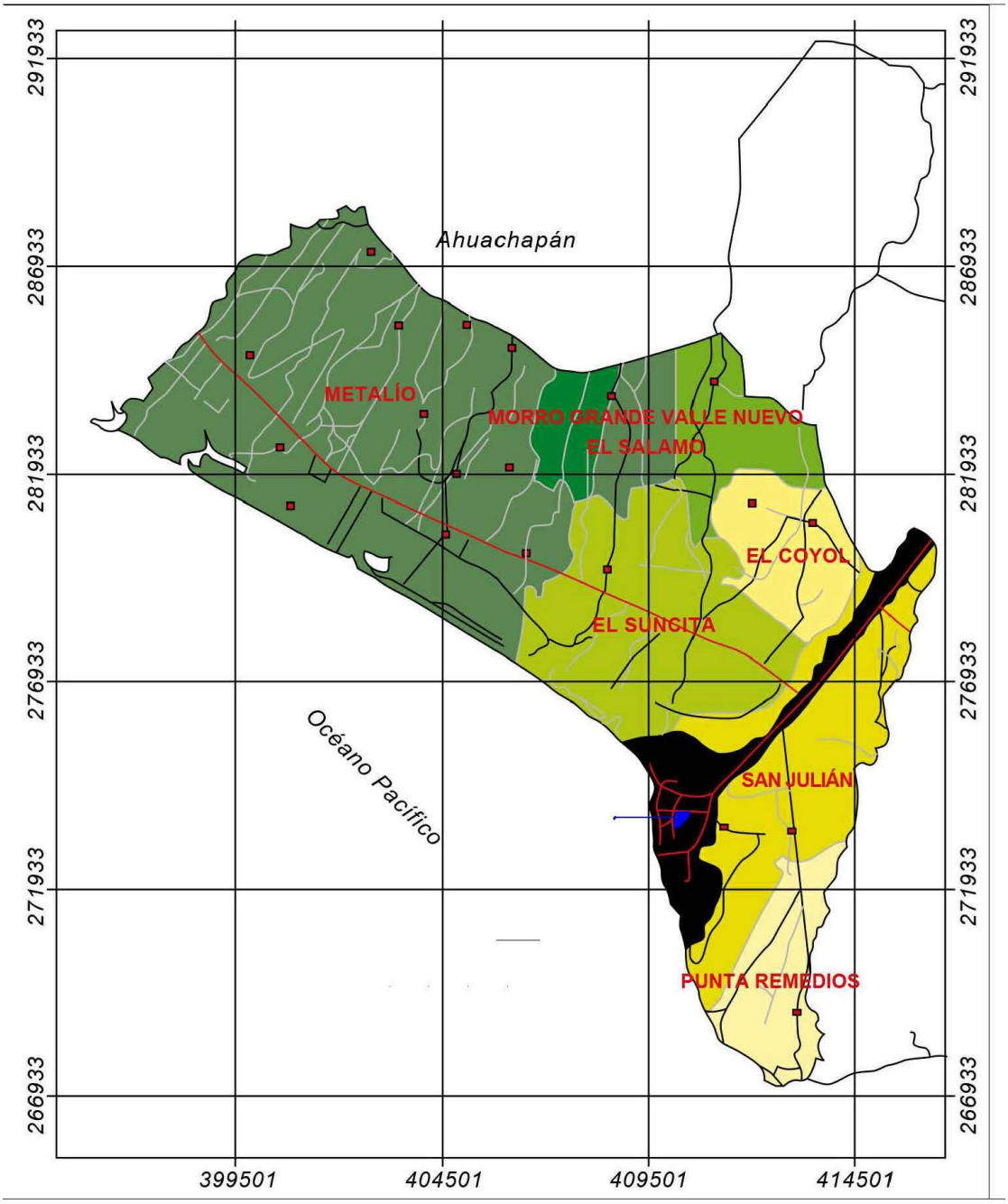
Figure 5.3 – Political-Administrative Division of Acajutla Municipality, Department of Sonsonate



Source: Promotion Project of Local Economic Development and Support to Territorial Rehabilitation in the Department of Sonsonate. Component of Territorial Planning, Geographic Information System, UNDP.

5.2 Physical Environment

The following describes the physical environment of the land to be directly affected by permanent structures of the Project: Thermal Power Plant, pipeline and marine terminal. The Project construction staging area is described in detail in Appendix 5A.

5.2.1 Climate and Meteorology

El Salvador is under the influence of the climate of the tropical belt[1], where daily periodic processes and local circulation dominate. Another important factor is the preponderance of the sea on the earth, as it acts as a buffer of thermal fluctuations, as well as a source of humidity that gives the area a marine climate, particulary in the southern parts.

The climate of the Municipality of Acajutla within which the Project is located presents a warm climate, since it is located on the western alluvial coastal plain of the department of Sonsonate. The annual temperature ranges between 27º to 40º C. On the other hand, the average annual rainfall varies from 1,400 to 1,700 mm, registers a relative air humidity between 67% and 70%, and a potential evapotranspiration of 1,400 to 1,600 mm[2]

Likewise, according to the biological configuration, climate, precipitation regime, temperature, range of elevations and prevailing geological characteristics in the jurisdiction of Acajutla, which is commonly referred to as a "life zone", it can be classified in the category of subtropical wet forest. See Figure 5.4.

5.2.1.1 Precipitation

The Acajutla rain gauge station (T-6) is the station unit with data of maximum rain intensities nearest to the Project area. The historical data of rain intensities of this Station are shown in Table 5.2 and its location in the following Figure 5.5.

[1] The weather in the tropics is dominated by the tropical rain belt, which oscillates from north to south of the tropics in the course of the year. This rain belt remains in the southern hemisphere from October to March, and from April to September it passes to the northern hemisphere.
[2] UNDP - United Nations Development Programme, “Human development and Millenium Objectives Monograph for Acajutla municipality, department of Sonsonate. El Salvador 2006. Page 38.

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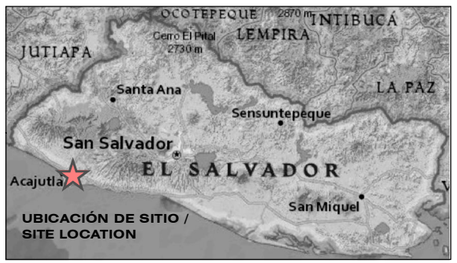
ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

ZONAS DE VIDA / LIFE ZONES

FIGURA 5.4 / FIGURE 5.4

- SITIO DEL PROYECTO / PROJECT SITE
- VIAS / ROADS
- LÍMITES MUNICIPALES / MUNICIPAL BOUNDARIES
- bmh-S (BOSQUE MUY HÚMEDO SUBTROPICAL / SUBTROPICAL FOREST HIGH HUMIDITY)
- bmh-S (BOSQUE MUY HÚMEDO SUBTROPICAL, TRANSICIÓN A HÚMEDO / SUBTROPICAL FOREST HIGH HUMIDITY, TRANSITION TO HUMID)
- bh-S(c) (BOSQUE HÚMEDO SUBTROPICAL / HUMID SUBTROPICAL FOREST)
- bh-S (BOSQUE HÚMEDO SUBTROPICAL, TRANSICIÓN A TROPICAL / HUMID SUBTROPICAL FOREST, TRANSITION TO TROPICAL)
- bh-T (BOSQUE HÚMEDO TROPICAL / TROPICAL RAIN FOREST)
- bh-T (BOSQUE HÚMEDO TROPICAL, TRANSICIÓN A SUBTROPICAL / TROPICAL RAIN FORESTS, TRANSITION TO SUBTROPICAL)
- WATER / AGUA



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N W E S

FUENTE / REFERENCE
MISIÓN DE MAPEO / MAPPING MISSION (SRTM)
LANDSAT-8 IMAGEN MOSAICO / LANDSAT-8 IMAGE MOSAIC (2014-01-30)
MINISTERIO DE MEDIO AMBIENTE Y RECURSOS NATURALES / MINISTRY OF ENVIRONMENT AND NATURAL RESOURCES (MARN, 2002)

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PROYECTO / PROJECT: 14-9114
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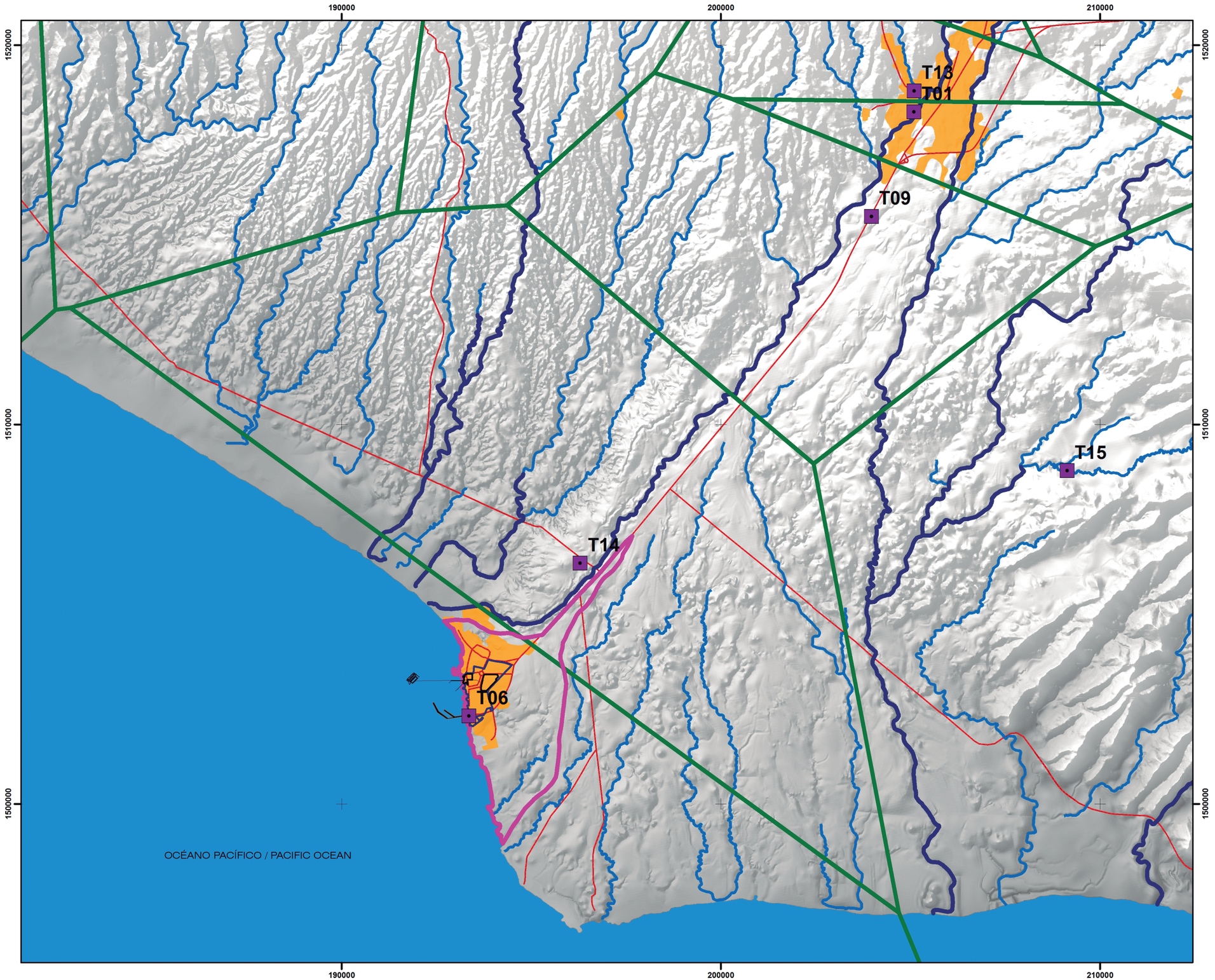

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MAPA DE ESTACIONES PLUVIOMÉTRICAS / PLUVIOMETRICAL STATION MAP

FIGURA 5.05 / FIGURE 5.05

- ESTACIONES PLUVIOMÉTRICAS / PLUVIOMETRICAL STATIONS
- RIOS PRINCIPALES / PRINCIPAL RIVERS
- RIOS SECUNDARIOS / SECONDARY RIVERS
- CARRETERA / ROAD
- POLÍGONOS DE THIESSEN / THIESSEN POLYGONS
- SUBCUENCA / SUBWATERSHED
- MICROCUENCAS / MICROWATERSHEDS
- SITIO DEL PROYECTO / PROJECT SITE
- ÁREAS URBANAS / URBAN AREAS
- TERRENO PROPIEDAD DE CEPA / CEPA PROPERTY

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N W E S

ELABORACIÓN PROPIA / OWN ELABORATION
DATOS SIG DEL MARN ESCALA 1:25,000 /
DATA GIS OF MARN SCALE 1:25,000

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PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONA 16 WGS84

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C:/HYDROGEOLOGICAL STUDY,ECO, DRAWING 1, EL SALVADOR/ ECO INGENIEROS

PROYECTO / PROJECT: 14-9114
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The maximum intensity of rain registered is 3.86 mm/min, corresponding to a duration of 5 minutes and a return period of 10 years. The data presented in this study correspond to the rain gauge station of Acajutla (T-6), for the period of 1959-1983, which is the most recent data available from the SNET[3]. The climate change that we are currently experiencing at a global level, is also affecting El Salvador, increasing the average maximum and minimum temperatures, meaning that at the present and in the future, the rain regime can change, considering that the maximum intensities of rain can increase.

Table 5.2 – Maximum Intensities of Rain (mm/min) for Different Durations (min) of Storms. Acajutla Station (T-6)

YEAR	5	10	15	20	30	45	60	90	120	150	180	240	360
1959	2.18	2.07	2.01	2.01	1.55	1.16	0.75	0.67	0.29	0.36	0.35	0.23	0.17
1960	3.26	2.38	1.61	1.47	1.06	0.73	0.70	0.43	0.34	0.33	0.30	0.25	0.21
1961	3.12	2.44	1.99	1.80	1.62	1.47	1.28	0.92	0.69	0.57	0.51	0.49	0.42
1962	3.56	3.00	2.72	2.47	2.16	1.62	1.23	0.79	0.65	0.49	0.45	0.39	0.24
1963	3.30	2.63	2.55	2.29	1.57	1.37	1.16	0.86	0.82	0.32	0.23	0.28	0.15
1964	2.64	2.39	1.96	1.70	1.27	1.16	1.03	0.77	0.62	0.50	0.46	0.23	0.21
1965	2.20	2.00	1.90	1.77	1.35	1.04	0.80	0.69	0.47	0.22	0.17	0.18	0.11
1966	2.00	1.69	1.58	1.53	1.37	1.02	0.89	0.73	0.52	0.39	0.37	0.10	0.10
1967	2.66	1.95	1.57	1.50	1.54	1.46	1.28	0.90	0.71	0.43	0.37	0.30	0.27
1968	2.22	2.00	1.77	1.56	1.26	1.13	0.98	0.71	0.64	0.33	0.29	0.23	0.16
1969	3.18	2.46	2.21	2.08	1.44	1.33	1.11	0.84	0.65	0.56	0.52	0.47	0.16
1970	3.84	2.76	2.13	1.95	1.55	1.41	1.29	1.17	1.17	1.01	0.86	0.66	0.54
1971	2.10	1.95	1.95	1.94	1.69	1.57	1.26	0.86	0.65	0.58	0.32	0.26	0.19
1972	3.86	3.29	3.09	2.83	2.57	1.93	1.50	1.02	0.77	0.63	0.53	0.41	0.30
1973	2.48	2.21	2.09	1.93	1.54	1.15	1.05	0.78	0.63	0.53	0.40	0.26	0.24
1974	2.10	1.96	1.77	1.95	1.62	1.22	0.95	0.68	0.53	0.45	0.41	0.26	0.17
1975	2.00	1.96	1.75	1.83	1.48	1.23	1.28	0.91	0.61	0.56	0.47	0.39	0.19
1976	2.82	2.65	2.33	2.11	1.85	1.41	1.11	0.84	0.36	0.32	0.25	0.23	0.14
1977	3.14	0.79	0.40	2.96	2.63	2.12	1.74	1.20	0.90	0.73	0.62	0.47	0.36
1978	3.08	2.24	2.24	2.22	1.84	1.33	1.03	0.67	0.52	0.42	0.37	0.29	0.21
1979	2.96	2.60	2.05	1.28	1.47	1.12	0.97	0.73	0.61	0.64	0.60	0.29	0.41
1980	2.40	2.26	2.07	1.61	1.45	1.27	1.17	0.96	0.74	0.60	0.50	0.38	0.25
1983	2.10	2.00	2.00	2.00	2.00	1.45	1.14	0.86	0.58	0.56	0.47	0.37	0.25

Source: SNET, 2002.

Likewise, the monthly and annual average values of precipitation for the station of Acajutla, are shown in the following table 5.3, as mentioned above, the values of average annual precipitation can vary from 1400 to 1700 mm.

[3] Servicio Nacional de Estudios Territoriales (National service of territorial studies).

Table 5.3 – Monthly and Annual Precipitation in mm														
STATION	**INDEX**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**ANNUAL**
Acajutla, Puerto Nuevo	T6	2.5	0.6	12.1	51.5	160.7	286.0	283.1	301.6	382.7	189.1	62.5	6.7	1,739.2

Source: SNET, 2002.

5.2.1.2 Temperature

Considering the Holdridge characterization of climate zones, the area of interest is classified as "Humid Subtropical Forest" (with a biotemperature <24°C, but with an annual mean air temperature >24°C). The maximum and minimum absolute temperatures in Acajutla are 40.2°C (March/1991) and 15.1°C (January/1956), respectively.

Wind directions are predominant from the Northeast, during the dry season, and from the East during the rainy season, the sea breeze occurs after noon, being replaced after sunset by a land-sea circulation (North/Northeast course) The average annual speed is 10.6 km/h.

According to information collected at SNET in 2002, the annual average maximum and minimum annual temperature for the meteorological station of Acajutla for a 30-year recording period are shown in Table 5.4 below.

Table 5.4 – Temperature. Acajutla Station (T-6)												
PARAMETER	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**ANNUAL**
Max. Temp. ºC	32.0	33.4	33.7	34.1	32.2	31.4	32.0	31.7	31.0	31.6	33.4	32.2	31.8
Min. Temp. ºC	22.4	21.9	22.3	24.1	24.2	23.4	23.1	23.1	23.0	23.1	22.4	22.0	22.9
Med. Temp. ºC	25.9	26.5	27.6	28.3	28.1	27.1	27.1	26.9	26.4	26.5	26.6	26.1	26.9

Source: SNET, 2002.

5.2.1.3 Winds

Wind directions are predominant in the Northeast, during the dry season and in the East in the rainy season, the sea breeze occurs after noon, being replaced after sunset by a land-sea circulation (North / Northeast course).

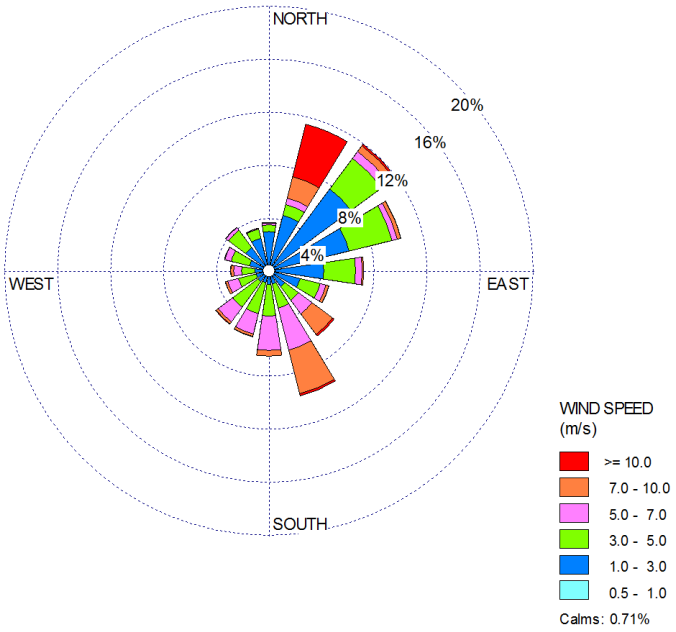
Based on estimated wind observations from the Acajutla climate station (a 10 years record), it is established that the prevailing wind comes from the Northeast, other noticeable directions are from the East and the West. The average speed reached by the winds varies between 9 and 12.5 Km/h. See Table 5.5.

Table 5.5 – Winds. Acajutla Station (T-6)														
ELEMENT	**Jan**	**Feb**	**Mar**	**Apr**	**Mar**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**	**Registration period**
Dominant course	NE	NE	NE	W	NE	E	NE-E	E	E	NE	NE	NE	NE	10 years
Average speed (km / h)	11.3	**12.5**	11.6	11.1	10.3	9.9	9.9	9.5	9.6	9.3	11.0	10.9	10.6	10 years
Absolute Max. speed (km / h)	38.9	50.0	42.5	38.9	46.9	50.0	51.8	**59.9**	51.8	38.9	38.9	38.5	59.4	9 years

Source: SNET, 2002.

The Project's wind rose shows two very marked directions, from the Northeast and the Southwest, coming from the sea. It can be seen in Figure 5.6.

Figure 5.6 – Wind rose in Acajutla



Source: Consulting Team, SNET data compilation.

5.2.1.4 Relative Humidity

According to the information collected in SNET in 2002, the average relative humidity recorded in the Acajutla weather station (T-6), for a 30-year recording period, is shown in Table 5.6.

Table 5.6 – Average Relative Humidity. Acajutla Station (T-6)													
MONTH	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**ANNUAL**
%	**69.3**	68.2	70.7	72.3	77.3	79.2	77.7	78.8	82.0	79.8	73.1	70.1	74.9

Source: SNET, 2002.

5.2.1.5 Evapotranspiration

The potential annual evapotranspiration reported at Acajutla Station is 1,926 mm, the detail per month can be seen in Table 5.7.

Table 5.7 – Potential Evapotranspiration, mm. Acajutla Station (T-6)													
MONTH	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**ANNUAL**
(mm)	146.3	147.8	177.9	179.7	177.8	165.0	173.6	170.5	151.8	151.2	142.8	141.5	1,926.0

Source: SNET, 2002.

5.2.2 Air Quality

Within the area of influence of the Project there are several potential sources of emissions:

- Emission of dust particles due to transit of both light and heavy vehicles, on main road CA-12, and on part of Alameda 25 de Febrero, in front of the truck parking area. See photo 5.5

Photo 5.5 – Heavy and light vehicle traffic on Alameda 25 de Febrero and Carretera CA-12

Source: Pictures taken by the consulting team

- Emissions coming from other installed industries, being the closest the Duke Energy Thermal Power Plant, with NOx, SO2 emissions, mainly particles. See photo 5.6.

Photo 5.6 – Stack Emissions from Duke Energy Power Plant

Source: Pictures taken by the consulting team

In order to evaluate the current conditions of air quality in the Project area and to establish an environmental baseline, a sampling of the main parameters established in the Special Regulation of Environmental Quality Technical Standards was carried out. Sampling conditions, sampling points and results are included in Appendix 5B. A summary of the results is presented below.

Background air quality monitoring requires the definition of indicator compounds; particular species that would be indicative of overall air quality and could be affected by the proposed Project. Indicator compounds, monitoring methodology and baseline concentrations are presented in the following sections.

To characterize the baseline, a monitoring of ambient air quality was conducted, in order to determine key indicator compounds. These indicator compounds are as follows:

- Nitrogen dioxide (NO_2);
- Nitrogen oxides (NO_X); and
- Carbon monoxide (CO).

These compounds represent the significant emissions from the proposed project and therefore form the focus of the background monitoring program and the assessment of potential impacts. Monitoring was also conducted for ozone (O3) and Nitrogen Oxide (NO), as these parameters are important in the

modelling of potential impacts of NO2, and for Particulate Matter <2.5µm (PM2.5) due to concerns that levels may already be elevated in the airshed.
The document "Atmospheric Environmental Air Quality" recommends that monitoring for Lead and Sulfur Dioxide may be relevant. Because the fuel to be used for the Project will be natural gas, there will be no significant emissions of lead or of sulfur dioxide, therefore no monitoring of lead or sulfur was conducted.

The equipment deployed allowed for continuous monitoring of ambient air quality, and therefore the data captured should be considered to be of higher quality than if passive monitoring was used. (See more details of the equipment in appendix 5C).

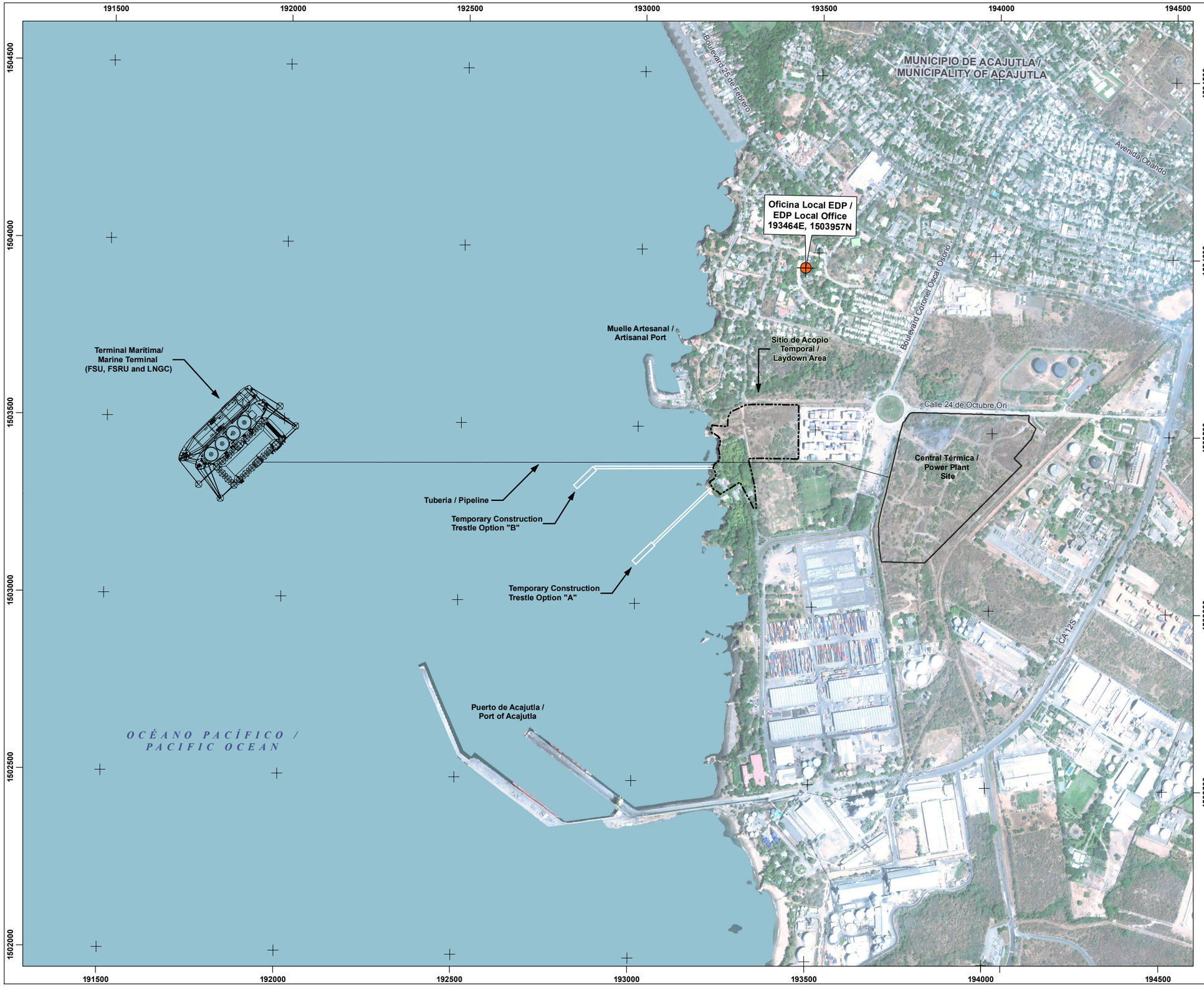
In 2014, air quality monitoring equipment was set up to monitor the selected compounds. However, for the 2016 monitoring campaign, an AQMesh-type monitoring system was chosen, which was set up in the same place, previously noted. The AQMesh monitoring system was calibrated by the manufacturer prior to deployment to the site. This system monitored ambient air quality for a range of compounds. From the data captured, the CO dataset was used within this assessment. Data available for other compounds was considered to be superseded by the data captured from the 2016 monitoring program.

5.2.2.1 Location of the Ambient Air Quality Monitoring Stations

In locating the monitors, consideration was given to the following factors:

- Location of the predicted maximum concentration of the proposed project;
- proximity to sensitive receptors (residences, schools etc.) to capture the current levels being experienced by these receptors;
- Presence of other significant emissions sources (e.g., port, existing power plant);
- Availability of a secure location for equipment; and,
- Access to an electrical power supply.

Based on these considerations, the monitors were deployed within the city of Acajutla and within the residential neighbourhood to the northeast of the proposed Project. The proposed location for the monitoring stations and the Project are shown in Figure 5.7.



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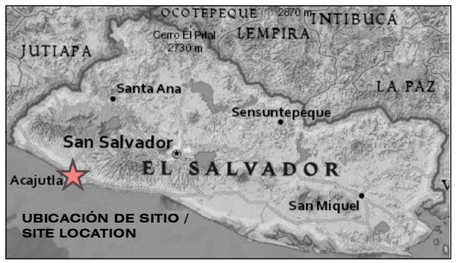
MONITOREO CALIDAD DE AIRE UBICACIÓN DE LA ESTACIÓN / AIR QUALITY MONITORING STATION LOCATION

FIGURA 5.7 / FIGURE 5.7

- MONITOREO ATMOSFÉRICO UBICACIÓN DE LA ESTACIÓN / AIR QUALITY MONITORING STATION
- SITIO DEL PROYECTO / PROJECT SITE
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA
- TERRENO PROPIEDA DE CEPA / CEPA PROPERTY



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PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL / FINAL
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5.2.2.2 Ambient Air Quality Baseline

Based on the collected ambient air quality, the 90th percentile values were taken as background concentrations. The annual averages of the baseline conditions were calculated from the 24-hour results because the monitoring was carried out for less than one year. Table 5.8 below shows baseline concentrations used in the evaluation.

Table 5.8 – Environment concentratins for NO_2, CO y $PM_{2.5}$

Average Period	NO_2 (µg/m³)	NO2 El Salvador Air Quality Criteria (µg/m³)	CO (µg/m³)	CO El Salvador Air Quality Criteria (µg/m³)	$PM_{2.5}$ (µg/m³)	$PM_{2.5}$ El Salvador Air Quality Criteria (µg/m³)
1-hour	—	—	540.91	40,000	—	—
8-hour	—	—	457.76	10,000	—	—
24-hour	11.0	150	—	—	17.93	65
Annual	2.11	100	—	—	3.44	15

Note: "—"Indicates averaging period is not applicable to the compound shown, based on the standards of "Ambient Air Quality Atmospheric Imissions, Salvadoran Standard NSO 13.11.01: 01

Source*: Monitoring carried out in 2016*

PM2.5 was monitored in response to concerns that baseline levels were elevated. As the PM2.5 levels monitored within the airshed were well below the criterion, and the PM2.5 emissions from natural gas combustion are expected to be very low, modeling of PM2.5 emissions was not conducted.

5.2.3 Noise Levels

There is no noise regulation in El Salvador. The World Bank's Environmental, Health, and Safety Guidelines identify two classes or groups of receptors. One group includes housing or residential, institutional and educational lands, and the other group includes industrial and commercial land use. As indicated in Table 5.9, noise levels are more restrictive for residential receptors.

Table 5.9 – Noise Level Guides from the International Finance Corporation

Recipient	One hour LAeq (dBA)	
	Daytime 07:00-22:00	Night time 22:00-07:00
Residential, institutional, educational	55	45
Industrial, commercial	70	70

Source: IFC Environmental, Health and Safety Guidelines, 2007.

Noise impacts shall not exceed the levels listed in the above Table, nor shall they result in a maximum increase in background noise levels of 3 dB at the nearest recipient. The highly annoying noises, such as

the noise of aircraft flying over a certain area and the passage of trains, are not taken into account when establishing background noise levels.[4]

Noise monitoring shall be carried out in order to establish existing levels of ambient noise in the area of proposed and existing facilities or to verify noise levels in the operational phase.

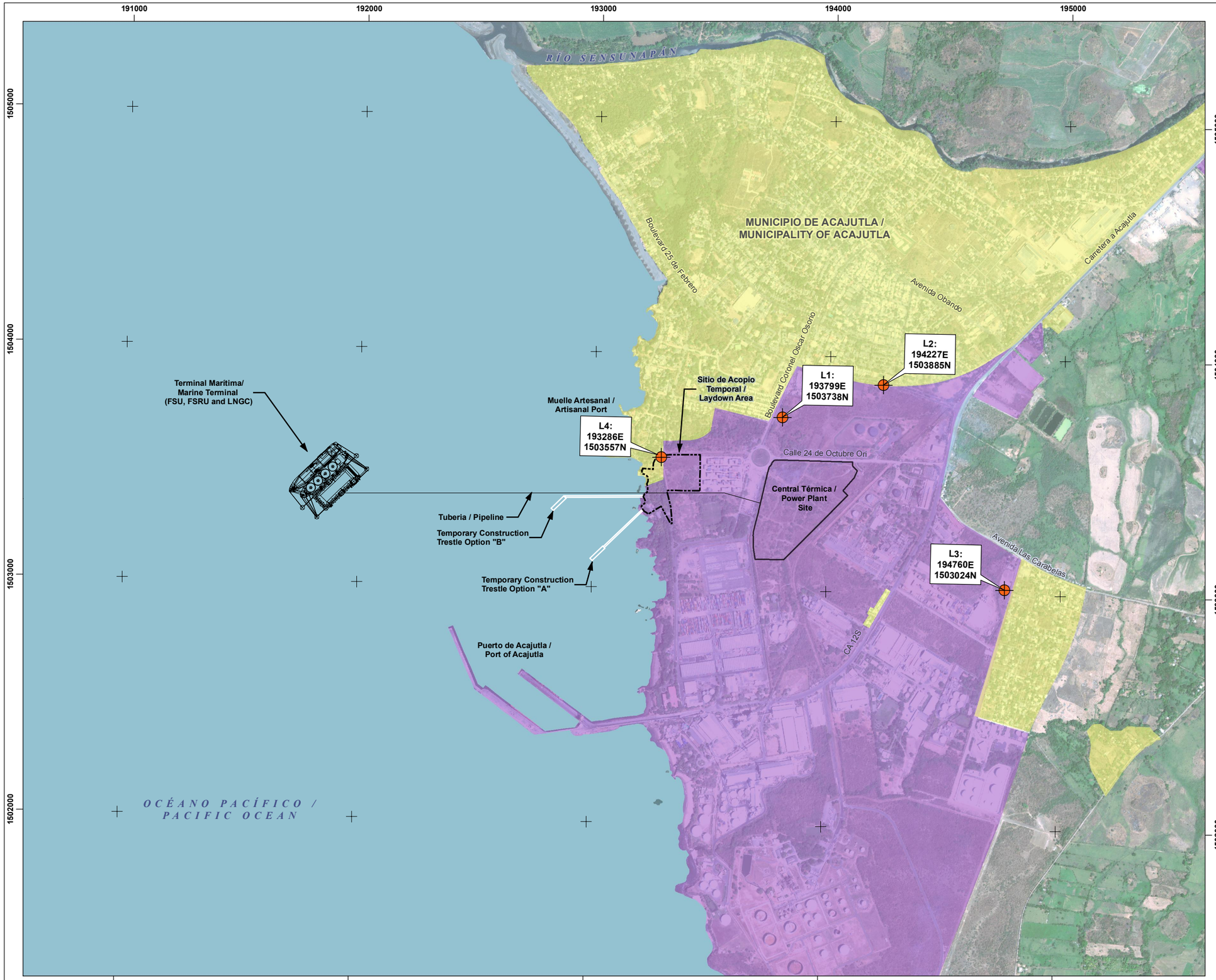
5.2.3.1 Land Use, Receptors and Location of Monitoring Points for Background Noise

The following Figure 5.8 shows the proximity of the residential land uses in areas adjacent to the site proposed for Project development.

The residential (housing) receptors closest to the Project are located on the west side of the "Boulevard Coronel Oscar Osorio", to the north of "Alameda 25 de Febrero ", and to the east of “Avenida Las Carabelas". The Residential receptors are located in the surroundings of the artisanal fishing pier.

The dominant source of stationary noise in the surroundings area of the Project, comes from the "Duke Energy" plant. Four representative points were identified to monitor each of the areas identified above and to collect continuous information, monitoring noise for extended periods of 48 to 96 hours. The noise monitoring points can be seen in Figure 5.9

[4] Environmental, Health and Safety Guidelines of the International Finance Corporation, April 2007.



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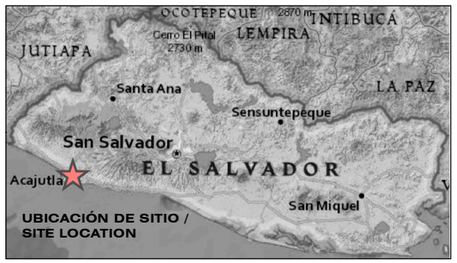
USO DE SUELO Y SITIOS DE MONITOREO DE RUIDO DE FONDO / LAND USE AND BACKGROUND NOISE MONITORING LOCATIONS

FIGURA 5.8 / FIGURE 5.8

- LUGARES DE MONITOREO DE RUIDO / NOISE MONITORING LOCATIONS
- RESIDENTIAL / RESIDENCIAL
- INDUSTRIAL
- SITIO DEL PROYECTO / PROJECT SITE
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA



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PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL / FINAL
FECHA / DATE: 12/7/2016

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5.2.3.2 Methods and Results of Continuous Noise Monitoring

Noise monitoring was carried out to establish the current levels of noise in the study area. The monitoring was completed in accordance with the "IFC Environmental, Health and Safety Guidelines," set forth on page 62 of that document. A total of 264 hours of continuous noise monitoring was collected, through the 4 monitoring points proposed. The following Table 5.10 shows the starting date, ending date, and approximate duration for each of the monitoring points.

Table 5.10 – Duration of Noise Monitoring for Each of the 4 Monitoring Points

Monitoring Point	Starting Date	Ending Date	Approximate duration (hrs)
1	Wednesday, April 9, 2014	Sunday, April 13, 2014	96
2	Wednesday, April 9, 2014	Sunday, April 13, 2014	96
3	Wednesday, April 9, 2014	Thursday, April 10, 2014	24
4	Friday, April 11, 2014	Sunday, April 13, 2014	48

Source: Own elaboration Dillon Consulting and ECO Ingenieros.

Background noise measurements were made with 3 meters or sounders, RION NL-22 model, equipped with windshield, microphone extension cable, protective case, and a data logger. The microphones were placed 1.5m from the ground approximately. The equipment was calibrated prior to the start of the field work and after the monitoring was completed. Certificates of such calibrations are presented in Appendix 5C. Following, a summary Table (Table 5.11) of the monitoring results and the identification of the noise criteria applicable to the Project (CAP) is presented.

Table 5.11 – Summary of Noise Background Monitoring 2014 and Noise Criteria Applicable to the Project

Monitoring Point in Residential Areas	Monitoring Dates	Per hour Leq (dBA)					
		Day: 0700 to 2200			Night: 2200 to 0700		
		Maximum	Minimum	Criterion	Maximum	Minimum	Criterion
1: To the northeast	April 9 –13,	63.8	48.3	55	63.9	50.3	50.3
2: to the North	April 9 –13,	66.1	53.9	255	62.6	53.6	53.6
3: to the Southwest	April 9 –10,	67.3	52.8	55	61.7	55.5	55.5
4: Close to Artisanal Pier	April 11 –13,	62.6	46.2	55	58.9	43.9	45

Source: International Finance Corporation Noise Level Guides

The minimum noise levels measured during the day (0700 hrs to 2200 hrs) at all monitoring locations were below the World Bank's 55 dBA (daytime) guideline. Therefore, the criterion of Project noise applicable to the day of residential areas in the vicinity of the Project would be the WB-EHS 55 dBA guideline. The minimum noise levels measured at night (2200 hrs at 0700 hrs) at the L1, L2 and L3

monitoring sites were above the World Bank's 45 dBA (night) guideline. For these locations, the noise criterion applicable to the Project for residential areas in the surroundings of the monitoring sites L1, L2 and L3 shall be the minimum measured values indicated in Table 5.11.

The minimum noise levels measured at night and monitored at the L4 location, which has the largest separation distance of the existing Duke Energy plant, were below the 45 dBA World Bank guideline (at night). Therefore, the Project's noise criterion applicable to the night in residential areas in the surroundings of L4 would be 45 dBA of the World Bank guideline (See Appendix 5C).

5.2.4 Geology

5.2.4.1 Geomorphology

The area where the Project is located is influenced by three geological structural units that are: The Coastal Plain, the Coastal Chain and the Inner Valley, with the following main features:

a) **Coastal Plains:** It is constituted by two bands, its petrography is varied since materials have been deposited by the rivers that cross the region, forming alluviums, as well as deposits of old volcanic eruptions. The land where the Project will be located, corresponds to this geomorphological unit.
b) **Coastal Chain:** Basically, it consists of thick and dense agglomerates of the Pliocene age, together with thin layers of andesitic lava, tuff layers and interlayers of ignimbrites
c) **Central Valley or Graben**: It is limited by steepness of different heights; its width varies between 10 and 30 km. The petrographic elements that constitute it are pumice, slag, llapilli, tuff and lava.

As already mentioned, the Project is in the geomorphological unit called the Coastal Plain, characterized, as expected, by low slopes of the terrain, forming an almost flat topography and is constituted by two strips isolated from each other.

5.2.4.2 Historical Geology

The region where El Salvador is currently settled was subjected to intense activity of volcanic origin during the Miocene and Pliocene periods of the Tertiary era, among the materials ejected in linear eruptions, that is by cracks or fissures of great length are: brecciated tufts, agglomerated tufts, melted, laharitic agglomerates, pyroclastics of various dimensions. The quality of these materials ranges from the andesitic to the basaltic and all of them are arranged in alternating layers of thick thickness. Interposed between them and sometimes covering the series are layers of lava as well as of andesite and basalt.

Subsequent, to the Tertiary era activity, a process of tectonic activity began. During which the plate formed by tertiary materials was fractured or dislocated by fault lines, the main ones being oriented from west-northwest. As a result of this diastrophism, blocks were raised beside sunken areas or tectonic basins. Erosive processes formed mountains in the first and valleys in the second ones. Simultaneously with the great west-northwest faults, there were also other dislocations, but with a north-northeast orientation, which affected the elevated block of the Coastal Mountain forming a sunken zone where the city of Sonsonate is located.

Basically, the lands where the Project is located are formed by rocks of volcanic origin, belonging to the tertiary period, covering approximately 95% of this region and 5% covered by more recent materials of sedimentary origin. We do not omit to mention that the historical tectonic activity of our territory influenced to a great extent the conformation of the Coastal Plain, due to the different transgressions and regressions of the sea during the Pleistocene Age, which allowed the marine erosion of the raised block (Coastal Mountain), generating the Coastal Plain of Acajutla, reaching these materials a thickness of up to 30 meters.

5.2.4.3 Surface Geology

The Project is located within the formation El Bálsamo, which is described below:

a) "BÁLSAMO" FORMATION:

This formation is presented in an approximate extension of 95% of the area of the micro-watersheds and has an overall impact on the site where Thermal Power Plant will be located, and corresponds to the Tertiary Era, transitional between the Upper and Lower Miocene, being composed of the geological member b1.

Member b1: The geological member b1 of the Geological Bálsamo Formation, is formed by: volcanic epiclastic and pyroclastics, locally basic effusives, intercalated intermediate, with incorporations of lapilli, of pumice and fluvial volcanic epiclastic, of which it can be said that it constitutes the most ancient basement of what forms the unit. The 95% of the area of the micro-basins analyzed is covered by this formation. However, there is a 5% that has been covered by soils of the San Salvador formation. The thickness of this formation is greater than 300 meters, likewise, the epiclastic and pyroclastics, due to their age, present a degree of intermediate consolidation, which is fundamentally a consequence of a natural diagenetic process.

5.2.4.4 Geological Characterization of the Land

The municipality of Acajutla is formed by the coastal plains in the south, (area in which the project is located), and by steep slopes or elevations, several kilometers to the north. The determination of the different geological aspects was based on field inspections and field trips, without neglecting the

adjacent components and elements of importance related to local geomorphology. Likewise, paying attention to the topographic plan, which did not show relevant features. It consists of a single geological formation, defined by a single member with a wide geographic coastal extension and conformed by a stratum with an undefined depth, but that sometimes exhibits more than 30 m of height in some parts of the coastal zone of El Salvador.

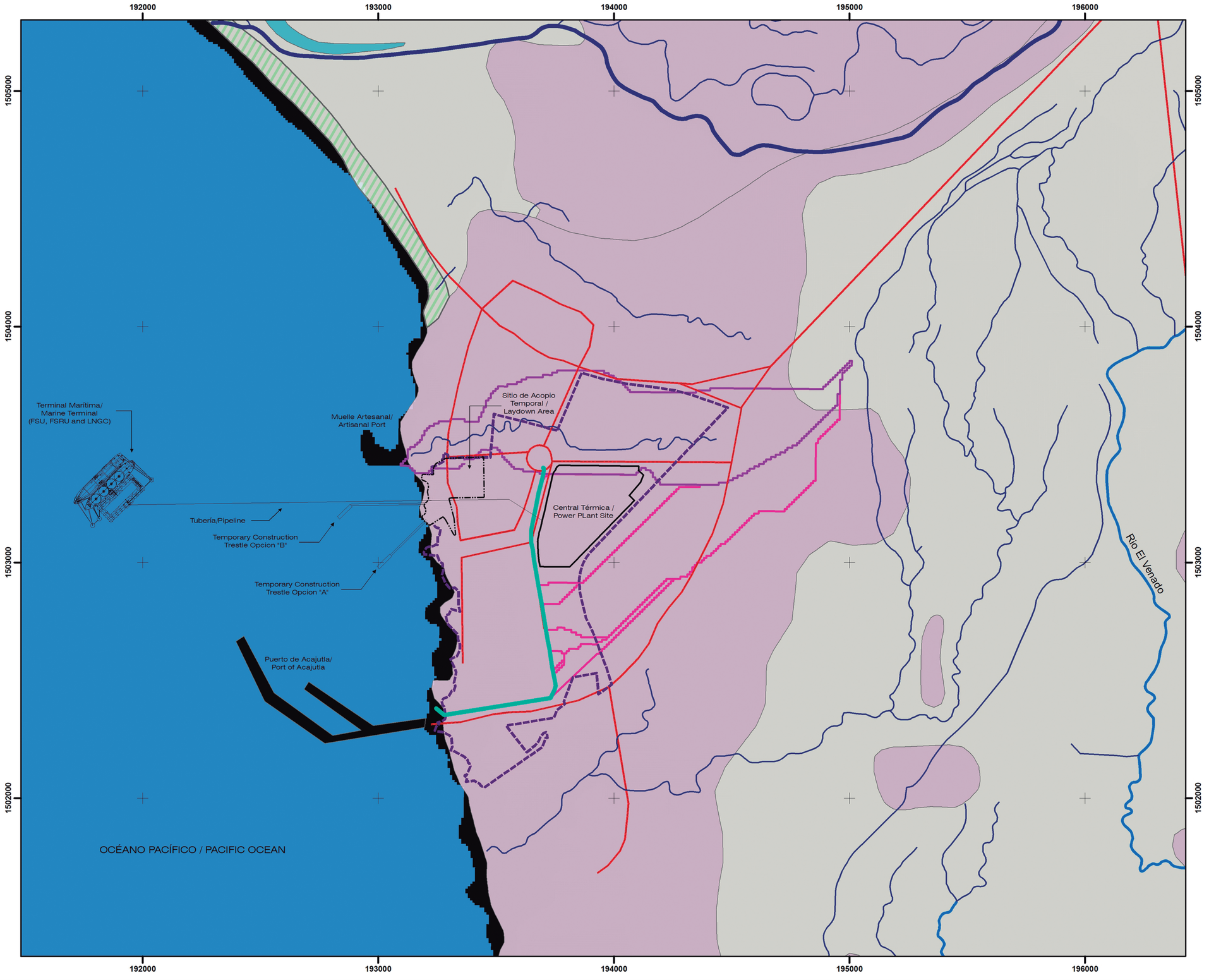
Baxter (2001) establishes four types of geomorphological units for the Salvadoran territory, the corresponding one for the area of Acajutla is the fourth type known as "Coastal Plain of the Pacific", which also recognizes two types of coastal geomorphologies, the "flat type" and "the cliffs". In general, the geographical area of Acajutla presents a combination of these coastal geomorphologies, especially in the industrial zone.

The natural foundation of the conglomerates that make up this stratum, make it one of the most stable materials by its compaction, to which is added the wide thickness of its horizon, only appreciable from the coastal edge, which sometimes reaches 30m without being able to define its depth below sea level. This same foundation, compaction and stability, are responsible for the low permeability. However, it is possible to locate underground water that can be exploited with deep wells, as well as it is possible to find some water springs at the foothills of the cliffs in the Coastal edges closer to the Project area. See Figure 5.9.

5.2.5 Geotechnical Analysis

Two field investigations have been carried out and concluded up to date, a third one is in process. Each of them is described below, presenting the main findings or results:

The **first survey** was carried out by the consulting company "*Suelos y Materiales*" in March 2013. The purpose of the research was to obtain information on the soil conditions at the site under investigation. The depth, thickness, extent and composition of each of the strata and the depth of the groundwater were the main objectives of the investigations. The complete document is in Appendix 5D. For this purpose, six (6) standard penetration trests (SPT), were distributed to analyze the area. The maximum depth explored was 2.50 m, with a total of 10.50 m of drilling. Below is an outline detailing the exploration sites within the project area. See Figure 5. 10.



Energía del Pacífico

ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

MAPA GEOLOGICO / GEOLOGICAL MAP

FIGURA 5.09 / FIGURE 5.09

- CANALETA / CHANNEL
- QUEBRADAS / STREAMS
- CARRETERA / ROAD
- SUBCUENCA / SUBWATERSHED
- MICROCUENCAS / MICROWATERSHEDS
- SITIO DEL PROYECTO / PROJECT SITE
- TERRENO PROPIEDAD DE CEPA / CEPA PROPERTY
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN SITE

GEOLOGÍA / GEOLOGICAL

- EL BÁLSAMO; EPICLASTITAS VOLCÁNICAS Y PIROCLASTITAS; LOCALMENTE EFUSIVAS BÁSICAS, INTERMEDIAS INTERCALADAS.
- SAN SALVADOR, DEPÓSITOS SEDIMENTARIOS DEL CUATERNARIO.

0 100 200 400 m

1:16,000

N
W E
S

ELABORACIÓN PROPIA / OWN ELABORATION
DATOS SIG DEL MARN ESCALA 1:25,000 /
DATA GIS OF MARN SCALE 1:25,000

MAPA CREADO POR / MAP CREATED BY: NSCH
MAPA REVISADO POR / MAP CHECKED BY: JMGR
PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONA 16 WGS84

RILE / ARCHIVO:
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C:/HYDROLOGICAL STUDY,ECO, DRAWING 1, EL SALVADOR/ ECO INGENIEROS

PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL
FECHA / DATE: 3/12/2016

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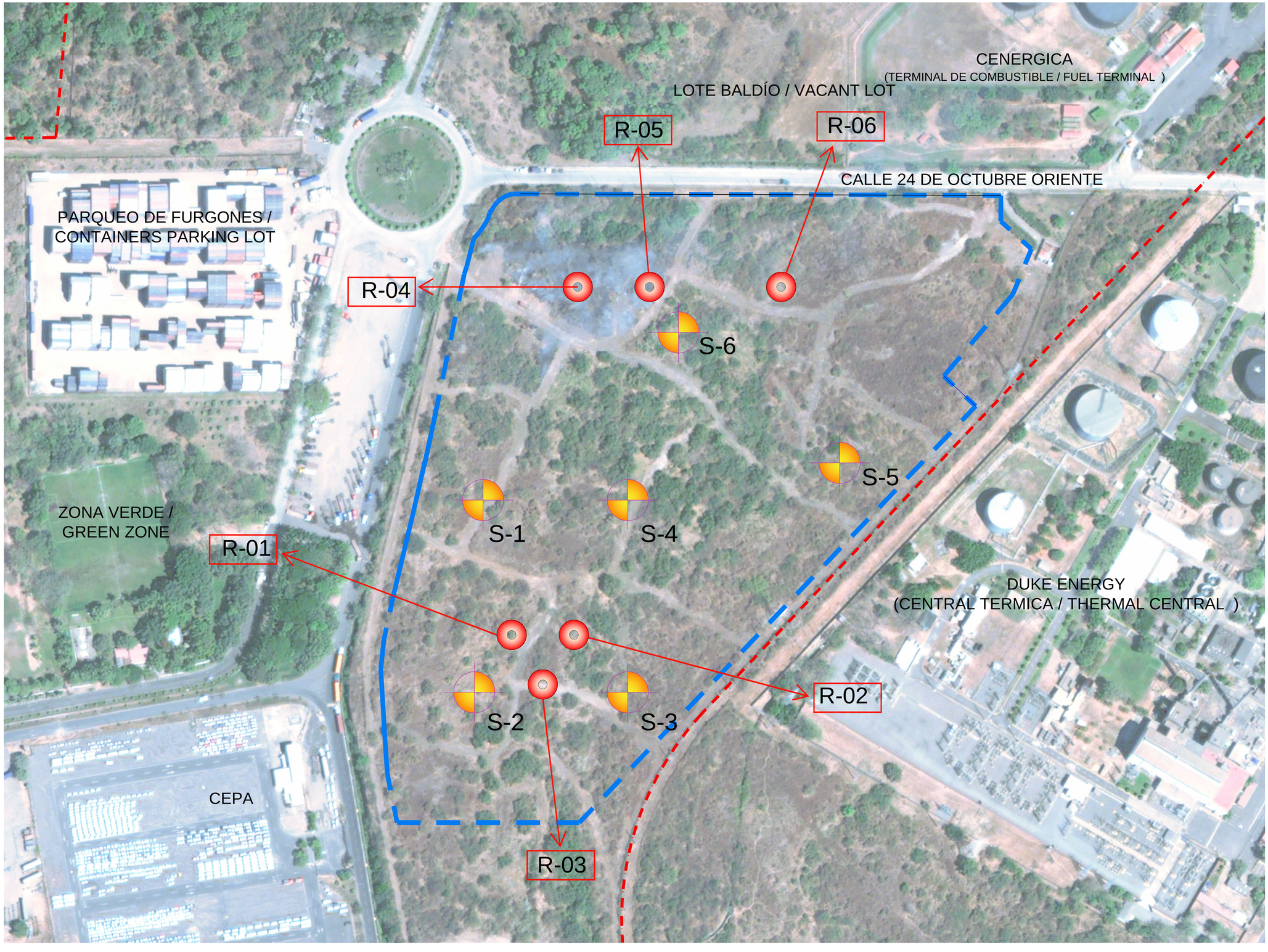


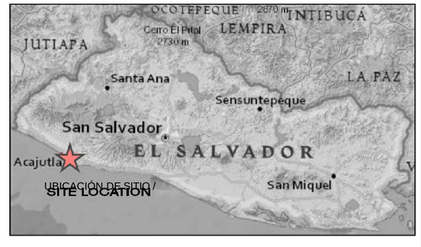
Energía del Pacífico

ENERGÍA DEL PACÍFICO
LNG TO POWER PROJECT

MAPA DE UBICACIÓN DE SONDEOS SPT, MARZO 2013 Y SEPTIEMBRE 2013 / LOCATION MAP PROBE SPT , MARCH 2013 AND SEPTEMBER 2013

FIGURA 5.10 / FIGURE 5.10

- UBICACIÓN DE SODEOS PRIMERA PARTE / PROBES LOCATION PART ONE
- UBICACIÓN DE SODEOS SEGUNDA PARTE / PROBES LOCATION PART TWO
- LIMITE DE PROPIEDAD DE CEPA / CEPA´S LAND LIMIT
- POLIGONAL DEL TERRENO / LAND POLYGONAL



0 10 20 30 40 50 m

1:2,500

N W E S

FUENTE / SOURCE:
VISIÓN DEL MUNDO 2 IMAGENES DE ALTA RESOLUCIÓN / WORLDVIEW 2 HIGGH RESOLUTION IMAGERY (2014-12-12)

MAPA CREADO POR / MAP CREATED BY: ECO INGENIEROS
MAPA REVISADO POR / MAP CHECKED BY: LF
PROYECCIÓN DE MAPA / MAP PROJECTION :
UTM ZONA 16 WGS84 / UTM ZONE 16 WGS84

ARCHIVO / FILE
C:/CAP 5,ECO,DIBUJO 1, EL SALVADOR/ ECO INGENIEROS
C:/CAP 5,ECO,DRAWING 1, EL SALVADOR/ ECO INGENIEROS

PROYECTO / PROJECT: 14-9114
ESTADO / STATUS : FINAL / FINAL
FECHA / DATE: 09/20/2014

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In this study it was concluded that the ground consists of very hard soil (tuff). The Phreatic Stratum was not detected, because it was not possible to drill down due to presence of very hard soil (tuff) found throughout all the site area.

Plastic strata were found, which are susceptible to volumetric changes when their moisture content varies and, therefore, leading to problems like settling, cracking, uprisings, etc. The natural moisture contents of the soil vary from Low to Saturated. See Table 5.12.

Table 5.12 – Values of Moisture by Saturated Soils Probing

DEEPNESS (m)		PROBING No. 1 HUMIDITY %	PROBING No. 2 HUMIDITY %	PROBING No. 3 HUMIDITY %	PROBING No. 4 HUMIDITY %	PROBING No. 5 HUMIDITY %	PROBING No. 6 HUMIDITY %
0.00	0.50	10.6	22.4	25.7	16.6	16.9	18.1
0.50	1.00	24.8	35.7	24.5	30.6	25.6	
1.00	1.50	29.5	39.6		37.7		
1.50	2.00	29.5	29.5				

Saturated Soils

Source: Own elaboration 2014.

There are soils containing organic matter, as detailed in Table 5.13. below

Table 5.13 – Depth of Soil with Organic Matter

PROBING No.	RIM ELEVATION (m)	DEPTH OF ORGANIC MATTER (m)
1	23.16	--
2	22.45	0.00 – 0.50
3	22.61	--
4	25.13	--
5	25.85	--
6	27.32	--

Source: Geotechnical Study, "Suelos y Materiales", March 2013.

For the soils in the site, the values of the following parameters can be taken:

- Humid Volumetric Weight γ = 1.8 Ton/m^3
- Angle of Internal Friction ϕ = 26°
- Apparent Cohesion C = 1.00 Ton/m^2

Considering that restitution by using select, healthy, non-plastic material, and suitably compacted, will be necessary, the values of the following parameters can be taken:

- Humid Volumetric Weight $\gamma = 1.5$ Ton/m^3
- Angle of Internal Friction $\phi = 32°$
- Apparent Cohesion $C = 0.00$ Ton/m^2

The ***second survey*** was carried out by the company "Rodio Swissboring" in September 2013, supervised closely by the consulting company EC[5]. A total of 6 drilled exploratory wells were located, at various locations within the site. The complete document is found in Appendix 5E and the location of the probing in Figure 5.11.

Probes R01, R02 and R03 were extended a depth of 60m, while probes R04, R05 and R06 were extended to a depth of 30m. Overall geotechnical analysis took into account field logs, laboratory analysis results, exploratory drill analysis results, MASW analysis results and CEPA-provided analysis of the existing well.

According to all the analyzes carried out for this campaign, it was concluded, based on the maximum depth of exploration executed, that the profile of the soils found corresponds to alluvial pyroclastic deposits, predominantly sand with silt and gravel presence. The presence of silt and gravel decreases to a greater depth.

The deposits found correspond to materials of a high density except those found in well R05, where materials with an average density were found. The observed shear wave velocity (Vs) were between 500 m / s and 1,000 m / s, which indicates that the existing materials have a high density, which in other words means a material highly competent from the engineering point of view.

According to all the analyzes made during this field survey, it can be concluded that the terrain is adequate to withstand the expected loads and to comply with the structural demands of the Project. Following the relevant recommendations and design of foundations according to a capacity of load of the floor of 200kPa (2.0 kg / cm2) and a minimum depth of foundations of 0.50m.

For areas where materials with a low to medium density (for example, R05) were found, it was recommended to perform excavation, restoration and stabilization of soils activities. The complete geotechnical report is attached in Appendix 5F "Geotechnical Campaign Final Report".

[5] Engineering Company of Central America, Estructuristas Consultores.

The ***third survey*** is being carried out in the area where the marine terminal and underwater pipeline of the LNG To Power Project will be located. This third field survey is being carried out by the company Fugro Consultants Inc. The objective of the survey is to obtain the detailed stratigraphy of the site, extracting samples in the field that will later be analyzed in a specialized laboratory.
The geotechnical campaign is being carried out using a jack-up platform, similar to that shown in Photo 5.7, the platform can operate with a minimum draft of 0.6 meters and has the possibility of self-propelling over short distances. The Jack-up operates above the influence of winds, waves and tides. Its stable and raised deck provides an ideal platform for deep drilling.

Photo 5.7 – Jack Up Platform

Source: Geotechnical Report

The jack-up barge to be used by the marine engineer is self-propelled by means of a hydraulic propeller. However, this platform is not totally independent of tugboats as they will be necessary for medium and long distance positioning.. Using the hydraulically operated "spud legs" system, the jack-up barge is able to move accurately between the drilling locations.

The geotechnical and geophysical work completed to date shows that the underlying soil layers are composed of a complex mixture of alluvium, volcanic rock and debris in which the continuity and strength of the vertical and lateral surfaces vary over short distances.

Although the three geological units are generally identifiable throughout the site, the lateral and vertical continuity are difficult to infer with accuracy. It is important to note the presence of rocks only a few meters from the seabed, which was unexpected. This could represent the final point of the advance of the debris deposited in a site of less energy; future investigations will verify or deny these preliminary findings.

Although only a 33% of geotechnical research has been done to date, the drilling and the on-site testing show a wide range in densities for granular materials that can vary from silica sand or compounds with higher silica quantity and less quantity of sand.

The granular density ranges from very loose to very dense (usually with increasing depth). The angles of effective alluvium friction were high for ground drilling and averaged 27 degrees in the drilling at sea. Gravel was also found in the perforations. Lithology is predominantly volcanic.

The total weight of units for all materials found averaged 18 kN / m3; The water content was in the range of 20 to 40%. Fine content of alluvial and granular materials corresponding to deposited debris were found in the range of 12 to 38%. Older volcanic content was in a lower range of 8-14%.

Specific Gravity Tests revealed a range of 2.5 to 2.75 throughout the site. The area of study can be divided into two main sections of design 1) the temporary trestle to the west of the site and 2) the pipeline route.

The study of liquefaction has shown that the upper layers of 3 to 6 meters from the -10 meter bathymetric contour are susceptible to liquefaction, and for the particular design of the Project the 4 meters above should be considered prone to liquefaction.

Material found within the construction trestle location is considered as loose to loose sand could be prone to liquefaction in case of earthquakes.

5.2.6 Soil Type and Class

With respect to land use in Acajutla, 8.38% of its surface (a small fraction) is composed of alluvial soils class II. These are very productive lands, but require careful management practices, as well as soil conservation or drainage. In general, it is considered that its limitations of use are small, although the selection of crops must be done carefully. Three quarters of the land of Acajutla, correspond to classes III and IV.

In these lands the range of alternatives for planting different types of crops is quite limited; A careful soil management and conservation program is required which includes the construction of terraces, drains, runoff diversions ditches or channels.

The slopes range from moderate to strong, from six to 20% inclination. They have a high susceptibility to erosion. They are characterized by a low or moderate depth of soil, between 30 and 100 cm, and are subject to frequent flooding due to the restricted drainage. Its apparent fertility is low or moderate. However, they are suitable for intensive or semi-intensive livestock farming and even for annual crops resistant to a certain degree of flooding and forest production.

5.2.6.1 Soil Types

The type of soil present in the terrain where the Project will be developed corresponds to Regosols and Halomorphic soils, varying its texture and depth depending on the relief of the terrain. These soils correspond to ancient plains of mount foot, almost without dissection and with very low relief.

The predominant slopes are less than 5%. The lower layers are constituted by Tuff, conglomerates and hard tapetates and low permeability.

Regosols are clayey, somewhat stony, black or very dark gray superficial soils over clayey subfloors and Franco clay with light colors. Generally, at least 1 meter below are the hard layers consisting of tuffs, conglomerates and tapetates.

They are low permeability soils very sticky, plastic, compact and crack when dry. The halomorphic soils are composed of clayey loam, dark reddish brown on clayey subsoils, strongly structured in reddish brown blocks.

At depths not greater than 80 cm are tufts and conglomerates that are not weathered. hese are somewhat slow permeability soils, sticky, plastics, of moderate fertility and something stony.

In general they have a somewhat restricted drainage and in the dry season they are very arid and crack. There are a number of plots dedicated to family provision crops, but most are dedicated to low-yielding grasses, mixed with shrubby vegetation.

Because of their low position, these areas can be irrigated, but prior to this it is necessary to determine which crop is the most appropriate and the most effective methods and practices. See Figure 5.11.

5.2.7 Topography

Because most of the territory of the municipality of Acajutla consists of plains, there are no significant hills within it, and the areas that are most prominent are located to the north, around the boundaries with the municipalities of Guaymango and Santo Domingo de Guzman. The whole area of Acajutla, where the Project is located, is predominantly flat, with very low slopes, descending towards the south-west, toward the Pacific Ocean, as shown in Figure 5.12 below.

Specifically, the land where the Project will be developed, has a predominant distribution of slopes between 2 and 7%. In the middle and lower part of the terrain there are predominant slopes in the range of 2 to 7% and the upper part predominates in the range of 0 and 2%.

Figure 5.13 shows a detail of the predominant slopes in the area where the Project will be developed. Figure 5.14 shows the topographic plane of the Project's terrain, which shows the contour lines that cross it, identifying the curves from number 21 to number 28.

As you can see, the highest point of the terrain is in the east corner and the lowest in a depression on the ground near the north-west corner. Basically, there are two flat levels, at level 27 and at level 25. The ground of the pipeline is also predominantly flat; it has been modified and is occupied by empty areas, gardens, sidewalks and streets.

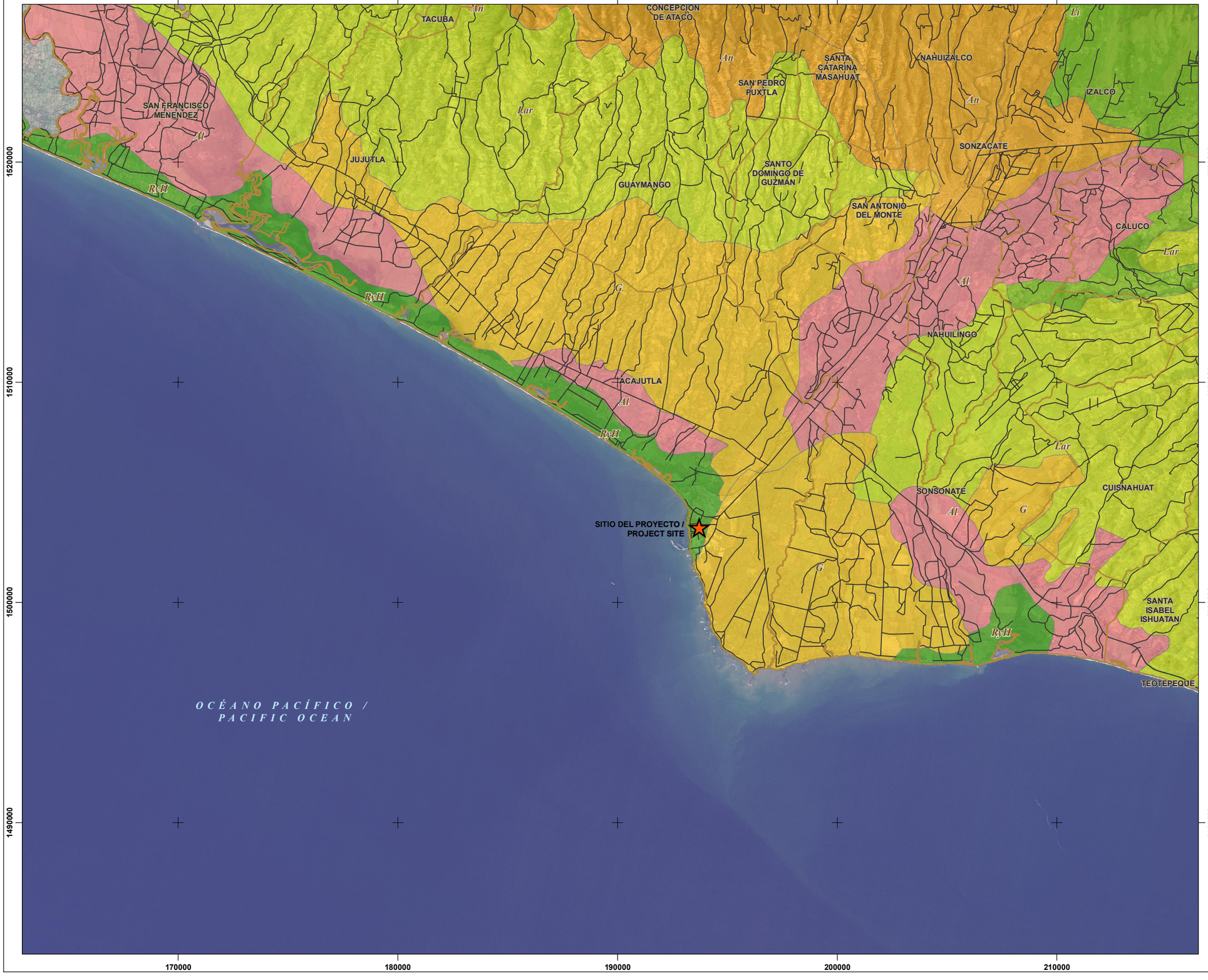
Energía del Pacífico

ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

TIPOS DE SUELO / SOIL TYPES

FIGURA 5.11 / FIGURE 5.11



SITIO DEL PROYECTO / PROJECT SITE

VIAS / ROADS

LÍMITES MUNICIPALES / MUNICIPAL BOUNDARIES

Al (ALUVIALES / ALLUVIAL)

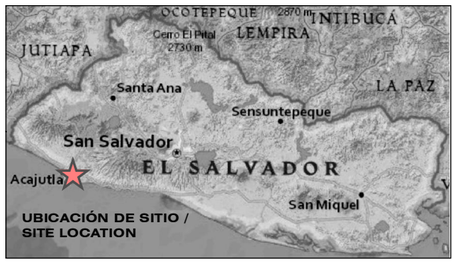
An (ANDISOLES / ANDISOLS)

G (GRUMOSOLES)

Lar (LATOSOLES ARCILLO ROJIZOS / LATOSOLS CLAY REDDISH)

Li (LITOSOLES / LITHOSOLS)

RyH (REGOSOLES Y HALOMORFICOS / REGOSOLS AND HALOMORPHIC)



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N W E S

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MINISTERIO DE MEDIO AMBIENTE Y RECURSOS NATURALES / MINISTRY OF ENVIRONMENT AND NATURAL RESOURCES (MARN, 2002)

MAPA CREADO POR / MAP CREATED BY: PFM
MAPA REVISADO POR / MAP CHECKED BY: MW
PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONE 16 WGS84

ARCHIVO / FILE:
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PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL / FINAL
FECHA / DATE: 12/7/2016

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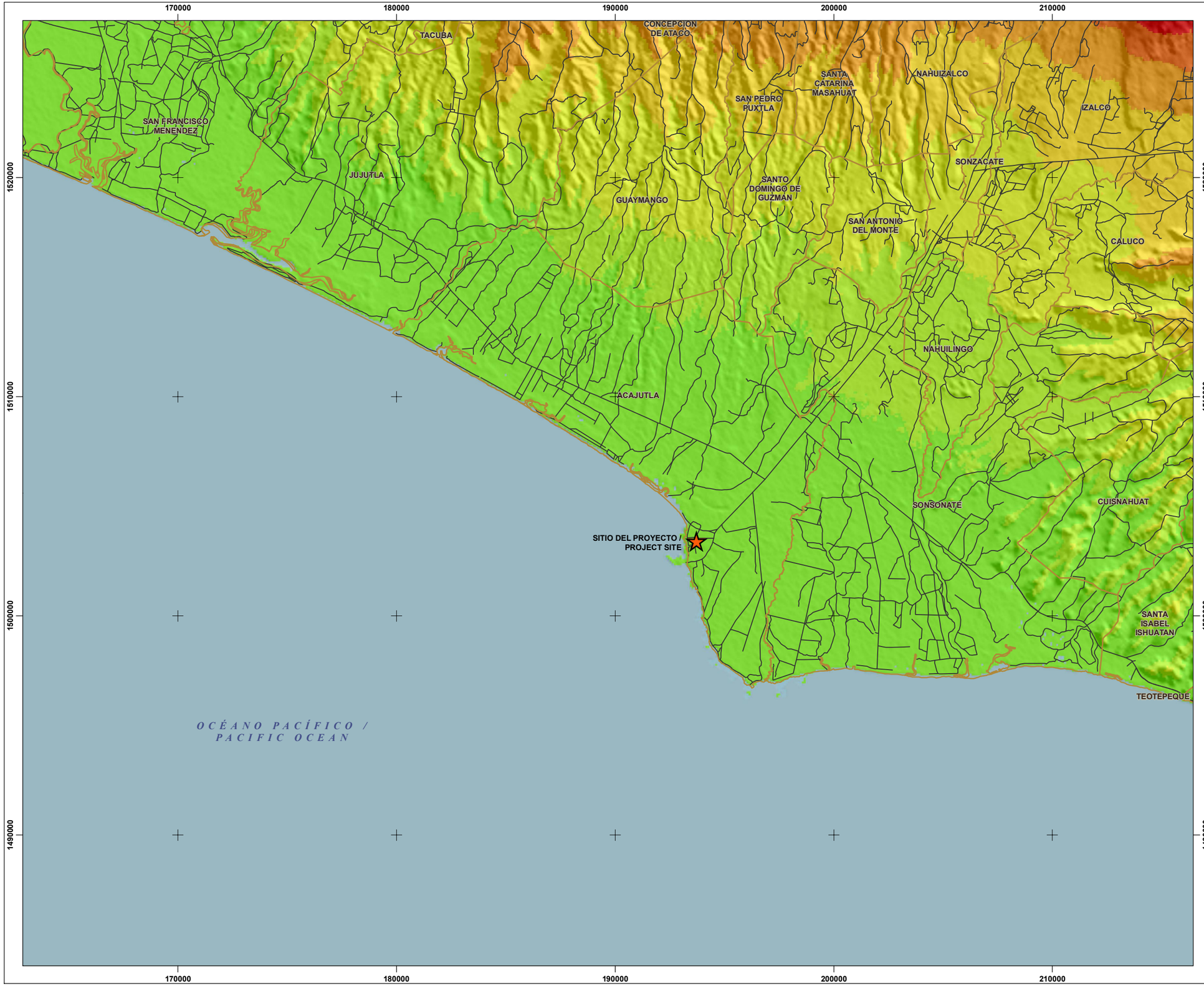


Energía del Pacífico

ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

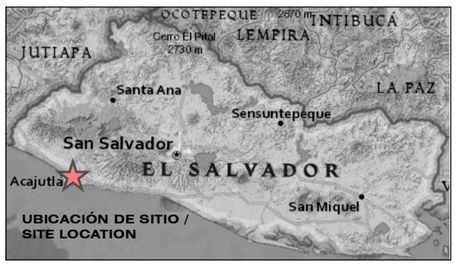
TOPOGRAFÍA / TOPOGRAPHY

FIGURA 5.12 / FIGURE 5.12

- SITIO DEL PROYECTO / PROJECT SITE
- LÍMITES MUNICIPALES / MUNICIPAL BOUNDARIES
- ROADS / VIAS

ELEVACIÓN / ELEVATION

- 0 - 100 m
- 100 - 200 m
- 200 - 400 m
- 400 - 600 m
- 600 - 800 m
- 800 - 1,000 m
- > 1000 m



0 1 2 4 km

1:170,000

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PROYECTO / PROJECT: 14-9114
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FECHA / DATE: 12/7/2016

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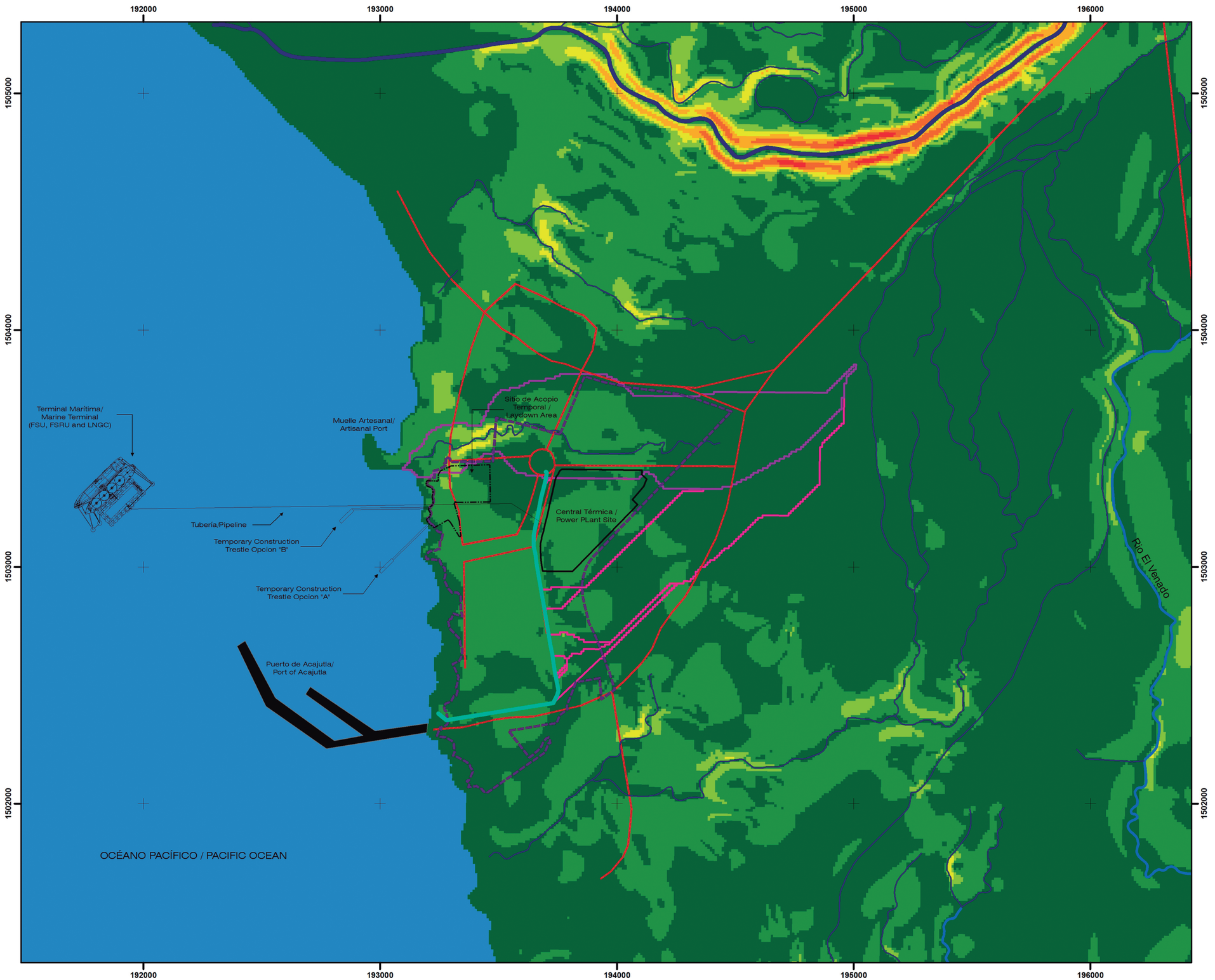

Energía del Pacífico

ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

PENDIENTES / SLOPES

FIGURA 5.13 / FIGURE 5.13

- CANALETA / CHANNEL
- QUEBRADAS / STREAMS
- CARRETERA / ROAD
- SUBCUENCA / SUBWATERSHED
- MICROCUENCAS / MICROWATERSHEDS
- SITIO DEL PROYECTO / PROJECT SITE
- TERRENO PROPIEDAD DE CEPA / CEPA PROPERTY
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN SITE

PORCENTAJE DE PENDIENTE / PERCENT SLOPE

- 0 - 2 %
- 2 - 7 %
- 7 - 15 %
- > 15 %

0 100 200 400 m

1:16,000

N
W E
S

ELABORACIÓN PROPIA / OWN ELABORATION
DATOS SIG DEL MARN ESCALA 1:25,000 /
DATA GIS OF MARN SCALE 1:25,000

MAPA CREADO POR / MAP CREATED BY: NSCH
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C:/HYDROLOGICAL STUDY/ECO, DRAWING 1, EL SALVADOR/ ECO INGENIEROS

PROYECTO / PROJECT: 14-9114
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FECHA / DATE: 3/12/2016

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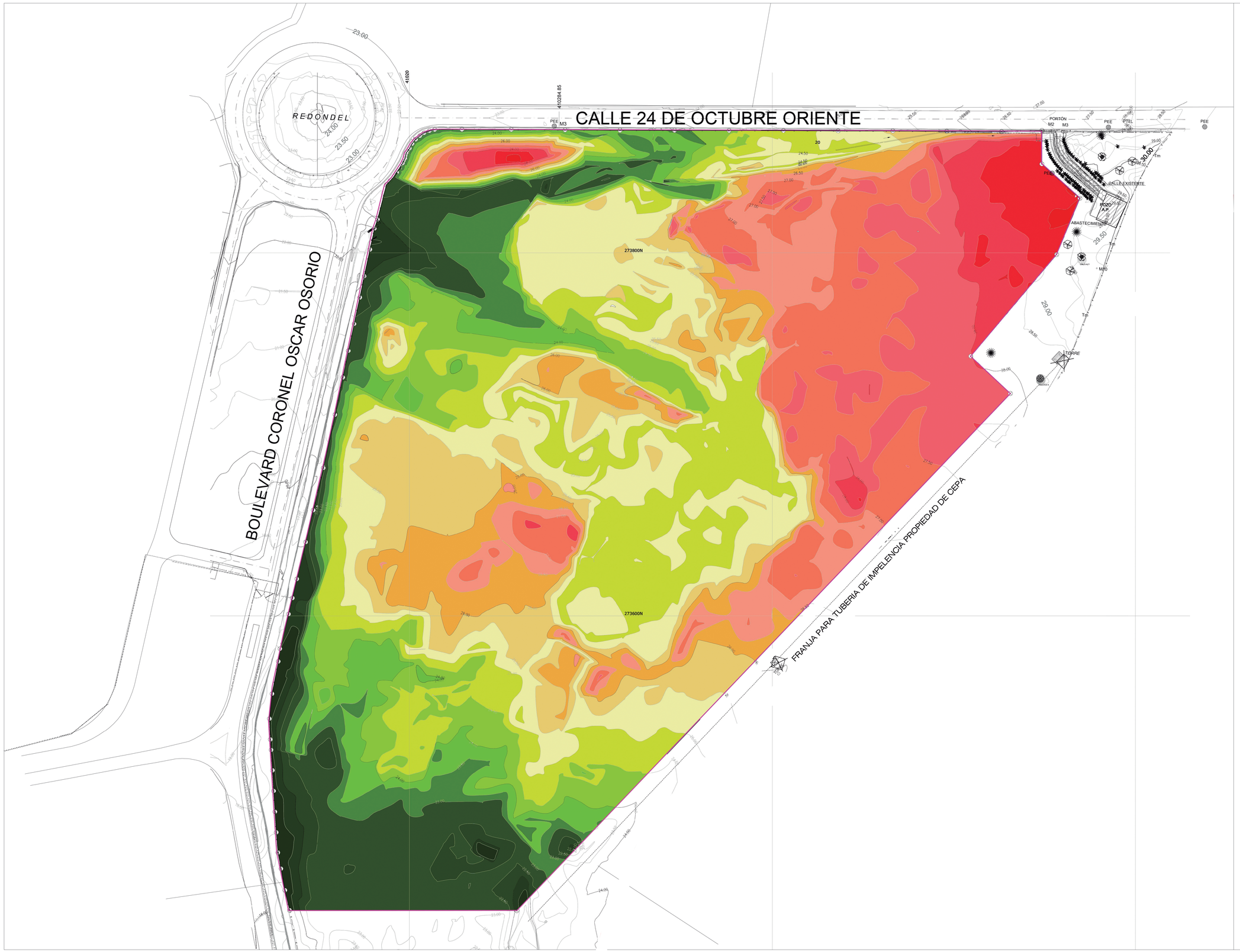

Energía del Pacífico

ENERGÍA DEL PACÍFICO
LNG TO POWER PROJECT

PLANO TOPOGRÁFICO /
TOPOGRAPHIC MAP

FIGURA 5.14 / FIGURE 5.14

CURVAS DE NIVEL / LEVEL CURVES

- 29.50 MSM
- 29.00 MSM
- 28.50 MSM
- 28.00 MSM
- 27.50 MSM
- 27.00 MSM
- 26.50 MSM
- 26.00 MSM
- 25.50 MSM
- 25.00 MSM
- 24.50 MSM
- 24.00 MSM
- 23.50 MSM
- 23.00 MSM
- 22.50 MSM

LIMITE DE PROPIEDAD DE CEPA / CEPA´S LAND LIMIT

POLIGONAL DEL TERRENO / LAND POLYGONAL

0 10 20 30 40 m

1:2,000

N W E S

FUENTE / SOURCE:
ECO INGENIEROS / ECO INGENIEROS

MAPA CREADO POR / MAP CREATED BY: ECO INGENIEROS
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UTM ZONA 16 WGS84 / UTM ZONE 16 WGS84

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5.2.8 Hydrology (Including Surface Water Quality)

5.2.8.1 Overview of the Study Area

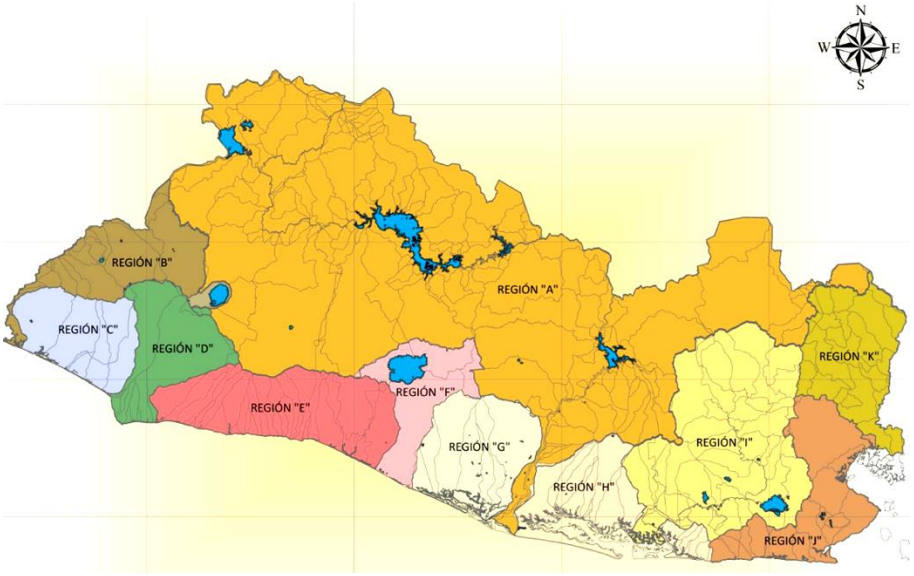
The hydrographic regions of El Salvador are determined by the delimitation of the basins of the main rivers of the country, there are 11 delimited regions and they are identified by the name of the main rivers at National level, as indicated in Table 5.14.

Table 5.14 – Hydrographic Regions of El Salvador		
1	Region A	Río Lempa
2	Region B	Río Paz
3	Region C	Río Cara Sucia
4	Region D	Río Grande de Sonsonate
5	Region E	Río Mandinga
6	Region F	Río Jiboa
7	Region G	Estero de Jaltepeque
8	Region H	Bahía de Jiquilisco
9	Region I	Río Grande de San Miguel
10	Region J	Río Sirama
11	Region K	Río Goascorán

Source: Classification of rivers by Water Basins of El Salvador, C.A., MAG 2012

The Region D that corresponds to the Rio Grande of Sonsonate, is of particular interest for the present study since within this is located the Project. Figure 5.15 delineates the water basins of the main rivers of the country.

Figure 5.15 – Delimitation of El Salvador's Hydrographic Regions



Source: General Directorate of Forestry, Water Basins and Irrigation, June 2012.

According to the "El Salvador's Classification of Rivers by Water basins"[6], similarly, a "**water basin**" can be divided in different ways. Considering the degree of concentration of the drainage network, it defines smaller units as sub-basins, micro-basins and streams. Here is a brief description of each of these smaller units:

- **Sub-basins:** It is an area that develops its drainage directly to the main course of the basin. Several sub-basins form a basin. (Faustino, 2007);
- **Micro-basins:** It is an area that develops its drainage directly into the main stream of a sub-basin. (Faustino, 2007); and
- **Stream:** It is an area that develops its drain directly into the mainstream of a micro-waterbasin. The term "*quebrada*", in several countries of Latin America, is a brook, small river or creek of a low flow when compared with an average river and not suitable for shipping or fishing. (Faustino, 2007).

The department of Sonsonate includes the following basins: Between the rivers Bandera and Chilama, Between Grande of Sonsonate and Bandera, Between Paz and Sunza, Río Bandera, Río Grande de Sonsonate, Río Lempa, Río Paz, Río San Pedro and Río Sunza.

The most important rivers of the department are: Las Monjas or Las Trozas, Sensunapán or Grande de Sonsonate, Negro or Ceniza, Chiquihuat, La Barranca or San Pedro, Las Marías, Banderas, Mandinga, Apancoyo, Zunzacuapa or Sunza, Acachapa, Cuyuapa, Los Three Rivers, Sunzapúa, El Rosario, Chimalapa, Huiscoyol, San Anotnio or Los Milagros, Oculto, Grande, Amayo, Los Dos Ríos, Tazula, Los Lagartos and El Bebedero.

The hydrographic network of the municipality of Acajutla, is constituted hierarchically by the hydrographic regions, basins, sub-basins, micro-basins and streams, which are shown in Table 5.15.

Table 5.15 – Hierarchy of the Hydrographic Network of the Municipality of Acajutla

HYDROGRAPHIC REGION	BASIN	SUB-BASIN	MICRO- BASIN (River)	STREAM
HYDROGRAPHIC REGION "C" (Río Cara Sucia)	Cauta		Cauta	
			Metalío	
			Chalata	
			Mascua	
	San Pedro		El Coyol	El Camalote
			Las Marías	Tepusnagua
			Copinula	
			Suncita	La Barranca

[6] General Directorate of Forestry, Watersheds and Irrigation, june 2012.

Table 5.15 – Hierarchy of the Hydrographic Network of the Municipality of Acajutla				
HYDROGRAPHIC REGION	**BASIN**	**SUB-BASIN**	**MICRO- BASIN (River)**	**STREAM**
			Sunzacuapa	
			San Pedro	Los Tres Ríos
HYDROGRAPHIC REGION "D" (Río Grande de Sonsonate o Sensunapán)	Grande de Sonsonate		Grande de Sonsonate o Sensunapán	Santa Lucía
	El Almendro		El Almendro	
	El Venado		El Venado	
	Las Marías			
	Las Hojas			
	Huiscoyol		Huiscoyol	Las Cañas
	Chimalapa		Chimalapa	La Mica
				De Domínguez
	Lempa	Sucio	El Ojushtal	
			Copapayo	
			Agua Caliente	
	Banderas		Chuteca o Agua Caliente	El Arriete

Source: Ministry of Agriculture and Livestock (MAG), Directorate General for Forest Management, Waterbasin and Irrigation (DGFCR)

5.2.8.2 Water Bodies in the Project Area

There aren't any rivers or winter streams[7] within or crossing the property, where the Project will be developed. There are only artificially created drains such as channels or gutters that flow to a CEPA main channel. Likewise, in the area of indirect influence of the Project, we find only streams that flow directly to the ocean, with predominant southwest direction, and the nearest river is the Sensunapán, located approximately 1.50 kilometers to the North, as can be seen in the following Figure 5.16.

Complete hidrology study is presented in appendix 5G.

5.2.8.3 Surface Drainage

The study area is located in two micro-basins that drain to the sea, these correspond to winter streams and only serve for infiltration, since the recharge areas of the deep confined aquifer are usually located in very distant areas and the information available, as well as the scope of the ongoing study is not enough to make a regional study that covers the areas of recharge of the deep aquifer, from the Santa Ana volcanic complex - Cerro Verde - Izalco, until its discharge in the Pacific Ocean. See Figure 5.17

[7] The winter streams are those whose flow only occurs during the rainy season and is dry the rest of the year. Generally, they have little and almost no depth, very little flow, and can be crossed by walking.

The morphometric characteristics of the two micro-basins are as follows:

Micro-Basin No. 1:

- Area: 0.2901 Km^2
- Perimeter: 3.26 Km.
- Maximum Elevation: 31.94 m.s.n.m.
- Minimum Elevation: 9.22 m.s.n.m.
- Runway length: 1.2974 Km.
- Runway slope: 1.75 %

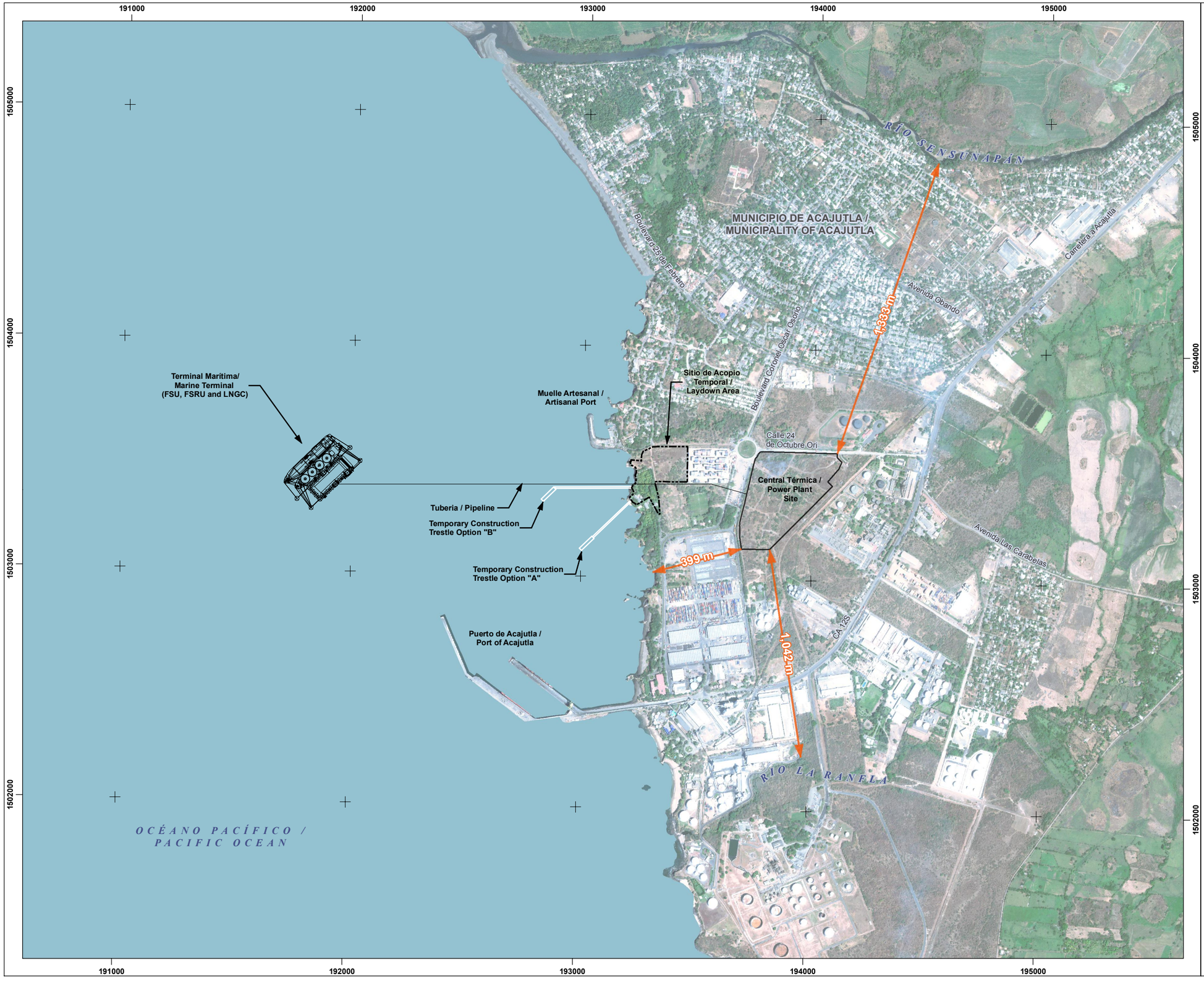
Micro-Basin No. 2:

- Area: 0.5749 Km^2
- Perimeter: 5.36 Km.
- Maximum Elevation: 38.06 m.s.n.m.
- Minimum Elevation: 7.89 m.s.n.m.
- Runway Length: 2.2507 Km.
- Runway Slope: 1.34 %

In the studied micro-basins, as well as in all the rivers and streams contained in the basin, there are no historical data of flows, since it is constituted by small micro-basins, which are not very important, and the streams are of short distance. The micro-basins under study are drained by winter streams; they are very small micro-basins.

The Project area crosses the two micro-basins. However, the drainage of the region consists of several rivers and many streams that drain superficially towards the sea in the form of an alluvial fan.

The site presents two portions that drain differently. The northern portion drains to the existing drainage canal along the access road to the north of the site. The southern portion presents a laminar flow, consequently draining to the CEPA drainage canal. See photos 5.8 and 5.9.



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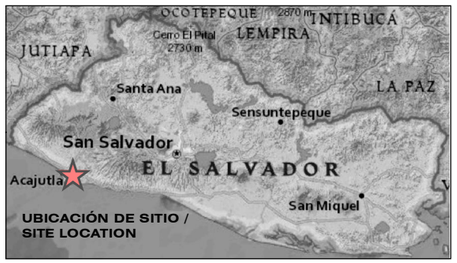
UBICACIÓN DE CUERPOS DE AGUA / WATERBODY LOCATIONS

FIGURA 5.16 / FIGURE 5.16

- DISTANCIA DE CUENCA / WATERBODY DISTANCE
- SITIO DEL PROYECTO / PROJECT SITE
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA



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WORLDVIEW 2 HIGH RESOLUTION IMAGERY (2014-02-12)

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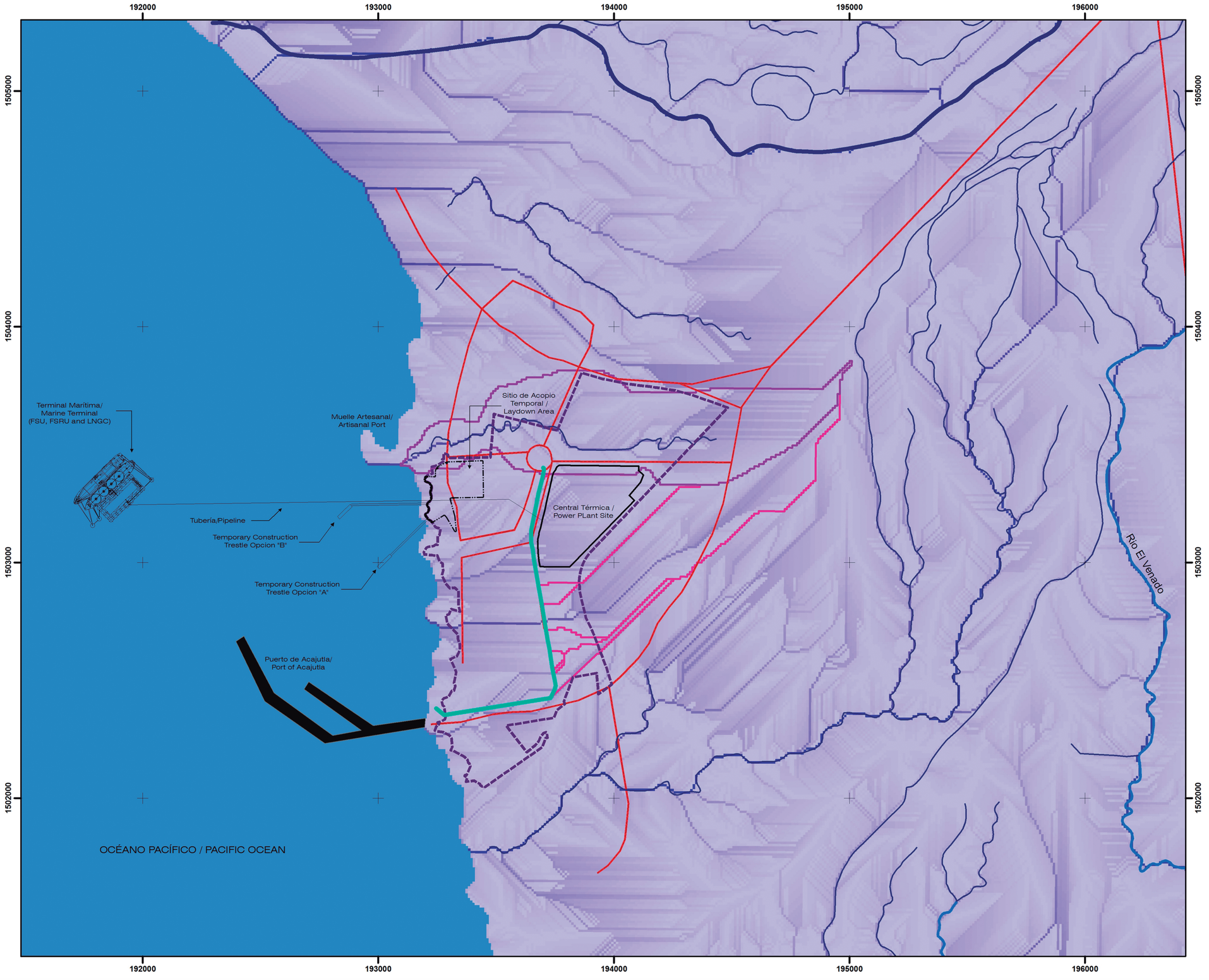

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RED DE DRENAJE / STREAM NETWORK

FIGURA 5.17 / FIGURE 5.17

- CANALETA / CHANNEL
- QUEBRADAS / STREAMS
- CARRETERA / ROAD
- SUBCUENCA / SUBWATERSHED
- MICROCUENCAS / MICROWATERSHEDS
- SITIO DEL PROYECTO / PROJECT SITE
- TERRENO PROPIEDAD DE CEPA / CEPA PROPERTY
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN SITE

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Photo 5.8 – Canal on the North boundary of the Site

Source: Photo taken by the consulting team

Photo 5.9 – CEPA Drainage Canal on Access Road

Source: Photo taken by the consulting team

5.2.8.4 Sanitary Quality of Waters of Hydrographic Region "D"

In 2007, MARN carried out the study "National Diagnosis of Sanitary Surface Quality Water of El Salvador". In the Sonsonate-Banderas Grande Hydrographic Region (Region D), samples were collected at 8 sites and sediment determinations were performed at one site. Table 5.16 presents the results of the Water Quality Index (WQI). The WQI is based on different pondered parameters, and classifies the water as: Excellent from 91 to 100, good from 71 to 90, regular from 51 to 70, bad from 26 to 50 and very bad from 0 to 25.

Table 5.16 – Sanitary Quality of Surface Water of Hydrographic Region "D"				
No.	**SAMPLING SITE**	**RIVER**	**SANITARY WATER QUALITY INDEX**	**CLASSIFICATION**
1	D-01-CENIZ	Ceniza	33.75	BAD
2	D-02-CENIZ	Ceniza	33.04	BAD
3	D-03-CENIZ	Ceniza	27.49	BAD
4	D-04-CENIZ	Ceniza	34.28	BAD
5	D-01-GRAND	Grande de Sonsonate	33.66	BAD
6	D-02-GRAND	Grande de Sonsonate	54.45	Regular
7	D-03-GRAND	Grande de Sonsonate	20.12	VERY BAD
8	D-04-GRAND	Grande de Sonsonate	11.95	VERY BAD

Source: Esquivel, O., 2007.

As a national result, 62% of sampled sites have "Bad" quality, 13% "Regular" quality and 25% have "Very Bad" quality. In the Hydrographic Region D, of 8 sampling sites, only 1 (12.5%) has "Regular" quality, 5 (62.5%) have "Bad" quality and 2 (25%) have "very bad" quality. Considering these results, surface water resources have a very poor quality, which indicates that it is necessary to carry out actions for the recovery and decontamination of surface water bodies.

5.2.8.5 Receiving Body Analysis

In March 2013, analysis was conducted for water quality of the CEPA drainage canal ("gutter of convergence of the Acajutla CEPA complex"), performed by the *Laboratorio de Calidad Integral* of *FUSADES*, included in the Appendix 5 H.

All parameters have values under the Standard NSO 13.49.01: 09, applying the values for "fuel stations" and the complementary parameters and permissible values for wastewater discharged to a recipient body, found in the same norm. Some values showed non-detected. See Table 5.17.

Table 5.17 – Sanitary Surface Water Quality of Hydrographic Region "D"		
DETECTED PARAMETER	**CEPA rain canal (mg/L)**	**Standard (mg/L)**
Biochemical Oxygen Demand	1.70	100.00
Suspended solids	4.00	100.00
Fats and oils	<6.3	30

Source: consulting team 2014.

For the Chloride and Silicon values, there is no range defined in the cited standard. The water in the drainage canal is of a very good quality, although many industries in the area discharge their rainwater to it.

5.2.9 Hydrogeology (Including Groundwater Quality)

5.2.9.1 Hydrogeological units

In the Project site, two geological formations emerge the San Salvador and Bálsamo formations. The records of the lithology found in the drilled wells of the area show a stratigraphic sequence of volcanic and sedimentary materials. These show different hydrogeological characteristics: Such characteristics have been the basis for the classification of these formations in Hydrogeological Units. What this investigation intends to determine, is if these units are able to provide sufficient flow to meet the demand of the Project without causing negative effects on any existing system. The complete hydrogeology report is included in Appendix 5I.

Hereunder, the hydrogeological units for the study area are described , according to the Hydrogeological Map of El Salvador. See Figure 5.18.

The hydrogeological units in the study area are the following:

5.2.9.1.1 Porous Aquifer Unit of Great Extension and Average Productivity.

This hydrogeological unit consists mainly of loose semi-compact volcanic materials, such as pyroclastic rocks and tuffs. In addition of alluvial origin materials, as are reworked pyroclastic, alluvial sediments and marine sediments. See photo 5.9.

In these, underground water is stored and transmitted via the pores left by the grains that constitute the geological formation. The flow of groundwater is slower and its hydraulic properties are less favorable.

5.2.9.1.2 Unit of Non-Aquiferous Rocks.

Non-aquiferous rocks are classified as those formations whose hydraulic properties are so low that it is not possible to classify the geological formation as aquifer. However, it is not possible to classify an entire region as Non- aquiferous rocks, based solely on the age of geological formations. This has been done in the Hydrogeological Map of El Salvador. In many cases, mainly due to lack of information.

Groundwater will always move through the geological environment that opposes less resistance, and in the case of old materials it will do so through the medium that is more fractured and less weathered, that is, with less clays. Groundwater manifests itself through springs or in their discharge into rivers.

Photo 5.10 – (A) Alluvial Sediments (B) Dacitic Ashes

Source: Pictures taken by the consulting team

"El Bálsamo" Formation, composed of pyroclastic and Tertiary Tuffs, due to its age and to consequent weathering presents a greater difficulty to the passage of water, but in the area of Acajutla constitutes the main aquifer. The water is moving through the cracks, that is, its porosity is secondary.

5.2.9.2 Characteristics of the Aquifer

The wells drilled in the area are taking advantage of the aquifers constituted by the materials of the Balsamo Formation, composed by strata of Agglomerated and Lytic Tuffs, Pyroclastic and Marine Sediments. See photo 5.11.

Photo 5.11 – Pyroclasts and Tertiary Tuffs

Source: Pictures taken by the consulting team

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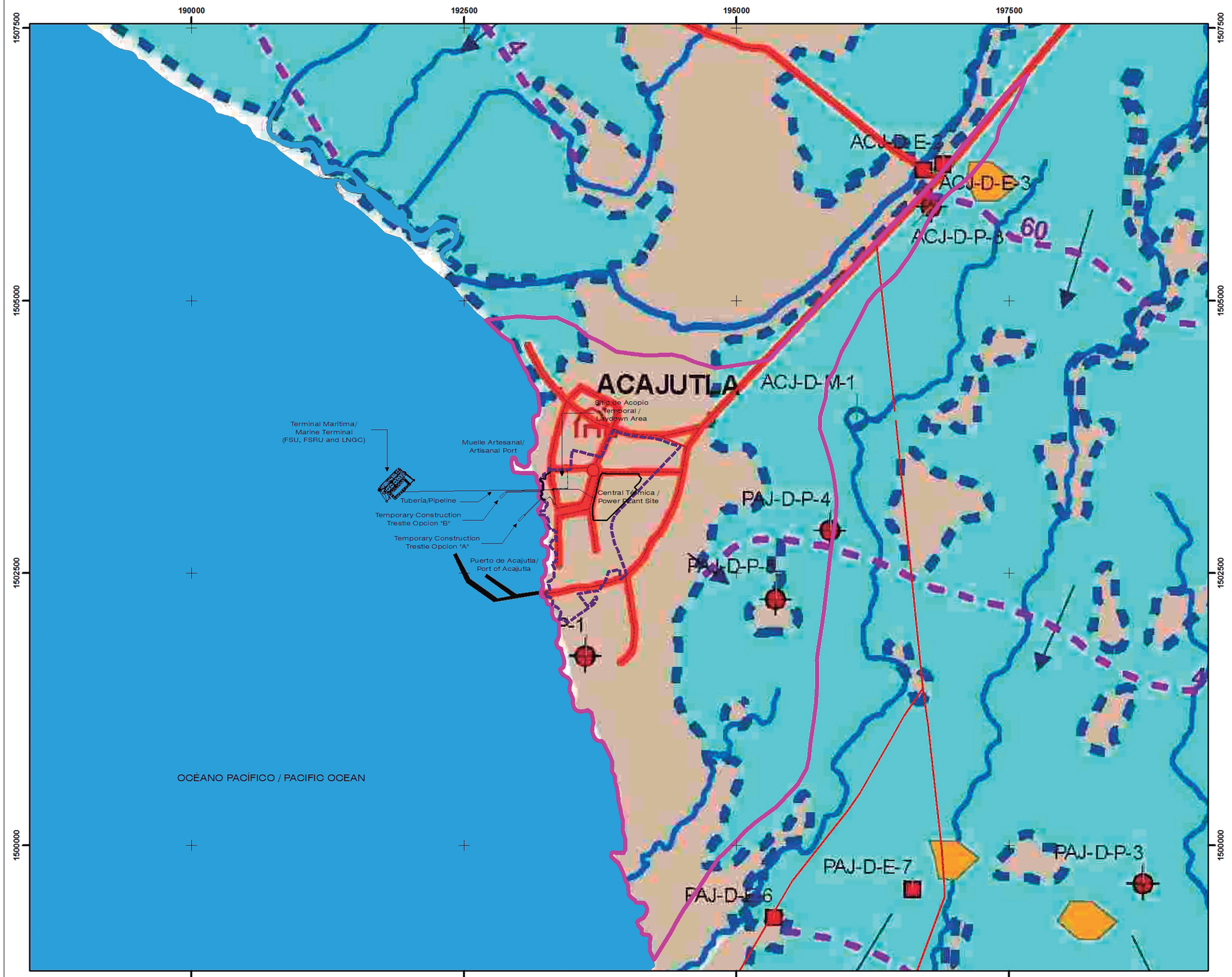
MAPA HIDROGEOLÓGICO / HYDROGEOLOGICAL MAP

FIGURA 5.18 / FIGURE 5.18



- POZOS EXCAVADOS
- POZOS PERFORADOS
- ÁREA URBANA
- FALLAS GEOLÓGICAS
- CARRETERAS ASFALTADAS
- RÍOS PRINCIPALES
- CURVAS PIEZOMÉTRICAS
- DIRECCIÓN DE FLUJO
- SITIO DEL PROYECTO
- TERRENO PROPIEDAD DE CEPA
- CUENCA DEL RÍO EL ALMENDRO
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN SITE

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5.2.9.2.1 Depth of the phreatic level

Static level information has been measured during the preparation of the Hydrogeological Study of the Project under analysis, along with historical data. To plot the piezometric curves, data was used only from some of the deep wells, which exploit the semiconfined aquifer. Those that are located far from the area of interest and which exploit a confined aquifer, were discarded,. A statistical extrapolation of the elevation of the Piezometric Level was carried out in the selected wells, determining a probable depth of a shallow aquifer between 7 and 8 meters. The depth to water found in the nearest drilled wells ranges from 24 to 30 meters, which is the most probable depth at which the water in the projected well for the Project will be found.

It should be taken into account that the semi-confined aquifers are at higher hydrostatic pressure than atmospheric, so that the water level inside the well does not correspond to the depth of the aquifer, the water level will rise according to its piezometric load, that is to the water pressure.

5.2.9.2.2 Groundwater movement

In the investigated area, the groundwater moves towards the West, towards the Pacific Ocean, as can be seen in Figure 5.19.

It should be noted that the recharge areas of the deep confined aquifer are not defined because they are normally located in very distant areas and the information available, as well as the scope of the ongoing study, are not sufficient to make a regional study that covers the recharge zones of the deep aquifer, in the Santa Ana volcanic complex - Cerro Verde - Izalco, until its discharge in the Pacific Ocean.

5.2.9.2.3 Hydraulic gradient.

The hydraulic gradient of the underground flow is defined as the difference between the elevation levels of the piezometric surface divided by the horizontal distance that separates the reference points, usually the piezometric curves.

Keeping the topographic conditions uniform, a minor hydraulic gradient would represent a better permeability of the land.

In the Project area, the underground water flowing under the ground flows with a variable hydraulic gradient, as this value is influenced by the land topography and mainly the piezometric surface. It has been estimated that the value of the hydraulic gradient ranges from 0.31% to 0.55%.

5.2.9.2.4 Transmissivity

The wells drilled in the area, cross stratified aquifers and the gratings have been placed in such a way that all aquifers present are used, therefore, the value of transmissivity found is basically an average of all aquifers. In the Project area, the Transmissivity ranges from 7 m2 / d to 983 m2 / d. It is estimated that the transmissivity that will be found in the field investigated will be approximately 300 m2 / d.

This property of the aquifer depends on its thickness and the hydraulic conductivity of the geological strata or materials that constitute it. All the deep wells around the Project site are exploiting the same semiconfined aquifer.

5.2.9.2.5 Storage Coefficient.

The Storage Coefficient is a property of aquifers that cannot be established from pumping tests that lack observation wells. This feature establishes the boundaries between what is a free aquifer and a confined aquifer.

In the study area, aquifers have been evaluated with the support of observation wells, such as CEPA Well No. 60, however, values have been estimated in the order from 0.01 to 0.005, and making a stratigraphic analysis in the area, we can say that the aquifers are being used.

In the area thses are free to semi-confined. This condition is important to perform the calculations of the capture area of the well, this can be better understood in the lithological profiles, where layers of strata and water level are seen.

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MAPA DE INVENTARIO DE POZO Y CURVAS ISOFREÁTICAS / MAP OF WELLS INVENTORY AND PHREATIC CURVES

FIGURA 5.19 / FIGURE 5.19

- POZOS EXCAVADOS
- POZOS PERFORADOS
- DIRECCIÓN DE FLUJO
- CURVAS PIEZOMÉTRICAS
- CARRETERAS ASFALTADAS
- RÍOS PRINCIPALES
- RÍOS SECUNDARIOS
- QUEBRADAS
- SITIO DEL PROYECTO
- TERRENO PROPIEDAD DE CEPA
- CUENCA DEL RÍO EL ALMENDRO
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN SITE

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5.2.9.3 Availability of Water Resources

Among all the basins that drain the country, there is a volume of 56,052.31 Mm^3 of water that falls as rain, of which 947.37 Mm^3 (1.69%) represent the evaporation of bodies of water. 31,762.78 Mm^3 (56.67%) are lost by actual Evapotranspiration. 130.29 Mm3 (0.23%) by evaporation in urban areas; 18,251.89 Mm^3 (32.56%) due to surface runoff and 4,959.98 Mm^3 (8.85%) represent the average storage change (SNET, 2005).

The storage change represents the subsurface flow that is generated in the basins, the recharge to the aquifers and the variations of the bodies of water. The negative values in storage changes occurring in some basins indicate that they do not generate surpluses on their own. However, that does not mean that there is no groundwater in it. What it means is that there may be an underground transfer from another basin that is contributing to the amount of water that the basin has or is being taken from its storage, and that the volume stored in an aquifer is considerably greater than that which is renewed in each hydrological cycle.

It is important to mention that the results obtained are annual averages of a period of 30 years, so that the individual values of each year may vary depending on the climatic conditions that arise. In years where the phenomenon of "El Niño", or droughts occur, these storage changes will be much smaller than the data obtained as average.

Figure 5.20 shows the Storage Change map in millimeters. As can be seen, the largest change in storage or recharge of aquifers occurs around the Santa Ana volcanic complex, which explains the high rates of groundwater extraction at Sonsonate and Acajutla. Table 5.18 shows the availability of water resources by hydrographic region.

The Hydrographic Region D, in which the Project area is located, presents a surface runoff of 497.29 x106 m^3 and a change of storage or recharge of aquifer of 246.84 x106 m^3, equivalent to a flow of 7.83 m^3 / s.

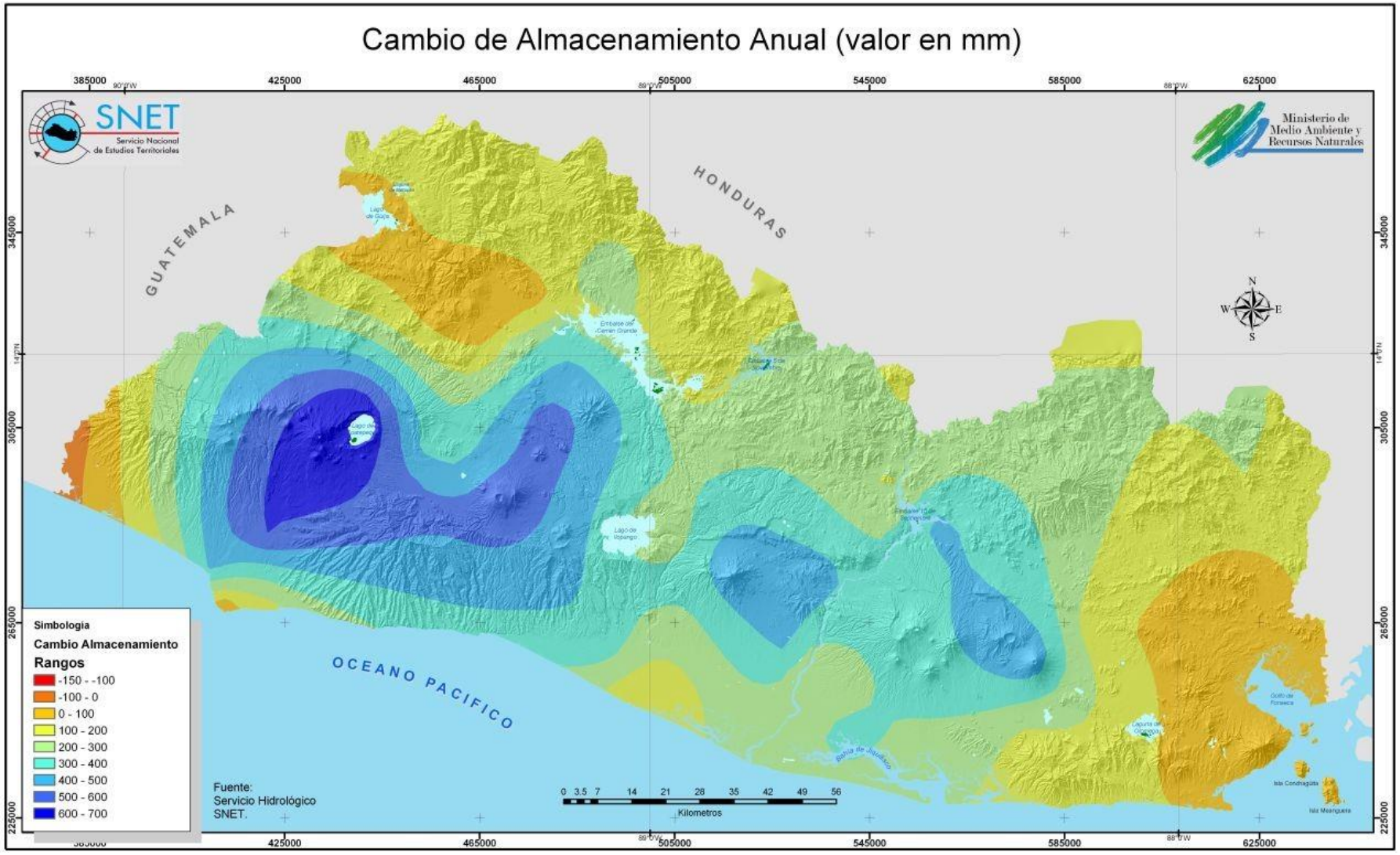
The aquifer of the Acajutla area is of good yield, as evidenced by some wells drilled in the area. However, several wells in industries and ANDA have a production between 40.0 and 60.0 l/s.

Table 5.18 – Water Resources by Hydrographic Region (Mm^3)

HYDROGRAPHIC REGION	AREA (Km^2)	PRECIPITATION	EVAPORATION OF WATER BODIES	REAL EVAPOTRANSPI-RATION	EVAPORATION OF URBAN AREAS	SURFACE RUNOFF	STORAGE CHANGE
A. LEMPA	17978.51	32483.41	528.08	18299.74	72.47	10937.19	2645.92
B. PAZ	2633.02	3616.63	56.03	2652.35	10.43	1104.72	206.91
C. CARA SUCIA-SAN PEDRO	769.16	1424.73	5.57	785.69	2.93	449.19	181.35
D. GRANDE DE SONSONATE-BANDERAS	778.43	1472.99	2.29	721.01	5.56	497.29	246.84
E. MANDINGA-COMALAPA	1294.22	2469.48	2.47	1258.88	5.36	663.03	539.74
F. JIBOA-ESTERO JALTEPEQUE	1638.62	3004.02	177.35	1554.20	8.96	782.28	481.23
G. BAHIA DE JIQUILISCO	779.01	1388.90	59.83	742.78	4.05	340.40	241.84
H. GRANDE DE SAN MIGUEL	2389.27	3782.03	68.91	2187.60	10.39	1182.65	332.47
I. SIRAMA	1116.79	1775.84	29.02	1042.72	3.66	481.18	219.27
J. GOASCORAN	2427.98	4634.28	17.82	2517.78	6.49	1813.94	278.24
TOTAL	**31805.01**	**56052.31**	**947.37**	**31762.78**	**130.29**	**18251.89**	**4959.98**

Source: SNET, 2005

Figure 5.20 – Change of Storage or Aquifer Recharge



Source: SNET, 2005.

5.2.9.4 Groundwater Quality

The quality of the groundwater is not immutable, it depends on the residence time that the water has had in the aquifer and the type of geological materials with which it has had contact. The underground water dissolves the elements present in the geological environment and incorporates in its composition. This alters its physical and chemical properties, including its content of salts and therefore its electrical conductivity.

Some basic field parameters were taken in some of the excavated wells. In addition, as an initial premise, it is understood that fresh infiltration waters generally have a typical variation of some parameters, such as pH, Temperature, Electrical Conductivity and Total Dissolved Solids, which tend to be lower, but in deeper waters with more residence time, these physical parameters increase their value.

These physical and chemical changes are related to the ability of water to form bonds with existing ions in the environment. For example, oxygen atoms adhere to iron atoms and form oxides. The water's ability to form these bonds is very unique because their molecules are like small magnets with positive and negative charge that trap ions of both polarities.

It is also observed a peculiar variation common among the Bicarbonates, Sulphates and Chlorides. This variation corresponds to the following sequence: HCO_3> SO_4> Cl, which is inverted in the discharge zones of deep aquifers. That is to say that Cl> SO_4> HCO_3, so that the quality of the water can reveal the origin of the underground flow and the residence time that it has had.

Table 5.19 shows the results obtained in the mentioned analysis, considering the parameters that help to know the possible residence time of the water and therefore its probable origin.

Table 5.19 – Basic Physicochemical Parameters

NAME	NORTH	EAST	ELEV. (MSNM)	PH	TEMP	STD	CND	HCO_3 (MG/L)	SO_4 (MG/L)	CL (MG/L)
Col. Alvarado	273325.00	411212.00	31.32	7.37	30.4	120.00	338.00			
Pozo ALBA	272771.77	411297.73	24.22	7.68	31.00	103.00	307.00			
Hda. El Zope	273255.60	412340.12	32.71	6.30		385.00		155.80	37.04	34.00
Valentín Sánchez	271831.37	411318.58	20.30	6.66	28.900		536.00			
Abelino Esquivel	273378.57	412691.71	30.50	6.68	29.70	110.00	223.00			
Zolia Cordero	273373.49	412159.48	32.86	7.63	28.60	28.6	317.00			
Hda. Kilo 5	276300.00	413200.00	54.94	6.55	29.80				63.00	31.00
Duke No.6	272700.00	412950.00	33.32	7.80	30.50	180.00	360.00	138	13.00	18.00
Chevron	273241.80	410403.70	16.00	7.20		142.00	285.00	182.30	3.60	25.80
Maura Valenzuela	272978.25	410228.17	18.92	6.91	28.30	692.50	1385.00			

Table 5.19 – Basic Physicochemical Parameters										
NAME	**NORTH**	**EAST**	**ELEV. (MSNM)**	**PH**	**TEMP**	**STD**	**CND**	**HCO_3 (MG/L)**	**SO_4 (MG/L)**	**CL (MG/L)**
Moisés Contreras	273199.25	411196.97	29.55	6.93	29.30	552.00	1104.00			
Sebastián Ruano	274070.88	409732.91	15.50	6.61	27.80	906.00	1812.00			
Jorge Alemán	274893.98	411653.67	37.66	6.82	28.70	530.50	1061.00			
Cristina Rodríguez	276775.33	413367.00	60.82	6.49	27.70	280.00	560.00			
Nubia Ramos	277038.72	412619.83	57.36	7.03	26.90	517.50	1035.00			
Angélica Peleón	275486.33	412779.95	46.56	6.75	28.25	245.50	491.00			
Hda. El Polvón	277450.00	416626.00	74.32	6.33	28.50	345.00	440.00	189.28	55.75	27
Punta Remedios	270807.00	413260.00	21.23	6.49	29.80	489.00	750.00	263.23	31.5	36

Source: The information presented in this Table was taken in the field and some studies during the ongoing research.

From the above Table it is observed that the variation of the Electrical Conductivity increases in the direction of the discharge zone of the aquifers in the Pacific Ocean. The pH value seems constant in the excavated wells, and it increases in the drilled wells of greater depth. This makes it evident that to a greater depth are the ground waters with a longer residence time.

With respect to chlorides it was not possible to cover the whole area, but the values obtained are not abnormal. It seems that these are normal ground waters, better said, Bicarbonated.

Table 5.20 shows results of the analysis of the waters extracted in some drilled wells in the study area.

Table 5.20 – Results of Physicochemical Analysis of Water				
PARAMETER	**MAXIMUM ADMISSIBLE LIMIT**	**COLONIA ALVARADO**	**DUKE ENERGY 6**	**CHEVRON**
Ph	9.00	7.70	7.80	7.20
Odor		Not objectionable	Non-Characteristic	Not objectionable
True color (Pt-Co)	15.0	1 Pt-Co	0	1Pt-Co
Apparent color (Pt-Co)		-	0	1Pt-Co
Turbidity (UNF)	5.0	0.25	0	1.0
Total Dissolved Solids (ppm)	600.00	222	180	142
Total Alkalinity (mg/L)	350.0		138	182.3
Total hardness (mg/L)	400.0	102.80	94	110.6
Carbon dioxide (mg/L)			8.41	24.5
Conductivity S/m	1,600.00		360	285
Carbonate hardness			94	110.6

Table 5.20 – Results of Physicochemical Analysis of Water				
PARAMETER	**MAXIMUM ADMISSIBLE LIMIT**	**COLONIA ALVARADO**	**DUKE ENERGY 6**	**CHEVRON**
$CaCO_3$				
Calcium (mg/L)	75.0		17.6	23.3
Magnesium (mg/L)	50.0		12.15	12.7
Total iron (mg/L)	0.30	<0.05 mg/L	Traces	0.16
Dissolved iron (mg/L)			0	0.08
Total manganese (mg/L)	0.10	0.05		0.15
Dissolved Manganese (mg/L)			0	0.1
Carbonates (mg/L)			0	0
Bicarbonates (mg/L)			138	182.3
Hydroxides (mg/L)			0	0
Chlorides mg/L	25.00		18	25.8
Nitrates (mg/L)	45.00	< 1.0 mg/L	0.08	0.02
Sulfates (mg/L)	250.00	15.70	13	3.6
Silica (mg/L)	125.00		91.98	25
Fluorides (mg/L)	1.50		0.31	0.5

Source: Own elaboration 2014.

According to the information of this physicochemical analysis there is no evidence that the groundwater in the Acajutla area is contaminated with sea water. However, it will be necessary to keep monitoring the quality of the water extracted from the well to confirm its potability or to determine whether prior treatment is required.

In these analyses, there are no results that reveal contaminates of industrial origin. However, there have been detected in some wells the presence of Fecal Coliforms, indicating a source of bacteriological contamination that requires a conventional disinfection treatment with chlorine. When drilling a well, it is always necessary to carry out the physicochemical and bacteriological analysis on the extracted water: Based on these results, it is verified whether a treatment of the water prior to its consumption is necessary, in case the water is used for drinking.

5.2.9.5 Danger of Groundwater Contamination

The industrial zone of Acajutla has such characteristics that there is always a risk of impact on the quality of groundwater, due to the discharges that occur from all industries present in the area. Given the scope of this study, no survey has been carried out of all possible sources of industrial emissions that exist in

the Acajutla area. However, it is obvious that there is a possibility of leakage of compounds derived from petroleum or another type of emission that could affect the quality of groundwater.
It is expected that any industry present in the area is taking the necessary measures so that their spills or leaks do not damage irreversibly the environment. It is also expected that the corresponding public entities are carrying out monitoring work to prevent a situation of emission that is irreversible.

The source of the most frequent emission is from the latrines of the surrounding communities: However, this type of emission generated by such cesspits is of bacteriological character, and can be eliminated with a basic treatment of chlorination. On the other hand, deeper aquifers are less vulnerable to this type of emission because microorganisms do not survive for long periods in the geological environment.

5.2.9.6 Risk of Saltwater Intrusion

In every coastal aquifer, there is a risk of contamination due to the phenomenon is known as Saltwater Intrusion, which is basically the permanent or temporary movement of sea water inland, displacing fresh water. Water from a well in a coastal aquifer is contaminated (salinised) when the grating or caption area is affected by the mixing zone of fresh water and salty water or by the salty water itself.

The simplest way to determine the position of the salt- wedge is through the Ghyben - Herzberg formula, which says that the interface of freshwater and saltwater is located at a depth below sea level equal to 40 times the level of fresh water above average sea level at that point. This means that if it is known that there is a salt-wedge, this will rise 40 times as the fresh water level drops.

The existence of a saline intrusion will be evidenced by a change in the quality of the water extracted from wells. Basically, the increase in the content of Chlorides will be determinant in any evaluation of saline intrusion.

Generally, in aquifer formations containing two miscible liquids (fresh water or salt water), there is no abrupt or boundary interface. It passes from one fluid to another through a mixing zone called the diffusion zone or transition, which reflects the chemical and hydraulic properties of each of the original liquids and their width, depends on the diffusivity and dispersity of the medium and the characteristics of the medium.

The balance of freshwater-saltwater in the coastal aquifer is a function of the flow of fresh water flowing into the sea either through the surface watercourse or through underground course. This would explain the phenomenon that exists in the area of Acajutla, where despite the nearness of the coast, the perforated wells do not present evidence of saline intrusion. As already mentioned, it is estimated that

an approximate flow of about 3 m^3 / s penetrates from the Río Banderas basin and transits the area towards the ocean.

On the other hand, the chemical analyses available to date have been reviewed, which do not show a saline intrusion. For example, for the wells DISAGRO1, DISAGRO3 and DUKE6 (wells with complete chemical analyses), the Calcium / Magnesium ratio oscillates between 1.2 and 1.8 mg/L, the Calcium/Sulphate ratio ranges from 0.46 to 1.35 mg / L, the Sodium / Chloride ratio varies from 0.78 to 1.51 mg / L. Appendix 5J includes laboratory results and chemical relationships.

These same values for seawater have the following values: Calcium / Magnesium Ratio is 0.319 mg / L, Calcium / Sulphate is 0.152 mg / L, Sodium / Chloride is 0.556 mg / L. As can be seen, the values obtained in the available analysis are far from the characteristics of seawater; therefore, to date, there are no indications of saline intrusion in Acajutla. Further details are presented in the hydrogeological study in Appendix 5J.

5.2.10 Coastal Processes: Bathymetry, Tides, Ocean Currents

The Port of Acajutla can be classified as a semi-protected area. The protection is given by Punta Remedios which is located to the South-Southeast, and by the coastline to the West-Northwest, for winds and waves of approximately three of the four quadrants.

There is no natural protection for winds and waves from the general area of the Southwest quadrant. The oceanography report is included in Appendix 5K.

5.2.10.1 Observed Tidal Data for Acajutla

The tides in the Port of Acajutla are semi-diurnal with two highs and two lows each day of tide. See Table 5.21.

Table 5.21 – Tidal Data

Place	Height of Survey Data, Adjusted to Data Table					Tidal Characteristics
Acajutla	High Tide		Mean Sea	Low Tide		Semidiurnal
N13°34’25.75”	Spring Tide	Slack Tide	Level (MSL)	Slack Tide	Spring Tide	
W89°50’17.32”	2.0m	1.6m	1.0m	0.60	0.0m	

Source: ACAJUTLA LNG Site data compilation Tractebel engineering Ed.2012/10/18.

Goda (2000) recommends that, for design at coastal depths, the design height should be 1.8xH1 / 3, so that the recommended design height is: H design = 1.8 x 4.43 m = 7.97 m. The operating platform at the lowest Marine Terminal is 8m, 2m above the breakwater, so the recommendation is duly met.

5.2.10.2 Marine currents in front of the Port of Acajutla

To determine the characteristics of the currents in the Project area, the following methodology was used:

- Deep water: Simulation data on numerical models using sea temperature and surface wind were downloaded from the MyOcean platform and a monthly climatology was reconstructed from monthly data available from 2001 to 2012. Fortran Programs were used to sort and graph this data.
- In front of the port: Data of an ADCP[8] anchored buoy of the Port of Acajutla (Figure 5.21), were acquired from the Ministry of Environment and Natural Resources (MARN) of El Salvador. Two periods were analyzed, one from September 2012 to February 2013, and the other from May 2013 to October 2013. Fortran and Matlab software were used to organize, average, and plot this data.

Figure 5.21 – Location of Port of Acajutla Buoy

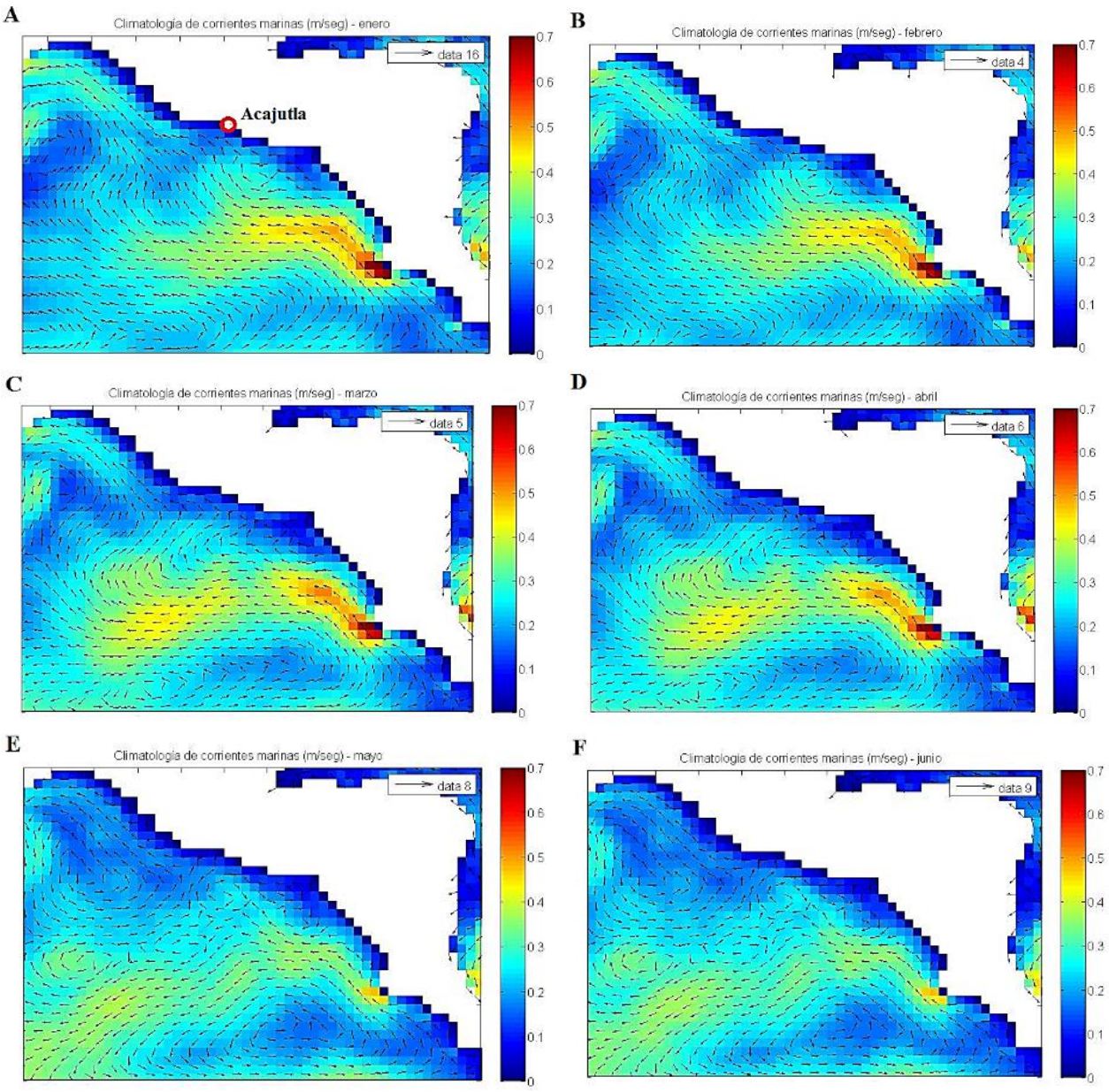
Source: Consulting Team

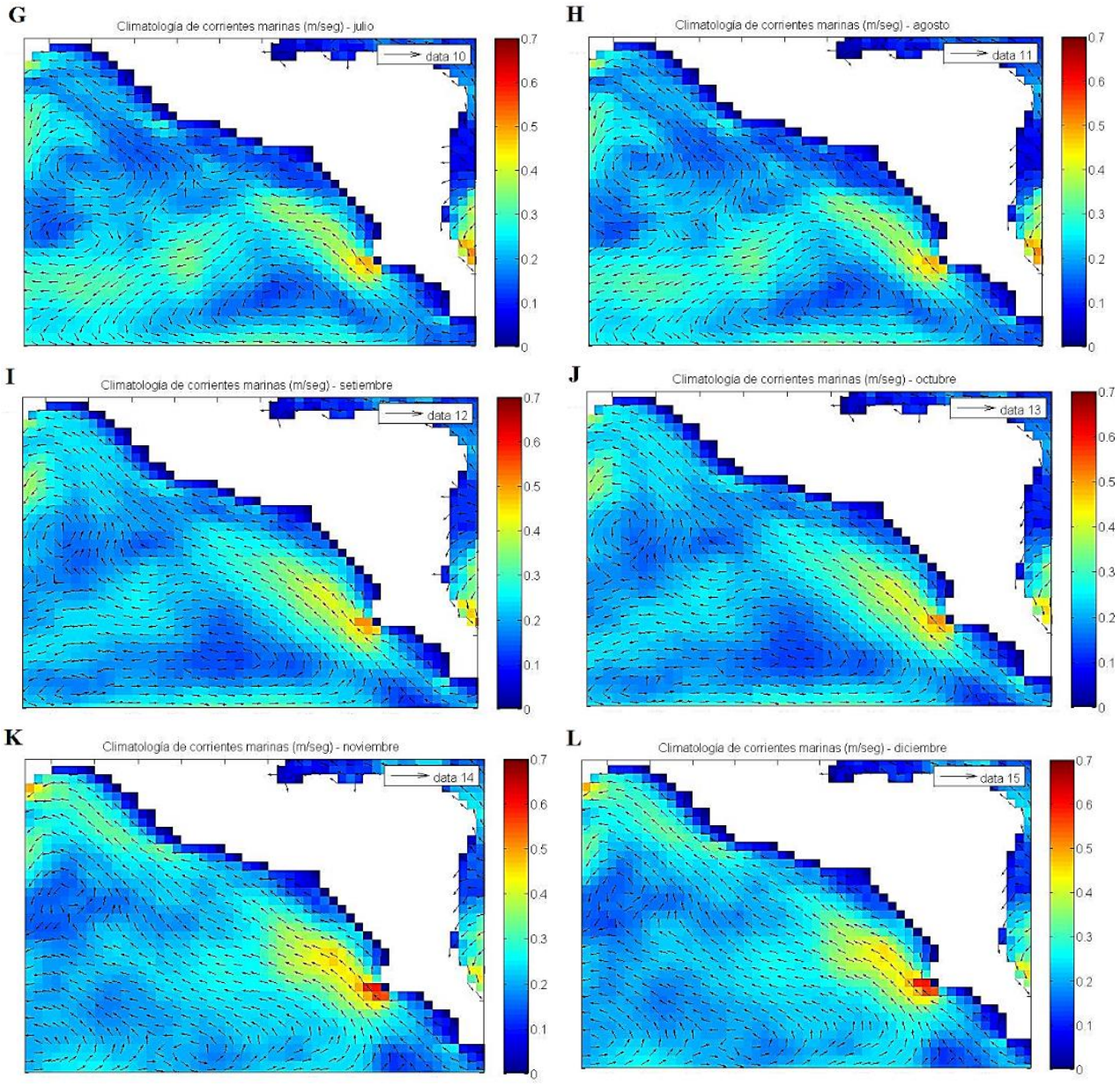
[8] "Acoustic Doppler Current Profiler" is a sonar-like hydroacoustic current meter that attempts to measure the velocities of water currents in a depth range using the Doppler effect of scattered sound waves that return from particles within the range of the water column.

5.2.10.3 Characteristics of Deep Water Marine Currents:

Figure 5.22 show the climatology of offshore currents that were modelled for this study.

Figure 5.22 – Monthly Climatology of Submarine Currents in El Salvador





Source: Consulting Team

From the analysis of the previous figures we can conclude the following:

a) In the first months of the year: January to April, there is a flow towards the west-northwest to the front of El Salvador with a current that meanders slightly in front of this region
b) For May and June shows a clockwise movement in front of this area;
c) In July returns a flow toward the northwest with a slight meandering in front of the region;
d) The flow is more coherent towards the northwest from August to December; and,
e) In all cases, the currents in front of this region do not exceed 0.2m / sec

5.2.10.4 Characteristics of Coastal Marine Currents

The analysis of ADCP (Acoustic Doppler current profiler) currents from the anchored Acajutla Port buoy (Figure 5.23 and 5.24) show a great variety in the direction of the currents in the water column. As shown in the figures included in the Appendix 5K. Independently of any daily variability, the measured currents from the buoy, have a strong southeast component. Given the directions of the offshore currents shown in Figures 5.23 and 5.24 sometimes the greatest frequency of currents to the northeast could be explained by the deep water circulation in the clockwise direction noted in the first months of the year in this area. But it could also be related to the interaction of offshore currents with coastal geomorphology south of the port.

Statistical analysis of the records of these flows is summarized in Table 5.22 and Figure 5.23 and following

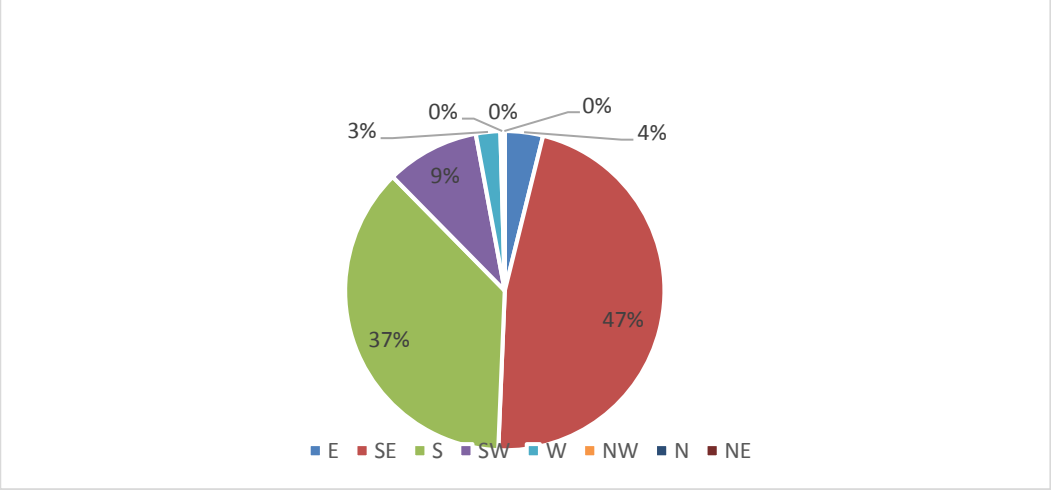
Table 5.22 – Some Statistics of the Marine Currents (in m / sec) Measures by the ADCP in Port Acajutla between September 2012 and February 2013

Direction	Frecquency	Average	Maximum	Average Direction*
E	370	0.12	0.25	101.44
SE	4481	0.18	0.40	139.60
S	3541	0.17	0.36	174.95
SW	906	0.16	0.33	220.06
W	237	0.18	0.29	263.70
NW	34	-	-	-
N	0	-	-	-
NE	8	-	-	-

* Average direction to where the currents go.

Source: Own elaboration

Figure 5.23 – Frequency of Direction of ADCP Currents Measures between September 2012 to February 2013



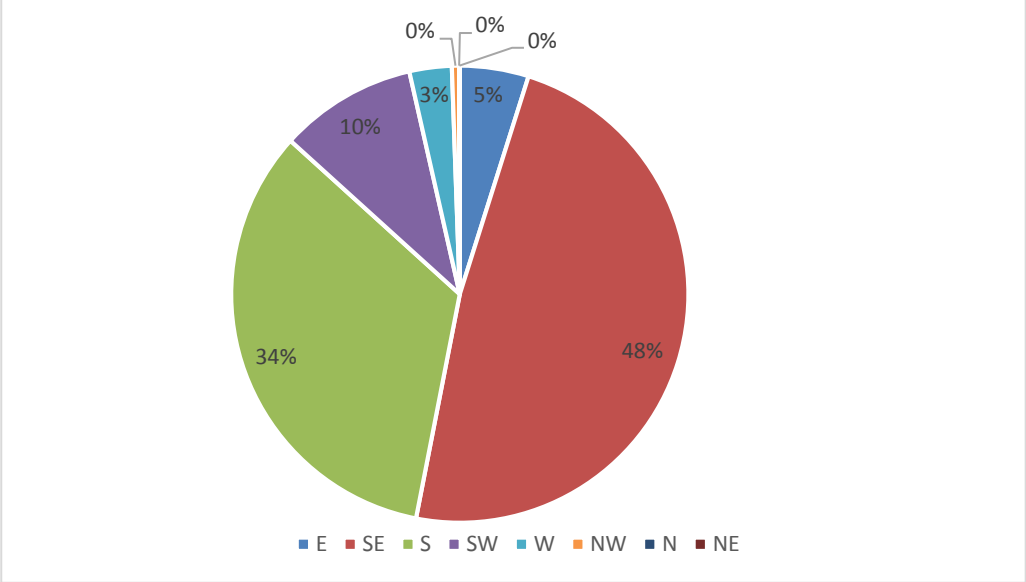
Source: Own elaboration

Table 5.23 – Some Statistics of the Marine Currents (in m / s) Measures by the ADCP in Port Acajutla between May and October of 2013				
Direction	**Frequency**	**Average**	**Maximum**	**Average Direction***
E	540	0.12	0.25	101.44
SE	5350	0.13	0.30	138.70
S	3734	0.12	0.39	175.76
SW	1080	0.12	0.28	138.70
W	332	0.14	0.28	265.10
NW	57	-	-	-
N	0	-	-	-
NE	5	-	-	-

* Average direction to where the currents go.

Source: Own Elaboration

Figure 5.24 – Frequency of Direction of ADCP Currents Measures between May and October of 2013



Source: Own Elaboration

Again, these results are consistent with the directions of the current vectors in Figures 2.6, 2.7 and 2.8 of Appendix 5K, which evidence a higher frequency of the SE addresses, followed by the S, and then SW.

The averages and the maximum speeds are slightly higher for the months at the end of the year (September 2012) and at the beginning of the year (February 2013), than for the months during the middle of the year (May to October 2013).

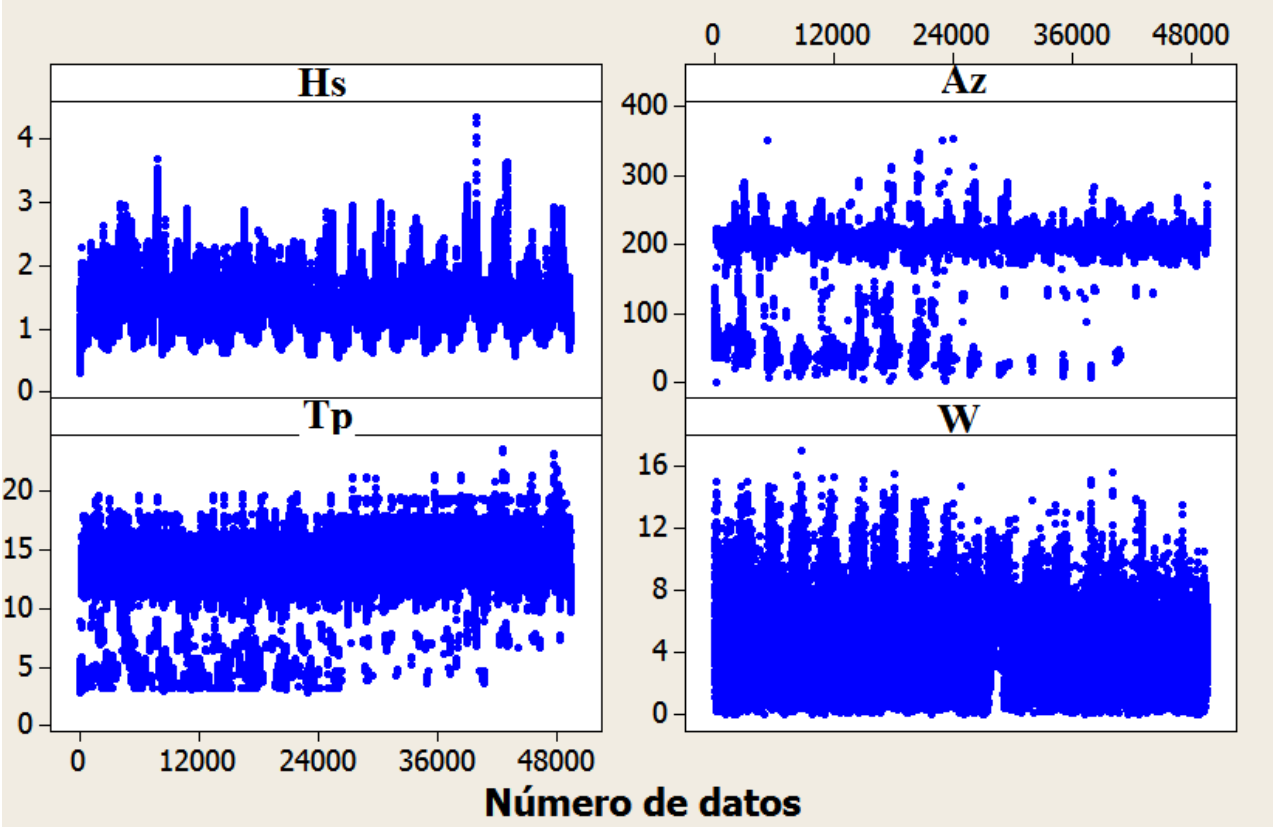
5.2.10.5 Characteristics of waves and wind in front of Puerto Acajutla

Data from the 3-hour re-analysis of wave (magnitude, direction and period) and wind components of the Wavewatch III Model (hereafter WW3) from February 1997 to 2013 were downloaded monthly from the

Environmetal Modeling server Center of NOAA. These data was decompressed and extracted specifically for the Pacific region of El Salvador (13.5N, 90.5W). Each data series has 49 441 values. They were reviewed to see their quality and consistency. Some suspicious values were deleted which can be seen in Appendix 5K.

Wave and wind data series (offshore, or deep water) were analyzed from the re-analysis of the NOAA WW3 model forecasts worldwide. There is data from 1997 to present. The following Figure 5.25 shows these series:

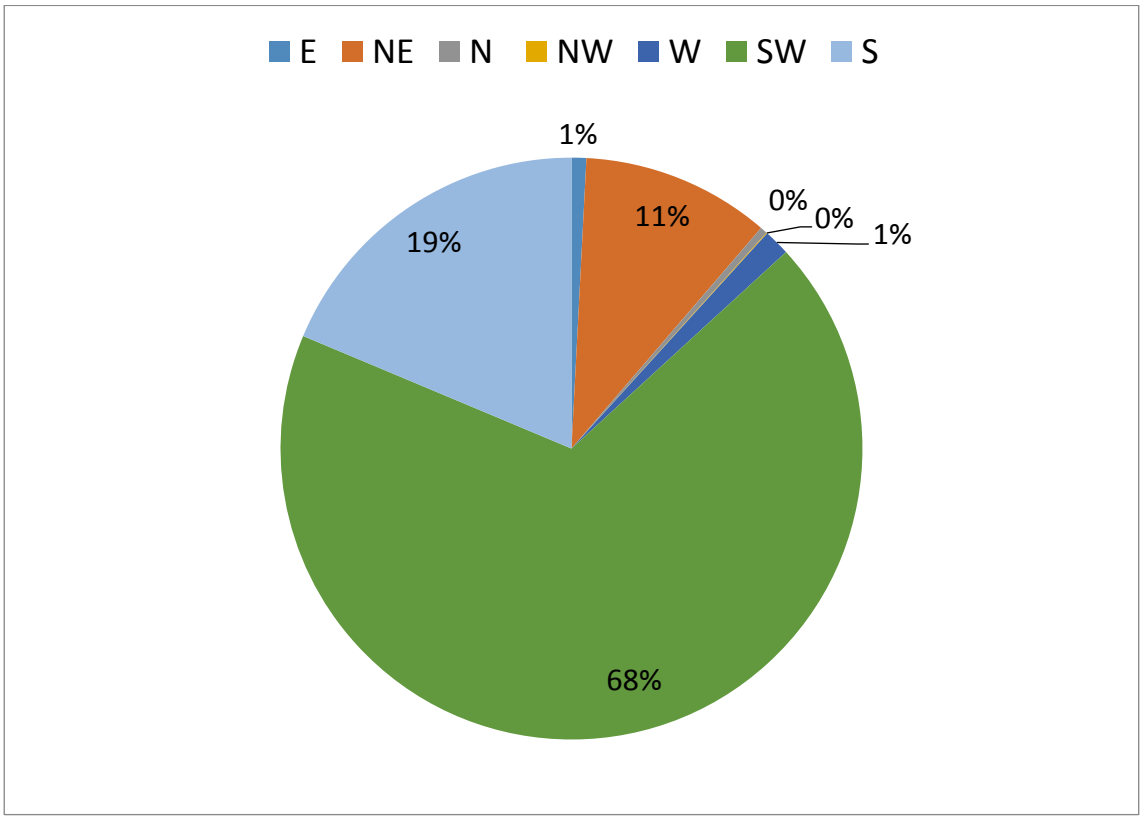
Figure 5.25 – Data series of the Re-analysis of Wavewatch III of Hs: Height (m) Significant of the wave, Az: Direction (degrees) of the wave, Tp: period (sec) of wave, and W: speed (m/sec) of the Wind



Source:Own Elaboration, 2014

The frequency analysis of the different directions from where the wave comes to the position of the WW3 model in front of El Salvador is shown in Figure 5.26.

Figure 5.26 – Distribution of the frequency of direction of the waves in front of El Salvador



Source:Own Elaboration, 2014

As shown in the above Table, the highest frequency of waves is from the Southwest (68%), followed by the South (19%) and then the Northeast (11%).

An interesting fact is that in this region, a significant percentage of wave generation is from the northeast. That is, in the offshore position from which the data was taken, there is enough scope for "Ocean Swell" type of wave generation (Lizano, 2007), which is directed towards the Southwest, and that has not been taken into account for this study, since this swell does not reach the Port of Acajutla. See Table 5.24.

Table 5.24 – Average Characteristics of the Wind and Wave Series for the Pacific in front of Puerto Acajutla			
Averages	**Directions**		
	SW	**S**	**NE**
$H_{1/3}$ (m)	1.40	1.34	1.41
Hmax (m)	3.50	2.52	2.72
Tp prom (seg)	13.33	12.45	4.6
Tp max(seg)	19.85	19.63	6.48
Tp min(seg)	3.15	3.14	2.79
θ_H (°)	212.80	195.50	40.62
W prom (m/seg)	4.17	4.14	8.76
W max (m/seg	15.23	13.9	17.06
W min (m/seg	0.00	0.02	0.50
θ_W (°)	191.54	190.00	225.58

$H_{1/3}$: Significant wave height

Tp prom (seg): Average wave period

Tp max(seg): Maximum period of the wave

Tp min(seg): Minimum period of the wave

θ_H: Direction to the north of the wave from where it comes

W: Average wind speed magnitude

θ_W: Direction to the north of the wind where it goes

Source: Own Elaboration

As indicated in Table 5.24, the highest wave heights in this region occur from the west, followed by the southwest, and then south. The longer periods of the waves would be from the southwest with almost 24 sec. The highest wind speeds would occur from the southwest and then west. Table 5.25 shows the wind characteristics in all possible directions.

Table 5.25 – Average characteristics of the series of wind (m/sec) for the Pacific in front of Puerto Acajutla				
Direction	**Frequency**	**Average Speed**	**Max. Speed**	**Average Direction**
N	4465	3.28	14.42	91.77
NE	3434	3.31	15.64	44.40
E	5093	3.75	15.20	267.34
SE	4967	3.41	10.25	315.72
S	6593	4.21	14.75	180.33
SW	13111	6.05	17.06	227.27
W	5077	3.94	12.61	190.83
NW	6701	4.45	13.15	137.12

Av.speed: average speed

Max. Speed: maximum speed

Ave.Direction: Average direction to the north to where the wind blows.

Source: Own Elaboration

According to the results of the previous Table, the wind blows in all directions in this region, being of greater frequency to the southwest direction. The direction also from having greater average speeds and the maximum speeds. Within Appendix 5K can observe the wave dispersion data and the wave period.

5.2.10.6 Analysis of Extreme Events on the Pacific in front of El Salvador.

An analysis was made of extreme values of the series of waves and wind of the re-analysis of WW3 to determine, through statistical distributions for long period, periods of return (RP) of waves and wind in the region of study.

As the possible directions of the waves that can reach Acajutla are south-west and south, all series were filtered according to these directions (height, period and direction of wave, magnitude and direction of the wind) to conduct the respective analysis.

An additional analysis was made with the extreme values of height and wave period to establish the relations between these two variables, and then to be able to use the information in the propagation of waves towards the interior of the Puerto de Acajutla. The Figures in Appendix 5K show this analysis, which also includes the equation that relates both variables and Table 5.26 summarizes the results of this extreme wave analysis.

Table 5.26 – Return Periods (RP) for the Swell in front of the Coasts of El Salvador. Distribution FT-I **, Kamphuis (2002)

W10-			S9.5+		S9.5.		SW10+		SW10-	
PR	***$H_{1/3}$**	**Tp**	*** $H_{1/3}$**	**Tp**	*** $H_{1/3}$**	**Tp**	*** $H_{1/3}$**	**Tp**	*** $H_{1/3}$**	**Tp**
2	3.43		2.93		2.41		3.30		3.53	
5	3.80		3.02		2.66		3.72		3.68	
10	4.05		3.09		2.83		4.02		3.79	
25	4.61		3.17		3.05		4.41		3.93	
50	4.84	9.56	3.17	13.93	3.20	6.56	4.70		4.03	8.74

W10-: Swell of the west with periods of waves smaller than 10sec.
S9.5+-: South swell with periods of waves over 9.5sec.
S9.5-: South swell with periods of waves smaller than 9.5sec.
SW10+: Southwest swell with periods of wave greater than 10sec.
SW10-: Southwest swell with periods of waves under 10sec.
* : Criterion of the extreme event threshold on H1 / 3 = 2.5 m for S, 2.75 m for SW10 + and S9.5 +, and 3.0 m for W10 + and SW10-.
**: Statistical distribution Fisher-Tippett Type I .

Sorce: Own elaboration

A wind analysis was also carried out with respect to the time series of the wind, and for each direction of interest. The summary of this analysis is presented in the following Table 5.27:

Table 5.27 – Return Periods for extreme wind magnitudes (m/sec) according to the direction for the Pacific in front of Puerto Acajutla. FT-I Distribution

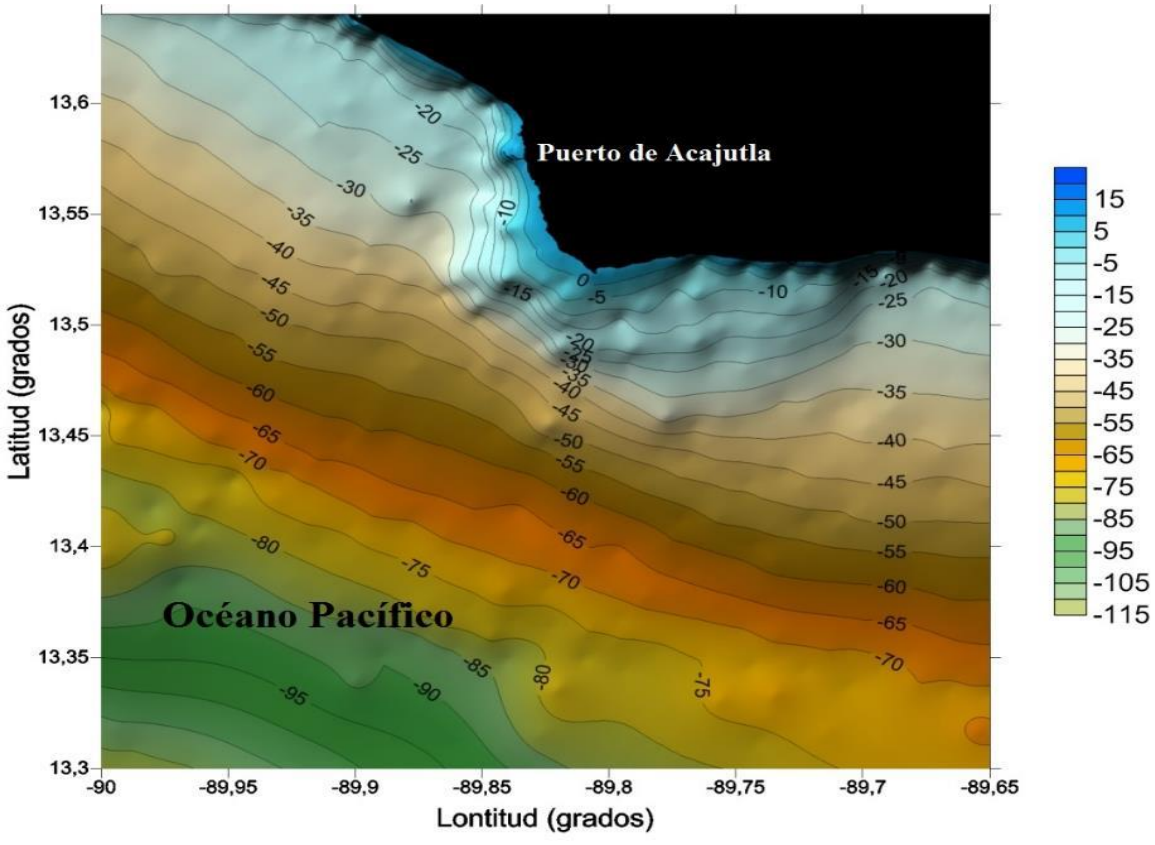
PR	S	SE	E	NE	N	SW	W	SW
2	12.71	9.13	11.65	13.33	8.48	11.63	13.31	15.07
5	13.41	9.58	12.12	14.21	10.67	12.14	13.86	15.55
10	13.92	9.87	12.45	14.81	12.12	12.49	14.22	15.89
25	14.57	10.25	12.88	15.58	13.96	12.94	14.68	16.34
50	15.06	10.53	13.20	16.16	15.32	13.27	15.03	16.67

Source: Own Elaboration

5.2.10.7 Bathymetry in front of Puerto Acajutla:

The bathymetries used for the propagation of waves from deep water to the coast of Puerto Acajutla are shown in the following Figure 5.27:

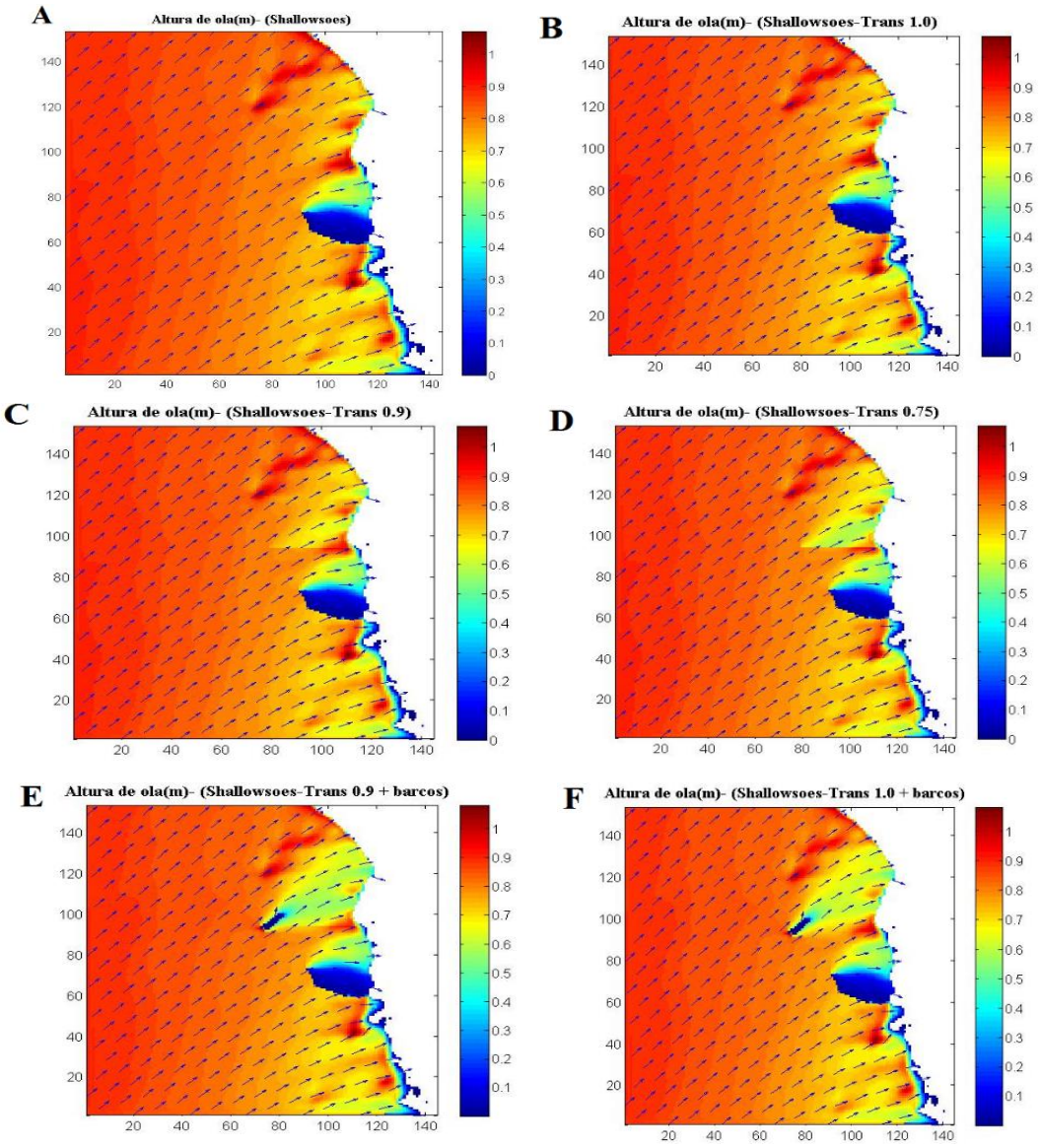
Figure 5.27 – Bathymetric contours (m) to propagate deep water swell in front of the Port of Acajutla



Source: Own elaboration

1m waves were spread from the south-west and south, in order to study the possible wave damping of the marine terminal, and the diffraction of the waves that the ships anchored, could generate. This allows us to evaluate the possible coastal modification to the northwest of this zone, which could generate this new wave pattern. The characteristics of the wave propagation towards the Port of Acajutla with different configurations for different conditions of the project's marine terminal and FSU, are shown in Figure 5.28, as well as the average conditions of waves and wind.

Figure 5.28 – Distribution of 1m Swell in Deep Water



Source: Consulting Team.

As shown in the above Figures, the current Acajutla pier, and the terminal with a 100% wave transmission, would not produce any change in the north-wave pattern of the project. As the structure produces a damping of the wave, a shade (less wave height) is generated to the north of this structure. Different cushions were tentatively put in place to see the effect of the terminal on the wave pattern (Figures 5.28, C and D).

The boats when anchoring at the marine terminal generate a wave shadow (by refraction and diffraction) to the northwest of this zone (Figures 5.28, E and F).

5.2.10.8 Extreme Conditions of Swell and Wind:

The summary of the characteristics of the swell and wind in extreme conditions are shown in the following Table 5.28:

Table 5.28 – Summary of characteristics of swell and extreme wind that was used for the status of the sea in front of the Acajutla Port

Direction	$H_{1/3}$ (m)	Tp(sec)	W (m/sec)	Az (degrees)
W10-	4.84	9.56	15	0.0
S9.5+	3.17	13.93	-	-
S9.5-	3.20	6.56	15	90
SW10+	4.70	12.07	-	-
SW10-	4.03	8.74	15	45

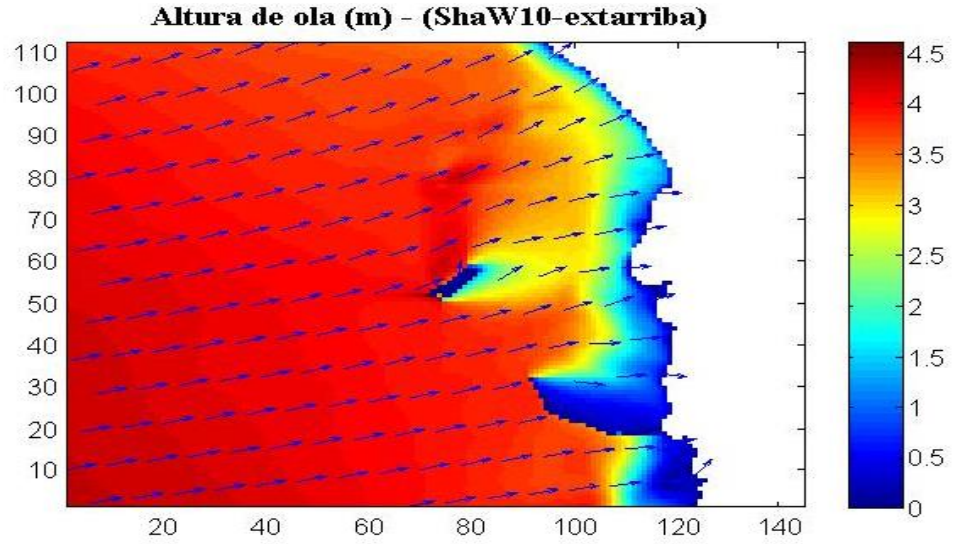
Source: Consulting Team.

Az: Wind direction where it goes with respect to the x + axis (convention used by the wave model).

Since it has been shown that the highest waves are of local origin, only a maximum wind in the same wave direction (more severe condition) has been used for short-term wave conditions. In the case of longer periods of 10 sec waves, which correspond to remote tides, local wind was not considered.

The propagation of this extreme wave is shown in Figure 5.29.

Figure 5.29 – Distribution Of Height (M) of Extreme Wave in front Of Puerto Acajutla from the West (W10-)

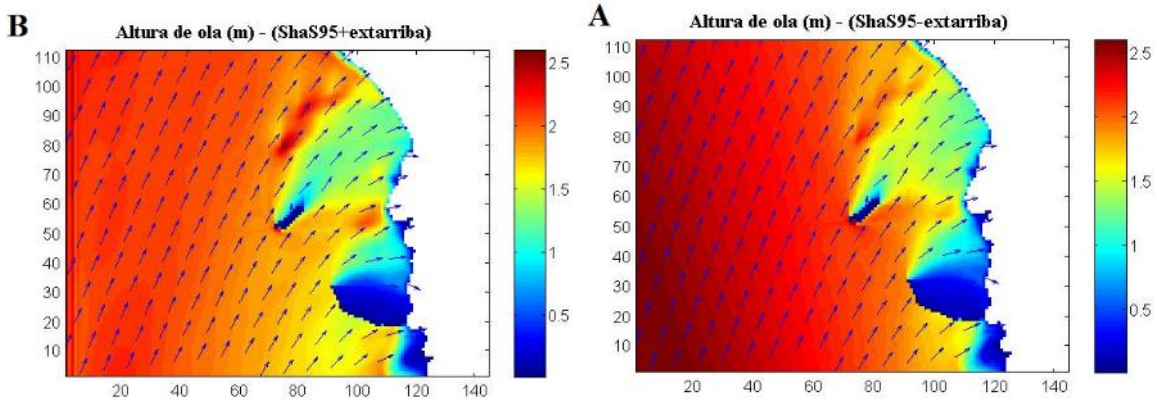


Source: Consulting Team.

As shown in the above figure, for a wave condition such as this, wave heights of about 4-4.5m would be generated in the area of the marine terminal.

The distribution of the wave height for the extreme conditions of wave from the south, are shown in the following Figure 5.30.

Figure 5.30 – Distribution of Height (m) of Extreme Wave in front the Acajutla Port from the South, in A: Periods Less than 9.5sec (S9.5-), and B: Periods Greater than 9.5secs (S9.5 +)

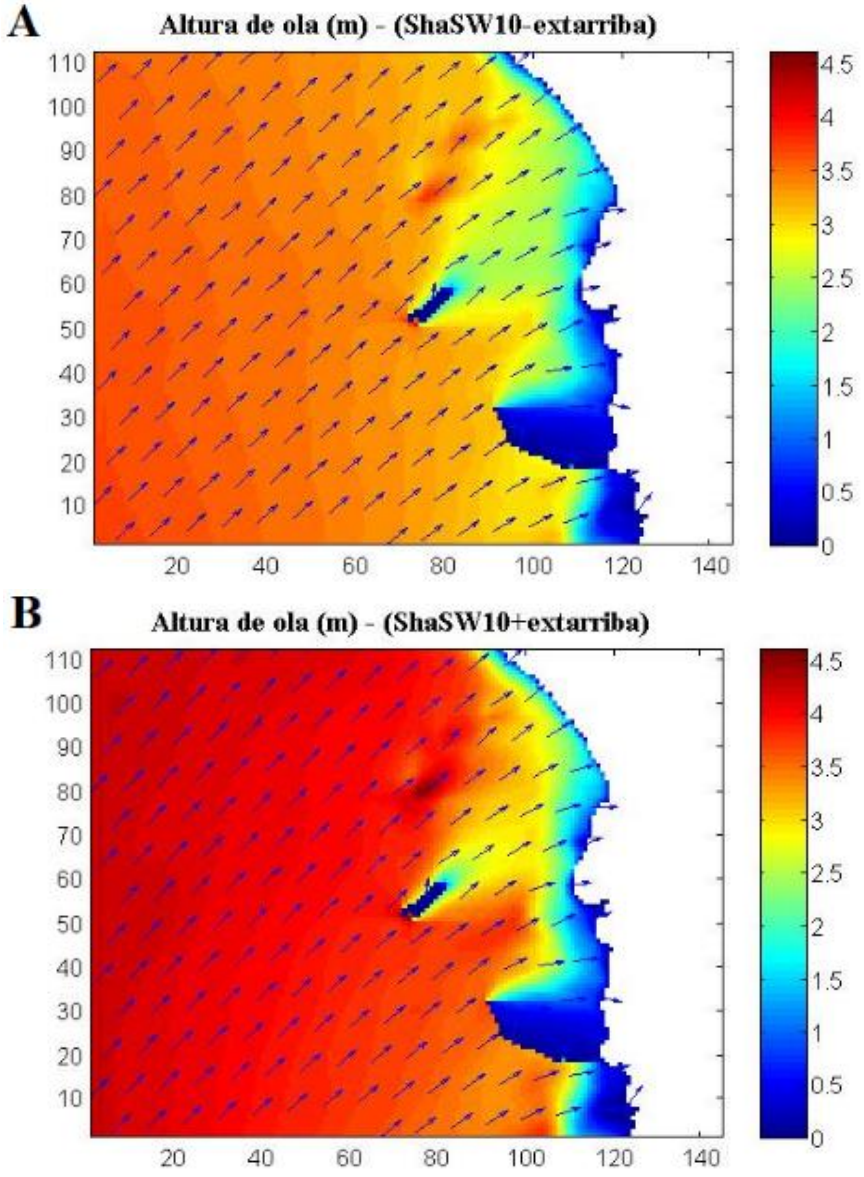


Source: Consulting Team.

Lower heights are present in this case in the area of the marine terminal, with heights of around 2-2.5m.

The extreme wave height distribution for the southwest direction (SW) is shown in Figure 5.31.

Figure 5.31 – Distribution of Height (m) of Extreme Wave from the Southwest to A): Periods Less than 10s and B): periods greater than 10s



Source: Consulting Team.

Heights of around 3m would be generated at the anchoring site of ships at the marine terminal under Condition A. For waves with periods greater than 10sec, the wave condition is more severe. Waves with heights of 4m could be generated at the place of anchoring of ships.

A summary of the wave characteristics that would be generated at the marine terminal are provided in Table 5.29:

Table 5.29 – Summary of Swell Characteristics at the End of the Underwater Pipeline			
Direction	**$H_{1/3\,(m)}$**	**Az (degrees)**	**Ub (m/sec)**
S-promedio	1.02	66.5	0.215
SW-promedio	1.22	63.6	0.223
S9.5-	2.28	70.2	0.282
S9.5+	2.07	68.6	0.460
SW10-	3.80	60.3	0.6.20
SW10+	4.43	60.7	0.928

Source: Own Elaboration

Az: Direction of the wave measured with respect to the X + axis, convention of the wave model.
Ub: Velocity of the current in the background generated by the wave.

As indicated in the Table above, the maximum height that can be taken at the marine terminal is approximately 4.43m, with south-easterly waves and for periods longer than 10 sec. The velocity of the fluid at the bottom, for this condition exceeds 90cm/sec, which is greater than the velocities measured by the ADCP in the buoy of the Port of Acajutla, as indicated in number 7.1.1.3.It is necessary to indicate that Goda (2000) recommends that for design at coastal depths, the design height should be $1.8 \times H_{1/3}$, so that the recommended design height is:

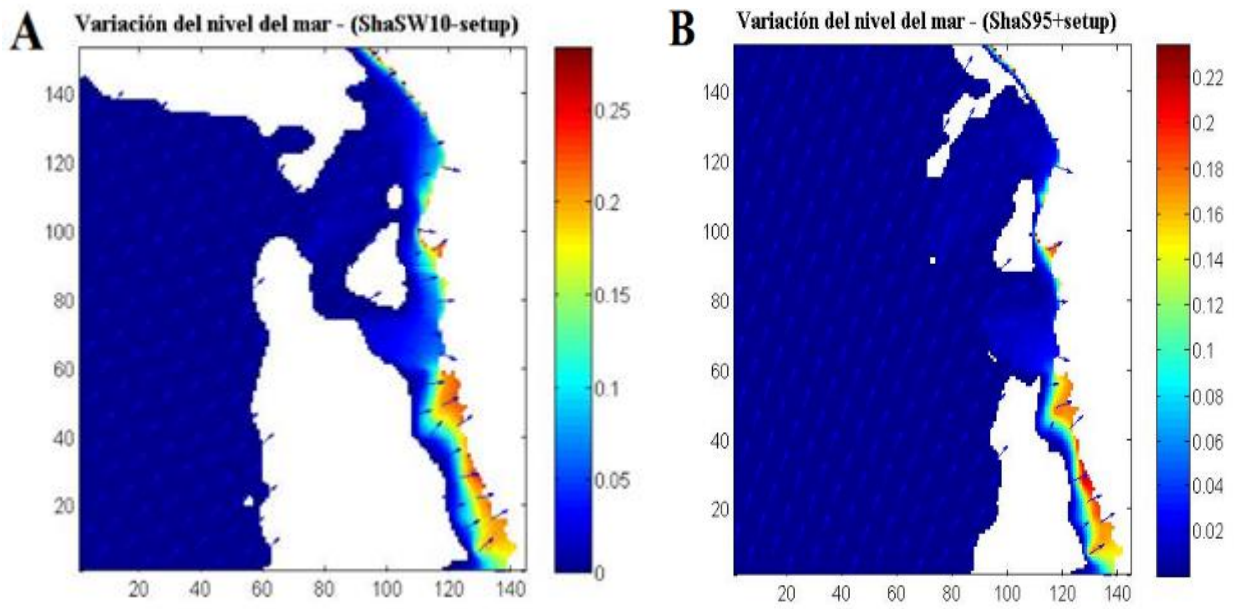
$$\mathbf{H_{design} = 1.8 \times 4.43\ m = 7.97\ m}$$

5.2.10.9 Variation of Sea Level by Wind and Swell Action

Sea level rise for wind action and wave breaking, called meteorological tide, was calculated using the wave propagation model. Its value is added to the value of the bathymetry used, which as indicated above, was elaborated with respect to the low sea level of the spring tide. This value can also be added to the value of the astronomical tide, to have the maximum of the level of the sea in the place that is required.

This component was calculated for the extreme swell and wind values of Table 5.28, and their results are shown in Figure 5.32 below.

Figure 5.32 – Variation of Sea Level, or Meteorological Tide, of Extreme Swell



Source: Own Elaboration

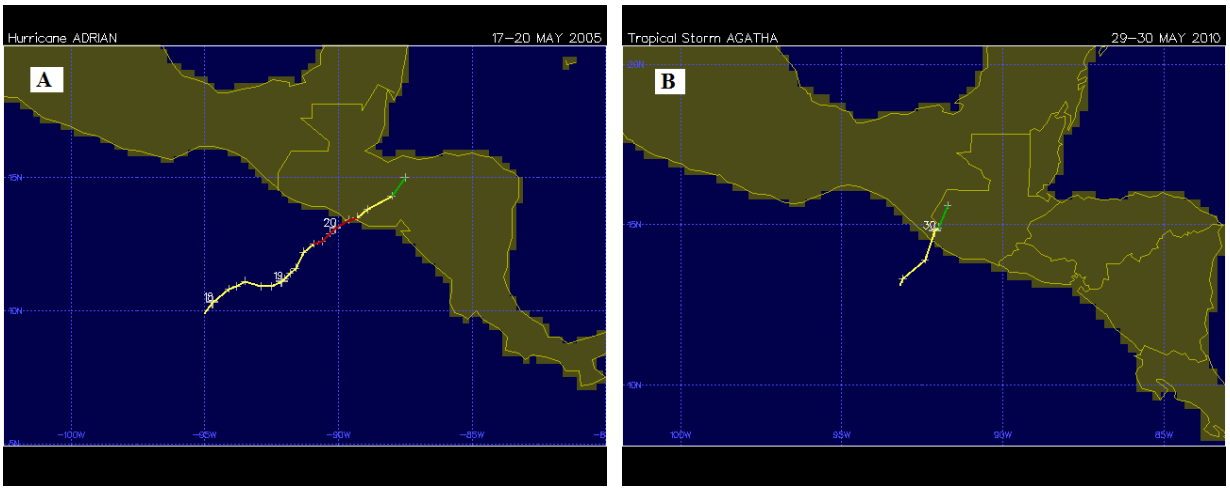
For A: direction W10-, B: direction S9.5 +, C: direction SW10 + and D: direction SW10-.

As the graphs show, the maximum value of this component is around 35cm. This maximum condition is given for the condition of the SW, with waves of periods greater than 10sec, and on the coast to the southeast of the current Acajutla Pier.

5.2.10.10 Conditions of Swell During Hurricane Adrian in 2005

Although most of the hurricanes that form in the eastern Tropical Pacific drift northwest most of the time, there have been exceptions, as shown in Figure 5.33 for Hurricane Adrian and Tropical Storm Agatha, two extreme events in the region. Given the anomaly of this trajectory, we wanted to simulate the conditions, considered as extreme, that could be generated at this time in Puerto Acajutla.

Figure 5.33 – Paths of tropical cyclones in our PTE Region

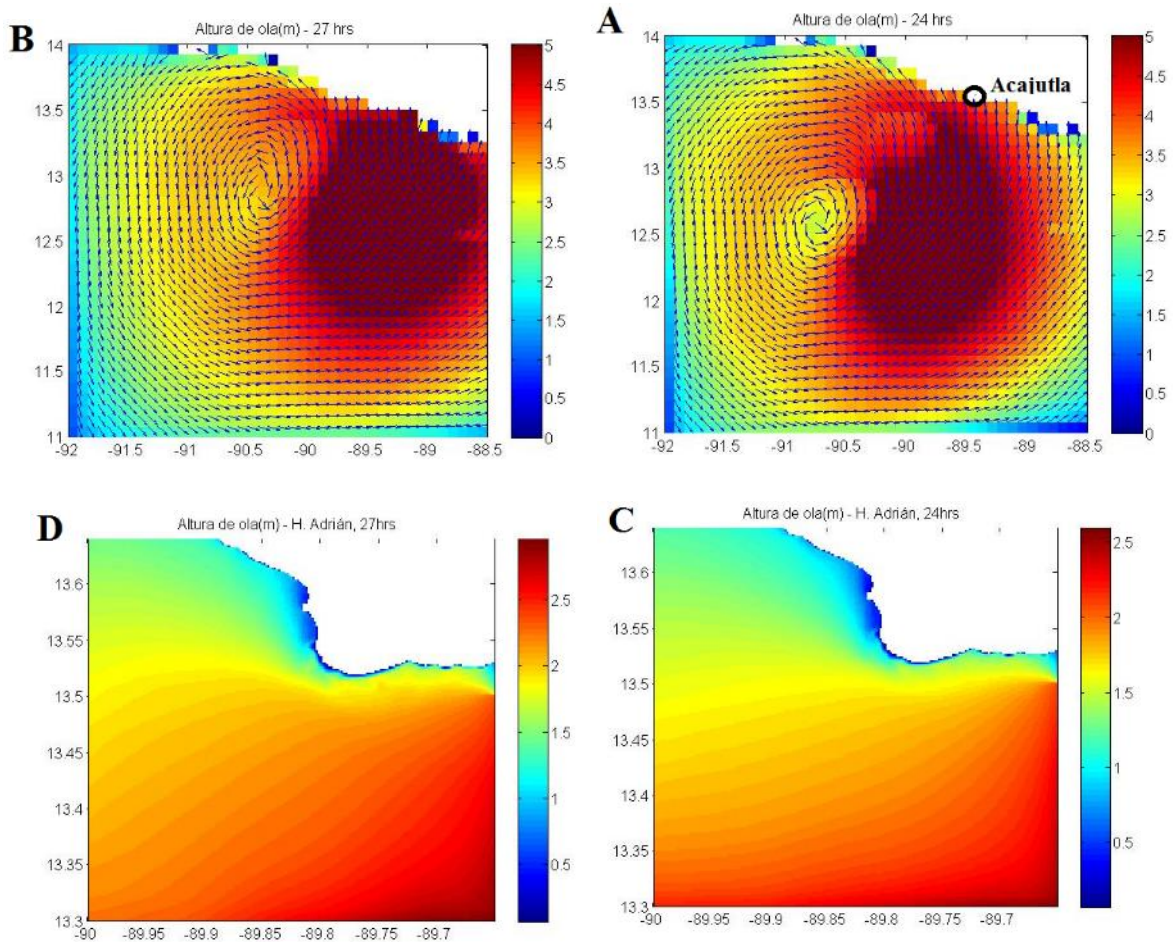


Source: Own Elaboration

In the previous Figure for A: Hurricane Adrian in 2005, B: Tropical Storm Agatha in 2010.

The distribution of the swell to be simulated for Hurricane Adrian is shown in Figure 5.34. Only the most significant simulated positions are shown, with the highest heights for Puerto Acajutla

Figure 5.34 – Distribution of Extreme Wave Height (Meters) during Hurricane Adrian



Source: Consulting Team.

In A): offshore at 24 hours of simulation, B): offshore at 27 hours of simulation, C and D: their respective wave height distributions for the above conditions.

As shown in the previous Figures, the simulation of this hurricane shows possible heights in front of El Salvador of up to 5m (Figure 5.34 A and B). However, the propagation of this wave towards the coast (Figure 5.34 C and D), show that the heights at the front of the Port could only reach 1.5m.

See Appendix 5K Full Oceanography report.

5.2.10.11 Analysis of Possible Sedimentation

The footprint of the terminal is relatively small compared to the open coast and scale of sediment transport on the coast. There may be localized impacts in the immediate vicinity of the terminal infrastructure, as the cellular structure will block currents in the north-south direction and the incoming

waves from the SW / SSW. Given the depths of the water and the expected movement of the sediments at this offshore location, it is more likely to create localized runoff than sediment transport.

The footprint of the Project is not expected to have an impact on inland transportation. The depth in the terminal is outside the "closing depth", which is the sea limit of an effective profile change in long-term time scales.

The connection to the PLEM (PipeLine End Manifold) of the seabed will be too narrow to cause an obstruction to the currents. However, as the pipe reaches the ground, the emerging pipeline will cause a small obstruction to the sediments on the beach. However, in this area the beaches consist of rocky promontories, so it is not expected to have an impact. Any interruption in sediment transport will be local between headlands.

In conclusion, regarding long-term sediment transport in the vicinity, the proposed EDP LNG terminal is expected to have little or no impact of Acajutla Port.

5.3 Biological Environment

The sub-chapters of the Biological Environment include the description of amicable environment in the study area for the following factors:

- Ecosystems and protected areas;
- Terrestrial Flora and Fauna;
- Terrestrial Flora and Fauna; and
- Disease vectors.

5.3.1 Ecosystems and Protected Areas

The location of the "LNG to Power" Project is close to two natural areas: **Barra de Santiago Natural Protected Area** and **Los Cóbanos Marine Protected Area**, 17 and 6 kilometers to the west and east of the Port of Acajutla, respectively. The second area contains a reef system considered within the most productive ecosystems worldwide. Additionally, the reef provides a series of structures that serve as refuges for marine life and that is why it is considered a site of great biodiversity at national level. Below, we describe both.

5.3.1.1 Area of Conservation El Imposible-Barra de Santiago

Located in the extreme south-west of the country, belongs to the Coastal Plain and Coastal Chain. It is one of the sites with the highest species richness and the occurrence of restricted species. It includes the protected areas: El Imposible National Park, **Barra de Santiago** and Garita Palmera, El Bijagual lagoon, El Salto, El Cortijo, Monte Hermoso and Las Colinas. It has a total area of 66,397 Ha. (MARN 2010).

The Protected Natural Area of the **Barra de Santiago** includes the largest extension of mangrove **(2,868 ha.)** In addition, the best preserved in the west of the country. This mangrove stands out for the variety of species of mangrove trees present (Rhizophora mangle, R. racemosa, Avicennia germinans, A. bicolor, Laguncularia racemosa and Conocarpus erectus), the heights of its trees and the great associated biological diversity. At the northwest end of the mangrove, there are remnants of extensive marshes that have undergone a severe drying and transformation process. Within these marshy relics, highlights (Brahea salvadorensis) species cataloged in danger at national level (Jiménez et al., 2004). **Barra de Santiago Complex (11,519.00 ha.)** was recently declared the first major bordering wetland in the country as a RAMSAR site.

Species of Special Concern: There are 160 species registered, reported at a national level as threatened or in danger of extinction at El Imposible - Barra de Santiago conservation area. These include amphibians (1 endangered and 3 threatened), reptiles (6 endangered and 13 threatened), birds (76 endangered and 44 threatened) and mammals (4 endangered and 1 threatened). Of these, one species of amphibian has been classified as being in critical danger status by IUCN, Agalychnis moreletii, one vulnerable: *Dermophis mexicanus* and two in the lesser concern category: *Incilius vallicep* and *Oedipina taylori*. At the same time, a reptilian species has been classified as endangered, ***Chelonia mydas***; two in vulnerable status, *Lepidochelys olivacea* and *Crocodrylus acutus*, and three threatened or endangered species, ***Agkistrodon bilineatus*, *Staurotypus salvinii* and *Caiman crocodilus*.** A new species of mammal is reported for the country, *Bauerus dubiaquercus* (Appendix 5L) (MARN 2010).

Ecosystem Services: Flood control, water purification, aquifer recharge, fish production, wood production, carbon fixation, climate regulation, protection and stabilization of the coastline and scenic beauty. See Figure 5.35.

5.3.1.2 Los Cóbanos Conservation Area

Located in the south of the country, it belongs to the Coastal Plain, of a coastal character and of particular relevance because it contains the only reef formation between Mexico and Costa Rica, as well as dry forests and cliffside vegetation. Includes the Los Cóbanos Marine Park, wetlands and "*morrales*"of the Sonsonate alluvial plain, El Zope, Banderas river mangroves, Las Bocanitas, Los Farallones, Plan de Amayo, El Balsamar and Ishuatan. It has a total area of 40,916 hectares (MARN 2010).

The rocky reef of Los Cóbanos stands out in the national scope as much for the richness of its biodiversity as for its almost unique character, which includes eight species of hard corals and several species of soft corals, numerous species of marine invertebrates and an ichthyofauna especially varied. The high turbidity of the waters prevents further development of coral species and unfortunately, this is favored by processes of deforestation and pollution around the reef, especially coming from the Port of

Acajutla.The rocky reef occupies about 1,500 ha. of the 20,736 ha. which conform the protected marine are Los Cobanos (including oceanic surface, estuaries, and a terrestrial portion) (*Jiménez et al*., 2004). **Ecosystem services:** fish production and scenic beauty. Los Cobanos Natural Protected Area (NPA) in the terrestrial area includes mangrove areas, among which the Mandinga mangrove stands out, of medium size (478 ha) located between areas dedicated mainly to the cultivation of sugar cane, teak forest plantations and pastures (there is a large flooded pastureland that is used for livestock). In the western zone there are abandoned salt mines. The mangrove is formed in its eastern zone mainly by Rhizophora mangrove trees and in the western zone by Avicenia nitida. It is a semi-dense mangrove, that has undergone serious processes of transformation of the habitat by invasion of land for housing establishment.

Species of Special Concern: there are 74 species of special concern, threatened or in danger of extinction in the ANP Los Cobanos. These include amphibians (2 threatened), reptiles (2 endangered and 5 threatened), birds (19 endangered and 34 threatened) and mammals (1 endangered and 3 threatened). Of these, a species of amphibian has been classified as vulnerable by IUCN, Dermophis mexicanus, a species of reptile under critically endangered status, **Eretmochelys imbricata**, one of reptile in less concern **Pliocercus elapoides** and another of amphibian, **Oedipina taylori** in the Same category (Appendix 5M).

For the specific case of the ANP Los Cobanos as a zone of direct influence of the Project are some species of conservation interest related to the marine biodiversity of the area (Appendix 5M). Outstanding among these *Pocillopora spp, Psamocora spp, Strombus galeatus, Epinephelus itajara, Rhincodon typus, Sphyrna lewini, Eretmochelys imbricata* y Dermochelys *coriácea.*

Energía del Pacífico

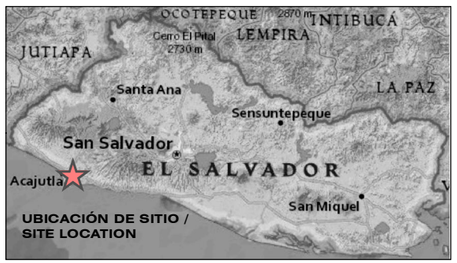
ENERGIA DEL PACIFICO

LNG TO POWER PROJECT

ECOSISTEMAS Y ÁREAS PROTEGIDAS / ECOSYSTEMS AND PROTECTED AREAS

FIGURA 5.35 / FIGURE 5.35

- SITIO DEL PROYECTO / PROJECT SITE
- VIAS / ROADS
- ÁREAS PROTEGIDAS / PROTECTED AREAS
- ÁREAS PROTEGIDAS CANDIDATOS / CANDIDATE PROTECTED AREAS
- LÍMITES MUNICIPALES / MUNICIPAL BOUNDARIES



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N W E S

FUENTE / REFERENCE
MISIÓN DE MAPEO / MAPPING MISSION (SRTM)
LANDSAT-8 IMAGEN MOSAICO / LANDSAT-8 IMAGE MOSAIC (2014-01-30)
MINISTERIO DE MEDIO AMBIENTE Y RECURSOS NATURALES / MINISTRY OF ENVIRONMENT AND NATURAL RESOURCES (MARN, 2010)

MAPA CREADO POR / MAP CREATED BY: PFM
MAPA REVISADO POR / MAP CHECKED BY: MW
PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONE 16 WGS84

ARCHIVO / FILE:
I:\GIS\163489 Acajutla\GIS\MXDs\Reporting - 2016\5-35 - Ecosystems Protected Areas.mxd

PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL / FINAL
FECHA / DATE: 12/7/2016

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5.3.2 Identifying the Area of Direct Influence (ADI) and Indirect (AII)

The Project area is located within the coastal plain of the department of Sonsonate between 10-30 msnm, with an average annual rainfall of 1700 mm and an average temperature of 27 ° C. Much of the land area in the coastal plain of the department of Sonsonate is intended for tourism activities, urban areas, industrial development, shrimp farms, salt marshes, pasture and basic grains crops with shrubs and trees, coffee, sugar cane. In addition, they exist along the plain, wet marshes, mangrove forest and deciduous forest (MARN 2006).

In the municipality, most of the soil is dedicated to low-yielding grasses and mixed with bushy vegetation. However, these are suitable lands for intensive or semi-intensive livestock activities, and even for annual crops resistant to a certain degree of flooding and forest production, mainly due to the geomorphological formation of the area, which makes the soils abundant in Aquifers with potential for irrigation, being this a natural determinant to strengthen agricultural and livestock production in the area.

The Project area is located at Acajutla Port, department of Sonsonate, El Salvador. Within the facilities of "Comisión Ejecutiva del Puerto de Acajutla" (CEPA). The site is characterized by the presence of infrastructure corresponding to the State Port Administration of the west of the country. It presents, within its facilities, green areas containing ornamental plantations and small patches of remnants of vegetation communities of "chaparrales", scrubs and savannah, as well as some species of trees that typify remnants of transitional vegetation between the dry tropical forest and the hot humid tropical forest.

The Project proposes to use the unpopulated areas within CEPA industrial complex, this is the Area of Direct Influence (ADI) of the project. This is the area that will experience changes or direct impacts from the construction of the Project. The Area of Indirect Influence (AII) is the area that will suffer indirect impacts with the construction of the Project. In the case of the "LNG to Power" Project, the proposed area presents delimited areas that specifically restrict the site of study, mainly limited by buildings, access roads and industrial zones within CEPA facilities (Figure 5.2).

Industrial development activities have allowed different modifications in the structure of the site's habitat; consequently most of the diversity of fauna and flora found, is composed by generalist species, and resistant to environmental disturbances. The richness of species identified shows high disturbance characteristics, both in the AII and ADI areas. The natural vegetation around the study site has been disappearing due to activities, inside and outside the study site as a result of the expansion of industry, agriculture, livestock, commerce, among others, which have a direct impact due to pollution and fragmentation of ecosystems (Rivera 1996). See photo 5.12.

Photo 5.12 – Typical view of the Study Area: Thermal power plant, Acajutla, 2014

Source: Consulting Team, 2014

The description of the selected site for the construction staging area of the Project is given in appendix 5A "Construction Staging Area". The said appendix includes a description of the flora and fauna identified on the site and its area of influence.

5.3.3 Sampling and Data Collection Methodology

5.3.3.1 Flora Methodology

A field survey of the area was carried out, to determine the sampling design, as well as to observe the form and structure of the vegetation present in the site. To facilitate the accounting of species of adult and young trees, and the identification of shrubs and grasses, an all-terrain course system was established, as well as linear transepts of 1000 m^2 (10x100m) with a measuring tape of 50m (Bolfor, 2000). The abundance and richness of arboreal, shrub and herbaceous species observed within the route and transepts were recorded. Parallel to this, a photographic record of some species was also recorded (Photo 5.13).

Taxonomic identification of most species was made in situ. The remaining were identified using Taxonomic Keys: *Flora of Nicaragua and Mesoamerican Flora*. In addition, the *List of Threatened and Endangered Species* of MARN (2009), the IUCN Red List of Threatened Species 2013, and the updated *List of Fauna and Flora species* are included in the *CITES* Appendix (2013), to verify their conservation category.

Photo 5.13 – Completion of transepts for the inventory of arboreal and shrub Flora, Acajutla, June 2014

Source: Consulting Team, 2014

5.3.3.2 Fauna Methodology

- Herpetofauna Methodology

Sweep-type trips were made within the study areas, as well as linear transepts of 1000m^2 (10x100m). Surveys were carried out twice during the day, the first of them in the morning after 7:00 am, to try to spot amphibians and keeping alert for the detection of some reptile that will present activity, ending near From 11:00 am. The second field trip was conducted around 12:00 pm following the same methodology mentioned above, to detect the presence of reptiles, until approximately 3:00 pm.

Searching techniques included direct and indirect visual sighting. The greatest attention was paid to the movement of the leaf litter, removing fallen logs and dry leaves from the ground, and looking at other elements like holes in trees with the help of serpentine sticks. The herpetofauna was identified using specialized field guides in this group of vertebrates by *Günther and Koller* (2006). The specimens that were captured were photographed, collected by hand or with the aid of serpentine hooks. To expand the inventory of amphibians and reptiles, a non-designed interview was conducted with the CEPA-Acajutla Shift Safety Supervisor (*Saúl Rivera Posada*), who knows the characteristics of the study area, as well as the flora and fauna. Report as Personal Communication (Per.Com.). Finally, the conservation status of the identified species was consulted with the Red List of Threatened Species (IUCN) and threatened MARN species by 2015.

- Avifauna Methodology

The Intensive Search technique described by Ralph et al. (1996) was used. This consists of touring the study site and stopping at specific points while recording the species of birds by direct observation or hearing (songs or calls), and thus quantify the number of individuals per species. Wild bird species were identified by song or eye contact using the Pentax 8x40 mm binoculars (Photo 5.14), the Birds of Mexico and Central America field guide (Perlo, 2006) and a Fujifilm 30x for image capture.

Photo 5.14 – Direct Observation of Waterfowl and Terrestrial Birds within the Project Area, Acajutla, June 2014

Source: Consulting Team, 2014

Regarding data collection, notebooks were used to take field notes, to record the species and its abundance in the area. The total data collected were placed in Tables with the taxonomic classification of the species identified in the research, organized by family, genus and specie.

Residence status was determined using the classification detailed by MARN (2009), where species are characterized per their seasonal presence:

- **Residents:** If nest building or the presence of too young juveniles is observed, to have a post-juvenile shedding completed;
- **Migratory:** species that spend part of the year in El Salvador, generally staying for an extended period (several months) before returning to their countries of origin. Most of the migrants reproduce in North America and spend the northern winter in El Salvador;
- **Partial migratory:** they are migratory that possess both reproductive and non-reproductive populations in El Salvador;
- **Migratory vagrants:** species with migratory behavior but of irregular occurrence in El Salvador;
- **Undetermined vagabonds:** species of which no reproduction has been observed in El Salvador and which have less than five records in total;
- **Transients:** migrants who are not regularly known during their winter stay in El Salvador;
- **State not defined for the country:** are residents or non-migratory species of which no reproduction has been observed in the country;
- **Reproductive migratory:** these are species that reproduce in El Salvador and later migrate to South America where they are "breeding visitors"; and
- **Extirpated:** species whose populations have disappeared throughout the national territory, but exist at a regional level. The risk category for the avifauna under study was determined based on the MARN List of Threatened and Endangered Species (2009).

In addition, they were classified according to the risk status of the MARN (2009) under the risk categories of *Threatened and in Danger of Extinction*. As well as conforming to the *IUCN* criteria (2014) as:

- **Extinct (EX):** when there is no reasonable doubt that the last existing individual has died. It is presumed that a taxon is extinct when exhaustive surveys of its habitats, known and/or expected, at appropriate times (daily, seasonal, annual), and throughout its historical range, has not been able to detect a single individual;
- **Extinct in the wild (EW):** when only survives in cultivation, in captivity or as population (or populations) naturalized completely out of its distribution original. It is presumed that a taxon is extinct in the wild when exhaustive surveys of its habitats, known and/or expected, at appropriate times (daily, seasonal, annual), and throughout its historical range, have not detected a single individual;
- **Critically Endangered (CR):** when the best available evidence indicates that it meets any of criteria A to E for Critically Endangered and is therefore considered to be facing an extremely high risk of extinction in the wild;
- **Endangered:** A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered and is therefore considered to be facing a very high risk of extinction in state wild;
- **Vulnerable (VU):** A taxon is Vulnerable when the best available evidence indicates that it meets any of criteria A to E for Vulnerable and is therefore considered to be facing a high risk of extinction in the wild;
- **Near Threatened (NT):** A taxon is Near Threatened when it has been assessed according to criteria and does not currently meet criteria for Critically Endangered, Endangered or Vulnerable; But is close to meeting the criteria, or possibly satisfying, in the near future;
- **Minor Concern (LC):** when, having been evaluated, it does not meet any of the criteria that define the categories of Critically Endangered, Endangered, Vulnerable or Near Threatened. Included in this category are abundant and widely distributed taxa;
- **Insufficient data (DD):** when there is insufficient information to make a direct or indirect assessment of its extinction risk based on the distribution and / or condition of the population. A taxon in this category may be well studied, and its biology be well known, but lack appropriate data on its abundance and / or distribution; and
- **Not evaluated (NE):** when it has not yet been classified in relation to the previous criteria**.**

Mastofauna Methodology

Full sweep routes were carried out in each of the areas of direct influence, carrying out an intensive search of traces of mammals present (traces, excreta, hairs, scrapers, burrows, claw marks on trees and animal remains). As well as direct observations of individuals when possible.

Based on the methodology of Aranda (2012), for each print, measurements of its dimensions were made using measuring tape (graduated in centimeters) and objects of comparison. In addition, photographs were obtained and important morphological traits were recorded for their later identification (Photo 5.15). For identification, the guidelines of *Reid* (1997), Aranda (2012) and *Carillo, et al*. (2002).

Finally, a review of the species reported with the *IUCN* Red List of Threatened Species and the *CITES* Mammalian Species Database and *MARN* categories was done and the information was tabulated by families, genus and species found.

Photo 5.15 – Methodology for Data Collection of Excreta and Footprints of Mastofauna within the Project Area, Acajutla, June 2014

Source: Consulting Team, 2014

5.3.4 Terrestrial flora

5.3.4.1 Flora within the Area of Direct Influence (ADI)

Due to the geographic location and climate of the area, there are trees that typify communities of the dry tropical forest (Holdridge, 1977). Since they occur between 0 and 800 masl, which support several types of natural vegetation communities: beach vegetation, mangroves, hot humid forest of the low lands, forest of gallery by the rivers edge, dry deciduous forest and savannahs composed by morrales and bushland. The flora in the site area of the collection site is described in Appendix 5A.

5.3.4.1.1 Arboreal, Shrub and Herbaceous Flora in pipeline Area

For the area of the pipeline, the arboreal flora of the study site is composed of 21 species belonging to 12 taxonomic families, being mostly trees cultivated for ornamental use and some fruit trees, the area is a resting and recreational area for workers of CEPA, and includes unused land. In Tables 5.30 and 5.31, the lists of tree, shrub and herbaceous species are presented in the pipeline area.

Table 5.30 – Arboreal Species in the Pipeline Area, Acajutla, June 2014					
No.	**Scientific name**	**Family**	**Common name**	**MARN 2015**	**Abu.**
1	*Mangifera indica L.*	Anacardiaceae	mango	---	33
2	*Cocos nucifera L.*	Arecaceae	Coco (coconut)	---	25
3	*Pithecellobium dulce (Roxb.) Benth.*	Fabaceae	Mangollano (Monkeypod)	---	15
4	*Ficus crocata (Miq.) Miq.*	Moraceae	Amate (Large-leaved rock fig)	---	12
5	*Terminalia catappa L.*	Combretaceae	Almendra (country-almond)	---	10
6	*Tabebuia rosea (Bertol.) DC.*	Bignoniaceae	maquilishuat	---	5
7	*Psidium guajava L.*	Myrtaceae	Guayabo (guajava)	---	4
8	*Cordia dentata Poir*	Boraginaceae	tihuilote	---	4
9	*Muntingia calabura L.*	Muntingiaceae	Capulín (mutingia)	---	3
10	*Gliricidia sepium (Jacq.) Kunth ex Walp.*	Fabaceae	madrecacao	---	3
11	*Anacardium occidentale L.*	Anacardiaceae	Marañón (cashewnut)	---	3
12	*Albizia niopoides (Spruce ex Benth.) Burkart*	Fabaceae	polvo de queso	---	3
13	*Crescentia alata Kunth*	Bignoniaceae	Morro (cresentia alata)	---	2
14	*Syzygium malaccense (L.) Merr. & L.M. Perry*	Myrtaceae	Marañon Japones (Otaheite cashew)	---	1
15	*Syzygium cumini (L.) Skeels*	Myrtaceae	Cerezo de Belize (java plum)	---	1
16	*Samanea saman (Jacq.) Merr.*	Fabaceae	barba de viejo (Spanish moss)	---	1
17	*Inga sapindioides Willd.*	Fabaceae	cuje	---	1
18	*Enterolobium cyclocarpum (Jacq.) Griseb.*	Fabaceae	conacaste	---	1
19	*Ceiba pentandra (L.) Gaertn.*	Malvaceae	ceiba	---	1
20	*Cecropia peltata L.*	Urticaceae	guarumo	---	1
21	*Bursera simaruba (L.) Sarg.*	Burseraceae	jiote	---	1

Source: Consulting Team

Table 5.31 – Total of Shrub and Herbaceous Species in the AID (Pipeline), Acajutla, June 2014				
No.	**Scientific name**	**Family**	**Common Name**	**MARN 2015**
1	*Adenopodia patens (Hook. & Arn.) J.R. Dixon ex Brenan*	Fabaceae	zarza	---
2	*Caesalpinia bonduc (L.) Roxb.*	Fabaceae	Avellana (hazelnut)	Threatened
3	*Citrus × limon (L.) Osbeck*	Rutaceae	limón indio (citrus lemon)	---
4	*Conyza laevigata (Rich.) Pruski*	Asteraceae	n/d	---
5	*Cyperus tenerrimus J. Presl & C. Presl*	Cyperaceae	n/d	---
6	*Megathyrsus maximus (Jacq.) B.K. Simon & S.W.L. Jacobs*	Poaceae	Zacate(grass)	---

Table 5.31 – Total of Shrub and Herbaceous Species in the AID (Pipeline), Acajutla, June 2014				
No.	**Scientific name**	**Family**	**Common Name**	**MARN 2015**
7	*Musa x sapientum L.*	Musaceae	Guineo, huerta (Banana orchard)	---
8	*Nerium oleander L.*	Apocynaceae	daffodil	---
9	*Opuntia guatemalensis Britton & Rose*	Cactaceae	tuna	---
10	*Paspalum notatum Alain ex Flüggé*	Poaceae	Grama (grass)	---
11	*Phoradendron quadrangulare (Kunth) Griseb.*	Loranthaceae	matapalo	---
12	*Yucca guatemalensis Baker*	Asparagaceae	Izote (soapweed yucca)	---

Source: Consulting Team

Caesalpinia bonduc has been reported in this area and has been categorized as a Threatened species according to the MARN 2015 criteria.

The shrub and herbaceous flora of the study area for the pipeline is composed of 12 species belonging to 10 taxonomic families, almost all of which are cultivated as ornamental or fruit trees (Table 5.31). See photo 5.16.

Photo 5.16 – Ficus Crocata (amate), B) Crescentia Alata (morro) Present within the Area of Direct Influence of the study site, Acajutla, June 2014

A) B)

Source: Consulting Team

5.3.4.1.2 Arboreal, Shrub and Herbaceous Flora in Central Thermal Power Land

The zone of the Central Thermal Power Plant is characterized by vegetal communities such as chaparrales, bushes and savannas of hills, as well as some species of trees that typify the zone of transition between the dry tropical forest and the hot humid tropical forest. Among the species of trees,

shrubs and herbs that typify this transition zone that have been found in the study site are: morro (*Crescentia alata*), zarzo blanco (*Acacia colinsii*), zarzo (*Machaerium biovulatum*), zarzo espino (*Acacia polyphylla*), pie de venado (*Bauhinia ungulata*), casco de venado (*Bauhinia aculeata*), Castaño (*Sterculia apetala*), Ceiba (*Ceiba pentandra*), almendro de río (*Andira inermis*) among others (Table 5.32 and Table 5.33).

The tree flora is composed of 21 species belonging to 8 families (Table 5.32).

Table 5.32 – Total Arboreal Species in the Central Thermal Power Plant Zone, Acajutla, June 2014

No.	Scientific name	Family	Common name	MARN 2015	Abu.
1	*Cordia dentata Poir*	Boraginaceae	Tihuilote (White Manjack)	---	16
2	*Esenbeckia berlandieri Baill.*	Rutaceae	n/d	---	12
3	*Crescentia alata Kunth*	Bignoniaceae	Morro (*Crescentia alata Kunth)*	---	11
4	*Guazuma ulmifolia Lam.*	Malvaceae	Caulote (bastard-cedar)	---	10
5	*Pithecellobium dulce (Roxb.) Benth.*	Fabaceae	Mangollano (monkeypod)	---	8
6	*Bauhinia aculeata L.*	Fabaceae	pie de venado	---	7
7	*Muntingia calabura L.*	Muntingiaceae	Capulín (mutingia)	---	4
8	*Senna reticulata (Willd.) H.S. Irwin & Barneby*	Fabaceae	flor amarilla (cassia alata)	---	4
9	*Albizia niopoides (Spruce ex Benth.) Burkart*	Fabaceae	conacaste blanco	---	2
10	*Andira inermis (W. Wright) Kunth ex DC.*	Fabaceae	almendro de rio	---	2
11	*Bauhinia ungulata L.*	Fabaceae	pie de venado	---	2
12	*Psidium guajava L.*	Myrtaceae	Guayabo (guajava)	---	2
13	*Acacia collinsii Saff.*	Fabaceae	zarzo blanco (Bull Horn Acacia)	---	1
14	*Acacia polyphylla DC.*	Fabaceae	zarzo	---	1
15	*Ceiba pentandra (L.) Gaertn.*	Malvaceae	ceiba	---	1
16	*Sterculia apetala*	Malvaceae	Castaño	**Endangered**	
17	*Ficus crocata (Miq.) Miq.*	Moraceae	amate	---	1
18	*Gliricidia sepium (Jacq.) Kunth ex Walp.*	Fabaceae	madrecacao	---	1
19	*Maclura tinctoria (L.) D. Don ex Steud.*	Moraceae	palo de mora (cockspur thorn)	**Endangered**	1

Table 5.32 – Total Arboreal Species in the Central Thermal Power Plant Zone, Acajutla, June 2014					
No.	**Scientific name**	**Family**	**Common name**	**MARN 2015**	**Abu.**
21	*Samanea saman (Jacq.) Merr.*	Fabaceae	barba de viejo (Spanish moss)	---	1

Source: Own Elaboration ECO Ingenieros, 2014

In this area, the species *Sterculia apetala* and *Maclura tinctoria* commonly known as "*castaño*" and "*palo de mora*", respectively, were reported which have been categorized as Endangered species according to the MARN 2015 criteria.

The shrub and herbaceous flora consists of 42 species belonging to 24 families (Table 5.33)

Table 5.33 – Total Shrub and Herbaceous Species Zone of Central Thermal Power Plant, Acajutla, June 2014				
No.	**Scientific name**	**Family**	**Common name**	**MARN 2015**
1	*Acacia farnesiana (L.) Willd.*	Fabaceae	espino blanco (cassie flower)	---
2	*Asclepias oenotheroides Schltdl. & Cham.*	Apocynaceae	matacoyote	---
3	*Bauhinia aculeata L.*	Fabaceae	pie de venado	---
4	*Bonellia longifolia (Standl.) B. Ståhl & Källersjö*	Primulaceae	Mirra (myrrh tree)	---
5	*Capparis indica (L.) Druce*	Capparaceae	n/d	---
6	*Cayaponia racemosa (Mill.) Cogn.*	Cucurbitaceae	n/d	---
7	*Cleome viscosa L.*	Capparaceae	Tabaquillo (Dog Mustard)	---
8	*Combretum farinosum Kunth*	Combretaceae	chupa miel	---
9	*Cordia cylindrostachya (Ruiz & Pav.) Roem. & Schult.*	Boraginaceae	n/d	---
10	*Croton argenteus L.*	Euphorbiaceae	n/d	---
11	*Cucumis melo L.*	Cucurbitaceae	Melón (melón)	---
12	*Cyperus sp.*	Cyperaceae	Zacate (grass)	---
13	*Dalbergia chontalensis Standl. & L.O. Williams*	Fabaceae	n/d	In danger
14	*Desmodium nicaraguense Oerst.*	Fabaceae	pega pega	---
15	*Gonolobus sp.*	Apocynaceae	cuchamper	---
16	*Gossypium hirsutum L.*	Malvaceae	Algodón (cotton)	---
17	*Helicteres guazumifolia Kunth*	Malvaceae	trompillo	---
18	*Heliotropium indicum L.*	Boraginaceae	cola de alacrán	---
19	*Ipomoea batatas (L.) Lam.*	Convulvolaceae	campanilla	---
20	*Ipomoea nil*	Convolculaceae	campanilla	---
21	*Iresine calea (Ibáñez) Standl.*	Amaranthaceae	coyuntura de pollo	---
22	*Lantana camara L.*	Verbenaceae	cinco negritos	---

Table 5.33 – Total Shrub and Herbaceous Species Zone of Central Thermal Power Plant, Acajutla, June 2014				
No.	**Scientific name**	**Family**	**Common name**	**MARN 2015**
23	*Lippia graveolens Kunth*	Verbenaceae	orégano silvestre (Mexicano regano)	---
24	*Lygodium venustum Sw.*	Lygodiaceae	n/d	---
25	*Machaerium biovulatum Micheli*	Fabaceae	zarzo	---
26	*Martynia annua L.*	Martyniaceae	uña de gato (Tiger's claw)	---
27	*Megathyrsus maximus (Jacq.) B.K. Simon & S.W.L. Jacobs*	Poaceae	Zacate (grass)	---
28	*Melochia nodiflora Sw.*	Malvaceae	escobilla	---
29	*Momordica charantia L.*	Cucurbitaceae	jaibita	---
30	*Nephrolepis cordifolia (L.) C. Presl*	Lomariopsidaceae	cola de ardilla (erect sword fern)	---
31	*Passiflora foetida L.*	Passifloraceae	granadilla de ratón (passionvines)	---
32	*Pityrogramma calomelanos (L.) Link*	Pteridaceae	n/d	---
33	*Randia aculeata L.*	Rubiaceae	Crucito (indigo Berry)	---
34	*Randia armata (Sw.) DC.*	Rubiaceae	crucito	---
35	*Randia pleiomeris Standl.*	Rubiaceae	tintero	---
36	*Rauvolfia tetraphylla L.*	Apocynaceae	amatillo	---
37	*Semialarium mexicanum (Miers) Mennega*	Celastraceae	matapiojo	---
38	*Serjania triquetra Radlk.*	Sapindaceae	n/d	---
39	*Sida sp.*	Malvaceae	escobilla	---
40	*Sinningia incarnata (Aubl.) D.L. Denham*	Gesneriaceae	n/d	---
41	*Struthanthus orbicularis (Kunth) Blume*	Loranthaceae	matapalo	---
42	*Waltheria indica L.*	Malvaceae	escobilla	---

Source: Own Elaboration Dillon Consulting - ECO Ingenieros, 2014

Table 5.34– Total of Shrub and Herbaceous Species Central Thermal Power Plant zone, Acajutla, June 2014				
No.	**Scientific Name**	**Family**	**Common Name**	**MARN 2015**
1	*Acacia farnesiana (L.) Willd.*	Fabaceae	espino blanco (cassie flower)	---
2	*Asclepias oenotheroides Schltdl. & Cham.*	Apocynaceae	matacoyote	---
3	*Bauhinia aculeata L.*	Fabaceae	pie de venado	---
4	*Bonellia longifolia (Standl.) B. Ståhl & Källersjö*	Primulaceae	mirra	---
5	*Capparis indica (L.) Druce*	Capparaceae	n/d	---
6	*Cayaponia racemosa (Mill.) Cogn.*	Cucurbitaceae	n/d	---

Table 5.34 – Total of Shrub and Herbaceous Species Central Thermal Power Plant zone, Acajutla, June 2014				
No.	**Scientific Name**	**Family**	**Common Name**	**MARN 2015**
7	*Cleome viscosa L.*	Capparaceae	tabaquillo	---
8	*Combretum farinosum Kunth*	Combretaceae	chupa miel	---
9	*Cordia cylindrostachya (Ruiz & Pav.) Roem. & Schult.*	Boraginaceae	n/d	---
10	*Croton argenteus L.*	Euphorbiaceae	n/d	---
11	*Cucumis melo L.*	Cucurbitaceae	Melón (melón)	---
12	*Cyperus sp.*	Cyperaceae	Zacate (grass)	---
13	*Dalbergia chontalensis Standl. & L.O. Williams*	Fabaceae	n/d	In danger
14	*Desmodium nicaraguense Oerst.*	Fabaceae	pega pega	---
15	*Gonolobus sp.*	Apocynaceae	cuchamper	---
16	*Gossypium hirsutum L.*	Malvaceae	Algodón (cooton)	---
17	*Helicteres guazumifolia Kunth*	Malvaceae	trompillo	---
18	*Heliotropium indicum L.*	Boraginaceae	cola de alacrán	---
19	*Ipomoea batatas (L.) Lam.*	Convulvolaceae	campanilla	---
20	*Ipomoea nil*	Convolculaceae	campanilla	---
21	*Iresine calea (Ibáñez) Standl.*	Amaranthaceae	coyuntura de pollo	---
22	*Lantana camara L.*	Verbenaceae	cinco negritos	---
23	*Lippia graveolens Kunth*	Verbenaceae	orégano silvestre	---
24	*Lygodium venustum Sw.*	Lygodiaceae	n/d	---
25	*Machaerium biovulatum Micheli*	Fabaceae	zarzo	---
26	*Martynia annua L.*	Martyniaceae	uña de gato (tiger's claw)	---
27	*Megathyrsus maximus (Jacq.) B.K. Simon & S.W.L. Jacobs*	Poaceae	Zacate (grass)	---
28	*Melochia nodiflora Sw.*	Malvaceae	escobilla	---
29	*Momordica charantia L.*	Cucurbitaceae	jaibita	---
30	*Nephrolepis cordifolia (L.) C. Presl*	Lomariopsidaceae	cola de ardilla (erect sword fern)	---
31	*Passiflora foetida L.*	Passifloraceae	granadilla de ratón (passion vines)	---
32	*Pityrogramma calomelanos (L.) Link*	Pteridaceae	n/d	---
33	*Randia aculeata L.*	Rubiaceae	crucito	---
34	*Randia armata (Sw.) DC.*	Rubiaceae	crucito	---
35	*Randia pleiomeris Standl.*	Rubiaceae	tintero	---
36	*Rauvolfia tetraphylla L.*	Apocynaceae	amatillo	---
37	*Semialarium mexicanum (Miers) Mennega*	Celastraceae	matapiojo	---
38	*Serjania triquetra Radlk.*	Sapindaceae	n/d	---

Table 5.34 – Total of Shrub and Herbaceous Species Central Thermal Power Plant zone, Acajutla, June 2014				
No.	**Scientific Name**	**Family**	**Common Name**	**MARN 2015**
39	*Sida sp.*	Malvaceae	escobilla	---
40	*Sinningia incarnata (Aubl.) D.L. Denham*	Gesneriaceae	n/d	---
41	*Struthanthus orbicularis (Kunth) Blume*	Loranthaceae	matapalo	---
42	*Waltheria indica L.*	Malvaceae	Escobilla (American Waltheria)	---

Source:Own Elaboration Dillon Consulting - ECO Ingenieros, 2014

In this zone, the species *Dalbergia chontalensis* has been reported that has been categorized as an Endangered species conforming to the criteria of MARN 2015.

5.3.4.1.3 Ecological Significance

In spite of the degradation and/or fragmentation of the natural vegetation, there are still some well-established plant communities (savanna of morro, thorny scrub and a portion of subcaducifolio forest), with species like Morro (*Crescentia alata*), espino blanco (*Acacia Farnese*), izcanal (*A. hindsii*).

As reported by the Map of Ecosystems by MARN 2011, the plant communities found are located within two types of vegetation: "Short graminoid savannah with deciduous broadleaved trees, variant Crescentia alata". Being the "morro" (Crescentia alata) the characteristic and abundant species, accompanied by some trees and shrubs typical of this vegetation like "mangollano" (*sweet Pithecellobium*).

In addition, this area reported the presence of species of trees and shrubs that have been considered at risk by the list of threatened species issued by MARN in the year 2015. These include the *Caesalpinia bonduc* shrub that has been categorized as a threatened species and the trees of the species *Sterculia apetala* and *Maclura tinctoria* commonly known as "castañot" and "palo de mora" respectively, which has been categorized as threatened species and *Dalbergia chontalensis* which has been categorized as an endangered species according to the criteria of MARN 2015.

5.3.4.1.4 Anthropogenic Significance

In the area where the construction of the plant is proposed, different anthropogenic actions can be observed that diminish the quality of the natural forest including traces of fires, burning of rubbish and the use of land for waste disposal. These factors disrupt the air and soil quality of the area.

It was also possible to observe the presence of plant species that are characteristic of disturbed areas, either by anthropogenic action or natural factors that occur over time, among thesevegetation are:

guarumo (*Cecropia peltata*), capulin (*Muntingia calabura*), Izcanal (*Acacia hindsii*), and coyolillo (*Cyperus tenerrimus*) among others.

In addition, there are some useful species known as medicinal, nutritional or other, including "cinco negritos", "uña de gato", "cola de ardilla", "algodón" (cotton), "melon".

At present, the site is fenced, and no advantages have been obtained from these anthropogenic species.

5.3.4.2 Flora in the Indirect Influence Area (IIA)

In indirect influence, trees such as "coco" (coconut), "caoba", "teca", "mango", "icaco", "nance", "almendro" (almond), "aceituno"(olive) and "arbol de fuego" among others. Most of these species have been planted and almost all are introduced for ornamental purposes. In the IIA, a total of 26 species of flora are reported, of which 13 are arboreal (Table 5.34) and 13 are shrub and herbaceous.

The arboreal flora of the IIA study site is composed of 13 species belonging to 11 taxonomic families (Table 5.35).

Table 5.35 – Total Arboreal Species Found in the IIA, Acajutla, June 2014

No.	Scientific name	Family	Common Name	MARN 2015	Abun.
1	*Cocos nucifera L.*	Arecaceae	Coco (coconut)	---	**20**
2	*Swietenia humilis Zucc.*	Meliaceae	caoba	**In danger**	**20**
3	*Tectona grandis L. f.*	Verbenaceae	Teca (teak)	---	**20**
4	*Roystonea regia (Kunth) O.F. Cook*	Arecaceae	palmera real (royal palm)	---	**10**
5	*Crescentia alata Kunth*	Bignoniaceae	Morro (Cresentia Alata Kunth))	---	**4**
6	*Mangifera indica L.*	Anacardiaceae	mango	---	**4**
7	*Delonix regia (Bojer ex Hook.) Raf.*	Fabaceae	árbol de fuego (Poinciana)	---	**3**
8	*Simarouba glauca DC.*	Simaroubaceae	Aceituno (olive)	---	**3**
9	*Andira inermis (W. Wright) Kunth ex DC.*	Fabaceae	almendro de río (climbing wild apricot)	---	**2**
10	*Chrysobalanus icaco L.*	Chrysobalanaceae	icaco	---	**2**
11	*Byrsonima crassifolia (L.) Kunth*	Malpighiaceae	nance	---	**1**

Table 5.35 – Total Arboreal Species Found in the IIA, Acajutla, June 2014					
No.	**Scientific name**	**Family**	**Common Name**	**MARN 2015**	**Abun.**
12	*Ficus elastica Roxb. ex Hornem.*	Moraceae	Hule (rubber Bush)	---	**1**
13	*Terminalia catappa L.*	Combretaceae	almendro (country-almond)	---	**1**

Source: Own Elaboration Dillon Consulting - ECO Ingenieros, 2014

In the area of indirect influence was observed the presence of the species "caoba" *Swietenia humilis Zucc* which was classified as endangered for El Salvador by the MARN 2015 list. It is expected that the degree of impact on this species is minimal because it is in the indirect area of influence of the Project.

5.3.4.2.1 Shrub and Herbaceous Flora in the Area of Indirect Influence

The shrub and herbaceous flora of the study site is composed of 13 species belonging to 9 taxonomic families (Table 5.36).

Table 5.36 – Total of Shrub and Herbaceous Species in the IIA, Acajutla, June 2014				
No.	**Scientific Name**	**Family**	**Common Name**	**MARN 2015**
1	*Acacia farnesiana (L.) Willd.*	Fabaceae	espino blanco (cassie flower)	---
2	*Calotropis procera (Aiton) W.T. Aiton*	Apocynaceae	algodón de playa (Apple of sodom)	---
3	*Chamaesyce hirta L.*	Euphorbiaceae	Pascuita (asthma-plant)	---
4	*Citrus × limon (L.) Osbeck*	Rutaceae	limón indio (citrus lemon)	---
5	*Cyperus tenerrimus L.*	Cyperaceae	Coyolillo (flatsedge)	---
6	*Gossypium hirsutum*	Malvaceae	Algodón (upland cotton)	---
7	*Ixora coccinea L.*	Rubiaceae	Izora (ixora)	---
8	*Nerium oleander*	Apocynaceae	Narciso (Oleander)	---
9	*Paspalum notatum Alain ex Flüggé*	Poaceae	Grama (bahiagrass)	---
10	*Rauvolfia tetraphylla L.*	Apocynaceae	Amatillo (Garden Rauvolfia)	---
12	*Waltheria indica L.*	Malvaceae	Escobilla (American Waltheria)	---

13	*Yucca guatemalensis Baker*	Asparagaceae	Izote (soapweed yucca)	---

Source: Consulting Team, 2014

Among the shrub and herbaceous flora found in the area of indirect influence, none have been reported under any category of conservation according to the list of threatened species of MARN 2015.

5.3.5 Fauna in the Study Area

Before presenting the results of each group of organisms studied, it should be clarified that, in the case of birds, their range of movement to carry out all activities of their life cycle cannot be limited to the areas of study, but rather to an area, generally, even beyond the indirect impact area of the Project.

With regard to the mammal group, the extent of their distribution is somewhat reduced because the mechanisms they use to move are completely terrestrial. However, it is important to note that individuals of the species identified in the study, can move from one area to another, inside and outside of CEPA lands, through doors and roads that are occasionally open or through permanent accesses, where there is complete absence of barriers, or by breaking of the fences bordering empty lots.

Unlike these two groups described above, some reptiles and amphibians have more restricted distribution domains that allow determining more precisely their habitat and areas of permanence. It is possible, however, the presence of the same individual in different sectors surrounding the CEPA lands or the Project, if there are no physical barriers that prevent them from moving.

The description of the site selected for the construction staging area is provided in Appendix 5A "construction staging area". Such appendix includes a description of the fauna identified on the site and its area of influence.

5.3.5.1 Results of Herpetofauna

In the case of the pipeline route, the site presents high anthropogenic disturbance due to its current use. Within the proposed pipeline route, nine species of herpetofauna were observed, including one amphibian species and eight reptile species. Within these, two species are registered as "Threatened" according to MARN (2009) and one species is recorded as "Exotic" (Table 5.37). See photos 5.17 and 5.18.

Table 5.37 – Herpetofauna Present in Pipeline Area, Acajutla, June, 2014					
Order / Suborder	**Family**	**Species**	**Common Name**	**MARN 2015**	**IUCN**
Anura	Bufonidae	*Rhinella marinus*	Sapo común (common toad)	---	LC
Sauria	Iguanidae	*Ctenosauria similis*	Garrobo (spiny-tailed iguana)	Threatened	---
Sauria	Iguanidae	*Basiliscus vittatus*	Tenguereche (brown basilisk)	---	---
Sauria	Iguanidae	*Iguana iguana*	Iguana verde (Green iguana)	Threatened	---
Sauria	Teiidae	*Aspidocelis deppii*	corredor rayado (Blackbelly Racerunner)	---	---
Sauria	Gekkonidae	*Gonatodes albogularis*	Geko nativo (Native geko	---	---
Sauria	Gekkonidae	*Hemidactylus frenatus*	Geko blanco White geko	---	---
Serpentes	Boidae	*Boa constrictor*	Masacuata (boa constrictor)	---	---
Serpentes	Colubridae	*Masticofis mentovarius*	Zumbadora (Neotropical Whip Snake)	---	---

Source: Own elaboration Dillon Consulting - ECO Ingenieros, 2014

Photo 5.17 – Species Registered in the Pipeline Area A) *Ctenosauria Similis*, B) Iguana *Iguana*, Acajutla, June 2014. (Photographs by: Samuel Álvarez)

A) B)

Source: Photos taken by Consultin Team

Photo 5.18 – Species Registered in the Pipeline Area *Gonatodes Albogularis* A) Female, B) Male, Acajutla, June 2014. (Photographs by: Samuel Álvarez)

A) B)

B) Source: Photos taken by Consultin Team

Within the proposed area for the development of the Thermal Power Plant, 16 species corresponding to the herpetofauna of the site were observed. Among them, there is a species of amphibian and 15 species of reptiles (Table 5.38). Three species are recorded under criteria as "Threatened" according to MARN (2009).

Table 5.38 – Herpetofauna Present at the Site Study Area of Thermal Power Plant, Acajutla, June, 2014

Order/ Suborder	Family	Species	Common Name	MARN Category	IUCN Category
Anura	Bufonidae	*Rhinella marinus*	Sapo común (common toad)	---	LC
Testudines	Geoemydidae	*Rhinoclemmys pulcherrima*	tortuga pintada (painted Wood turtle)	---	
Sauria	Iguanidae	*Ctenosauria similis*	Garrobo (painy-tailed iguana)	Endangered	---
Sauria	Iguanidae	*Basiliscus vittatus*	Tenguereche (brown basilisk)	---	---
Sauria	Iguanidae	*Iguana iguana*	Iguana verrde (Green iguana)	Endangered	---
Sauria	Iguanidae	*Anolis sericeus*	Anolis punto azul (Anolis blue point)	---	---
Sauria	Iguanidae	*Sceloporus variabilis*	Lagartija espinosa (Spiny lizard)	---	
Sauria	Teiidae	*Ameiva undulata*	lagartija pintada (Rainbow	---	---

Table 5.38 – Herpetofauna Present at the Site Study Area of Thermal Power Plant, Acajutla, June, 2014					
Order/ Suborder	**Family**	**Species**	**Common Name**	**MARN Category**	**IUCN Category**
			Ameiva)		
Sauria	Scincidae	*Mabuya unimarginata*	Salamanqueza (Central American Mabuya)	---	---
Sauria	Teiidae	*Aspidocelis deppii*	corredor rayado (Blackbelly Racerunner)	---	---
Sauria	Gekkonidae	*Gonatodes albogularis*	geko nativo (Yellow-headed Gecko)	---	---
Serpentes	Boidae	*Boa constrictor*	Masacuata (boa constrictor)	---	---
Serpentes	Viperidae	*Porthidium ophryomegas*	Víbora castellana (Slender Hognose Viper)	---	---
Serpentes	Colubridae	*Lampropeltis triangulum*	Falso coral (False coral)	Endangered	---
Serpentes	Colubridae	*Leptodrymus pulcherrimus*	Serpiente verde (green head vine snake)	---	---
Serpentes	Colubridae	*Masticofis mentovarius*	Zumbadora (Neotropical Whip Snake)	---	---

Source: Own elaboration 2014.

In an interview with Saúl Rivera Posada, he reported the presence of specimens that were not identified during the field survey, so it is slightly possible that there are some species of reptiles and amphibians additional to the ones contained in this report. See photos 5.19 and 5.20.

Photo 5.19 – Species Registered in the Thermal Power Station Area A) *Anolis Sericeus*, B) *Sceloporus Variabilis*, Acajutla, June 2014. (Photos by: Samuel Álvarez)

A) B)

Source: Photographs taken by Consulting Team

Photo 5.20 – Species Registered in the Project Area A) Rhinella Marinus, B) Boa Constrictor, Acajutla, June 2014. (Photographs by: Samuel Álvarez)

A) B)

Source: Photos taken by Consulting Team

Reptiles were found in the open area, which are typical of arid and hot areas, characteristic of the coastal zone. However, it was impossible to determine abundances with the methodologies used in the foregoing study. Most ophidians are more difficult to observe, therefore, only their presence is recorded; but local people indicate a significant abundance of *Ophidia* species (snakes), as well as abundance of *Iguana* (iguana) and *Ctenosauria similis* (Garrobo).

The physical characteristics of the site and the notorious anthropogenic impact, gas releases from the surrounding areas of the Port of Acajutla, burning of vegetation, and deposition of solid waste, do not contribute to the conservation of an optimal habitat for the development of this group of fauna, specifically amphibians which are susceptible to environmental changes. The lack of optimal conditions for this type of fauna enables species that are resilient to these disturbance conditions, to dominate and prosper while the more vulnerable are displaced.

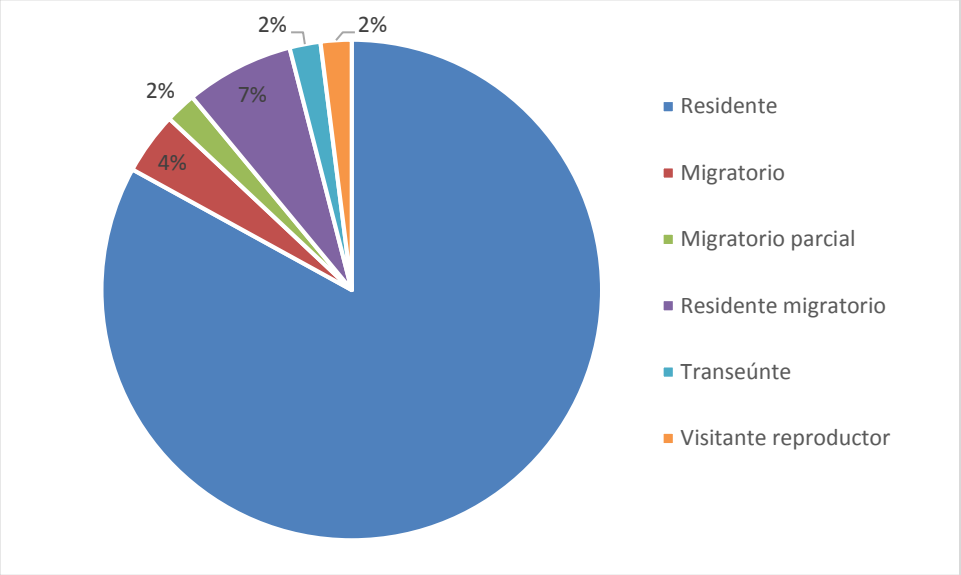
The threatened species reported in the area are *Iguana* iguana, *Ctenosauria similis*, *Porthidium ophryomegas, Lampropeltis triangulum* and *Leptodrymus pulcherrima* all are in the category of threatened according to the list of species issued by MARN in the year 2015.

5.3.5.2 Results of Avifauna

There are 53 species distributed in 30 families (5N). The family best represented in terms of abundance was Tyrannidae with 7 species, followed by *Columbidae*, *Emberizidae* and *Icteridae* with 4 species each (Table 5.39 and 5.40). By its abundance, the dominant species were *Pelecanus occidentalis*, *American Mycteria, Inca Columbina, Tyrannus melancholicus* and *Asian Zenaida*, while 26 species presented the minimum frequency (1 individual).

Giving to their seasonality (MARN, 2009), six categories were recorded (Figure 5.36), of which the "Resident" category represents the largest number of species recorded in the study site, representing 83%, followed by category "Resident-migratory" with 7%, "Migratory" with 4% and the rest with 2%.

Figure 5.36 – Percentage of Bird Species by Seasonal Category Observed at the Study Area, Acajutla, June 2014



Residente= Resident, Migratorio=migratory, migratorio parcial= Partial migratory, residente migratorio= Migrant resident, transeúnte = transient visitante reproductor = breeding visitor

Source: Own elabration

A total of 7 active nests belonging to resident species of *Icterus pustulatus* (3), *Pachyrampus aglaiae* (1), *Crotophaga sulcirostris* (1), *Melanerpes aurifrons* (1) and *Campylorhynchus rufinucha* (1) were found (Photos 5.20 and 5.21). They are categorized as Residents and generally go to the same territory every year to build their nests and perpetuate the species (Photos 5.21 and 5.22).

Per the MARN (2015) vulnerability status, none of the reported species is within a conservation category, and according to IUCN (2011) all species are in the Minor Concern status (see Table 5.38).

Photo 5.21 – Nests of Resident Species on the site A) *Campylorhynchus Rufinucha* and B) *Icterus Pustulatus*, Acajutla, June, 2014

A) B)

Source: Photos taken by Consultant Team

Photo 5.22 – Nests of Resident Species on the Site A) *Columbina talpacotti* and B) *Pachyrampus aglaiae* Acajutla, June, 2014

Source: Photos taken by Consultant Team

5.3.5.2.1 Pipeline Area and its Surroundings

29 species of birds in this study area, highlighting an adult and a juvenile of *Rupornis magnirostris*, who use vegetation to search for prey hiding for the young bird, as well as a family of *Tyrannus melancholichus* (two juveniles and one adult). Active nests of *Icterus pustulatus* and *Pachyrampus aglaiae* were also found, as well as potential nesting sites for several species such as *Pitangus sulphuratus, Turdus grayi, Melanerpes aurifrons, Megarhynchus pitangua, Tyrannus melancholichus* and *Columbina talpacotti*.

It is important to note that in the case of birds one cannot limit their location to a specific site because of their nature, since they have a high capacity of movement along the areas that they inhabit.

Table 5.39 – Taxonomic Category, Common Name, Seasonal Classification according to IUCN and Conservation Status according to MARN and Abundance of Birds Observed in Pipeline Area, Acajutla, June 2014

N°	Family	Scientific name	Common name	Seasonality	UICN Category	MARN 2015	Frequency
1	Fregatidae	*Fregata magnificens*	Fragata (Magnificent frigatebird)	Partial migratory	Least Concern	----------	1
2	Accipitridae	*Rupornis magnirostris*	gavilán de los caminos (roadside hawk)	Resident	Least Concern	----------	2
3	Columbidae	*Columbina talpacoti*	tortolita rojiza (ruddy ground-dove)	Resident	Least Concern	----------	1
4	Columbidae	*Columbina inca*	tortolita colilarga (inca dove)	Resident	Least Concern	----------	2
5	Columbidae	*Columba livia*	paloma de castilla (Rock	Resident	Least Concern	----------	2

Table 5.39 – Taxonomic Category, Common Name, Seasonal Classification according to IUCN and Conservation Status according to MARN and Abundance of Birds Observed in Pipeline Area, Acajutla, June 2014

N°	Family	Scientific name	Common name	Seasonality	UICN Category	MARN 2015	Frequency
			dove)				
6	Columbidae	*Zenaida asiatica*	paloma ala blanca (white-winged dove)	Resident	Least Concern	----------	1
7	Apodidae	*Chaetura vauxi*	Vencejo (Vaux's Swift)	Resident	Least Concern	----------	1
8	Trochilidae	*Amazilia rutila*	colibrí canela (Cinnamon hummingbird)	Resident	Least Concern	----------	1
9	Picidae	*Melanerpes aurifrons*	cheje, carpintero (Woodpecker)	Resident	Least Concern	----------	1
10	Tyrannidae	*Megarhynchus pitangua*	luis piquigrueso	Resident	Least Concern	----------	1
11	Tyrannidae	*Pitangus sulphuratus*	Cristofué (great kiskadee)	Resident	Least Concern	----------	1
12	Tyrannidae	*Myiozetetes similis*	Chío (flycatcher)	Resident	Least Concern	----------	4
13	Tyrannidae	*Tyrannus melancholicus*	Tirano (Tropical kingbird)	Resident	Least Concern	----------	8
14	Hirundinidae	*Stelgidorpteryx serripennis*	golondrina aliserreña (rough-winged swallow)	Resident	Least Concern	----------	1
15	Hirundinidae	*Progne chalybea*	golondrina pecho gris (Grey-breasted Martin)	Resident	Least Concern	----------	4
16	Hirundinidae	*Tachycinetta albilinea*	golondrina de manglar (Mangrove swallow)	Resident	Least Concern	----------	2
17	Troglodytidae	*Camphylorhynchus rufinucha*	Guacalchía (Rufous-naped Wren)	Resident	Least Concern	----------	2
18	Icteridae	*Dives dives*	tordo de ojos negros (Black-eyed Thrush)	Resident	Least Concern	----------	2
19	Icteridae	*Icterus pustulatus*	chiltota dorsirayada (Streak-backed Oriole)	Resident	Least Concern	----------	1

Table 5.39 – Taxonomic Category, Common Name, Seasonal Classification according to IUCN and Conservation Status according to MARN and Abundance of Birds Observed in Pipeline Area, Acajutla, June 2014

N°	Family	Scientific name	Common name	Seasonality	UICN Category	MARN 2015	Frequency
20	Fringillidae	*Euphonia affinis*	Eufonía (Scrub Euphonia)	Resident	Least Concern	----------	1
21	Procellaridae	*Puffinus ophistomelas*	pardela mexicana (Black-vented Shearwater)	Migratory	Least Concern	----------	4
22	Hydrobatidae	*Oceanodroma melania*	petrel de las tormentas (Black storm petrel)	Migratory	Least Concern	----------	2
23	Pelecanidae	*Pelecanus occidentalis*	pelícano café (brown pelican)	Resident	Least Concern	----------	11
24	Ardeidae	*Egretta tricolor*	garza tricolor (Tricolored Heron)	Residente migratorio	Least Concern	----------	1
25	Ardeidae	*Egretta thula*	garza de las nieves (Snowy egret)	Migrant resident	Least Concern	----------	1
26	Sternidae	*Chlidonias niger*	gaviota de mar (Black tern)	Transient	Least Concern	----------	7
27	Turdidae	*Turdus grayi*	Chonte (Clay-colored thrush)	Resident	Least Concern	----------	1
28	Emberizidae	*Sporophila torqueola*	Collarcito (White-collared Seedeater)	Resident	Least Concern	----------	1
29	Icteridae	*Quiscalus mexicanus*	clarinero, zanate (Great-tailed Grackle)	Resident	Least Concern	----------	6

Source: Own elaboration 2014.

5.3.5.2.2 Thermal Power Plant Site

These were the locations where the highest avifauna abundance was observed with 43 different bird species (Table 5.39): Highlighting species with active nests such as *Crotophaga sulcirostris* and *Pitangus sulphuratus*, while potential nesting sites were observed for *Volatinia jacarina, Sporophila minuta, Sporophila torqueola* and *Myiarchus tuberculifer*, showing that as well as these species other resident birds can take advantage of the vegetation of this site to perform important reproduction activities, resting sites and for feeding. See Figure 5.37 and photos 5.23 and 5.24.

Photo 5.23 – Species of *Rupornis Magnirostris* "gavilán" (roadside hawk) Observed at the Site, Acajutla, June 2014

Source: Photos taken by Consulting Team

Photo 5.24 – Species of Pelecanus occidentalis "brown pelican" and Buteo Plagiatus "gray hawk" Observed in the study site, Acajutla, June 2014

Source: Photos taken by Consulting Team

Table 5.40 – Taxonomic Category, Common Name, Seasonal Classification according to IUCN and Conservation Status according to MARN and Abundance of Birds Observed at Thermal Power Plant, Acajutla, June 2014

N°	Family	Scientific Name	Common Name	Seasonality	UICN caategory	MARN 2015 category	Frecquency
1	Anatidae	*Dendrocygna autumnalis*	Pichiche (Black-bellied whistling duck)	Resident	Least Concern	----------	2

Table 5.40 – Taxonomic Category, Common Name, Seasonal Classification according to IUCN and Conservation Status according to MARN and Abundance of Birds Observed at Thermal Power Plant, Acajutla, June 2014

N°	Family	Scientific Name	Common Name	Seasonality	UICN caategory	MARN 2015 category	Frecquency
2	Ciconiidae	*Mycteria americana*	Cigüeña (stork)	Partial migratory	Least Concern	----------	12
3	Pelecanidae	*Pelecanus erythrorhynchus*	Pelícano (pelican)	Resident	Least Concern	----------	5
4	Pelecanidae	*Pelecanus occidentalis*	pelícano café (Brown pelican)	Resident	Least Concern	----------	21
5	Cathartidae	*Cathartes aura*	zope cabeza roja (turkey vulture)	Migratory resident	Least Concern	----------	1
6	Cathartidae	*Coragyps atratus*	zope cabeza negra (black vulture)	Resident	Least Concern	----------	6
7	Accipitridae	*Rupornis magnirostris*	gavilán de los caminos (roadside hawk)	Resident	Least Concern	----------	2
8	Accipitridae	*Buteo plagiatus*	gavilán gris (gray hawk)	Resident	Least Concern	----------	2
9	Columbidae	*Columbina talpacoti*	tortolita rojiza (Ruddy Ground-Dove)	Resident	Least Concern	----------	4
10	Columbidae	*Columbina inca*	tortolita colilarga (inca dove)	Resident	Least Concern	----------	8
11	Columbidae	*Zenaida asiatica*	paloma ala blanca (white-winged dove)	Resident	Least Concern	----------	9
12	Psittacidae	*Brotogeris jugularis*	Catalnica (Orange-chinned parakeet)	Resident	Least Concern	Theratened	7
13	Cuculidae	*Morococcyx erythropygus*	chonte bobo (Lesser ground cuckoo)	Resident	Least Concern	----------	1
14	Cuculidae	*Crotophaga sulcirostris*	Pijuyo (Groove-billed Ani)	Resident	Least Concern	----------	3
15	Apodidae	*Chaetura vauxi*	Vencejo (chimney Swift)	Resident	Least Concern	----------	1
16	Trochilidae	*Amazilia rutila*	colibrí canela (cinnamon hummingbird)	Resident	Least Concern	----------	2
17	Picidae	*Melanerpes aurifrons*	cheje, carpintero (Golden-fronted Woodpecker)	Resident	Least Concern	----------	1
18	Momotidae	*Eumomota superciliosa*	Torogoz (turquoise-browed motmot)	Resident	Least Concern	----------	2

Table 5.40 – Taxonomic Category, Common Name, Seasonal Classification according to IUCN and Conservation Status according to MARN and Abundance of Birds Observed at Thermal Power Plant, Acajutla, June 2014

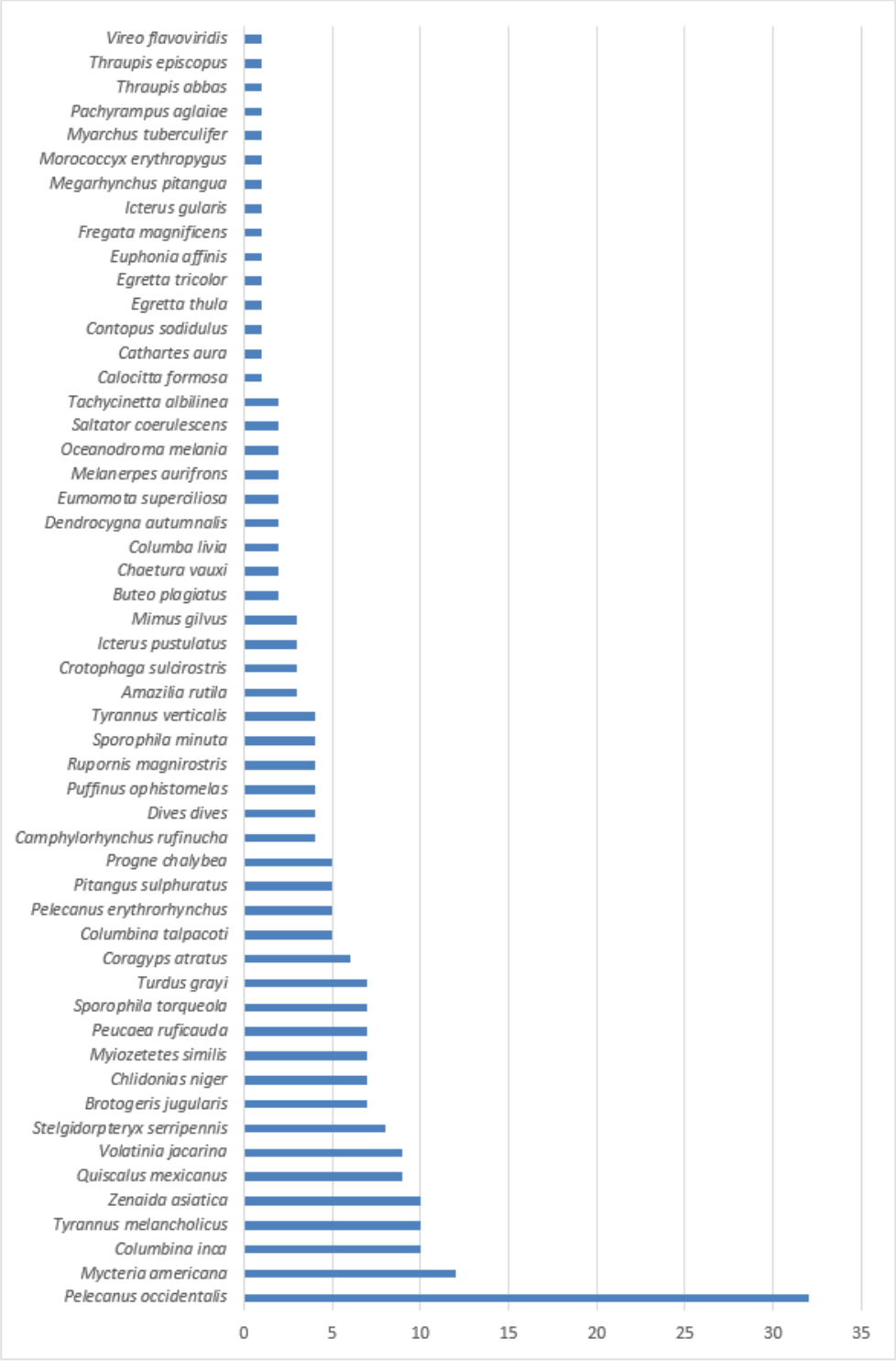
N°	Family	Scientific Name	Common Name	Seasonality	UICN caategory	MARN 2015 category	Frecquency
19	Tyrannidae	*Myarchus tuberculifer*	copetón triste (Dusky-capped Flycatcher)	Resident	Least Concern	----------	1
20	Tyrannidae	*Contopus sodidulus*	Copetón (Western Wood Pewee)	Transient	Least Concern	----------	1
21	Tyrannidae	*Pitangus sulphuratus*	Cristofué (great kiskadee)	Resident	Least Concern	----------	4
22	Tyrannidae	*Myiozetetes similis*	Chío (fly cátcher)	Resident	Least Concern	----------	3
23	Tyrannidae	*Tyrannus melancholicus*	Tirano (tropical kingbird)	Resident	Least Concern	----------	2
24	Tyrannidae	*Tyrannus verticalis**	Mosquero (western kingbird)	Resident	Least Concern	----------	4
25	Tytiridae	*Pachyrampus aglaiae*	cabezón degollado (Roose-throated Becard)	Resident	Least Concern	----------	1
26	Vireonidae	*Vireo flavoviridis*	vireo de ojos rojos	Breeding Visitor	Least Concern	----------	1
27	Corvidae	*Calocitta formosa*	Urraca (yellow-green vireo)	Resident	Least Concern	----------	1
28	Hirundinidae	*Progne chalybea*	golondrina de pecho gris (Gray-breasted Martin)	Resident	Least Concern	----------	1
29	Hirundinidae	*Stelgidorpteryx serripennis*	golondrina aliserreña (rough-winged swallow)	Resident	Least Concern	----------	7
30	Troglodytidae	*Camphylorhynchus rufinucha*	Guacalchía (Rufous-naped Wren)	Resident	Least Concern	----------	2
31	Turdidae	*Turdus grayi*	chonte, cenzontle (clay-colored thrush)	Resident	Least Concern	----------	6
32	Mimidae	*Mimus gilvus**	Sinzontle (tropical mockingbird)	Resident	Least Concern	----------	3
33	Thraupidae	*Thraupis abbas*	azulejo de ala amarilla (yellow winged tanager)	Resident	Least Concern	----------	1

Table 5.40 – Taxonomic Category, Common Name, Seasonal Classification according to IUCN and Conservation Status according to MARN and Abundance of Birds Observed at Thermal Power Plant, Acajutla, June 2014

N°	Family	Scientific Name	Common Name	Seasonality	UICN caategory	MARN 2015 category	Frecquency
34	Thraupidae	*Thraupis episcopus*	Azulejo (Blue-grey Tanager)	Resident	Least Concern	----------	1
35	Emberizidae	*Volatinia jacarina*	Volatín (Blue-black Grassquit)	Resident	Least Concern	----------	9
36	Emberizidae	*Sporophila minuta*	Semillero (ruddy breasted seedeater)	Resident	Least Concern	----------	4
37	Emberizidae	*Sporophila torqueola*	Collarcito (White-collared Seedeater)	Resident	Least Concern	----------	6
38	Emberizidae	*Peucaea ruficauda*	Chichiguitero (Stripe-headed Sparrow)	Resident	Least Concern	----------	7
39	Cardinalidae	*Saltator coerulescens*	Dichosofuí (Amazonian Grey Saltator)	Resident	Least Concern	----------	2
40	Icteridae	*Dives dives*	tordo de ojos negros	Resident	Least Concern	----------	2
41	Icteridae	*Quiscalus mexicanus*	clarinero, zanate (Great-tailed Grackle)	Resident	Least Concern	----------	3
42	Icteridae	*Icterus gularis*	Chiltota (Altamira Oriole)	Resident	Least Concern	----------	1
43	Icteridae	*Icterus pustulatus*	chiltota dorsirayada (Streak-backed Oriole)	Resident	Least Concern	----------	2

Source: Own Elaboration 2014.

Figure 5.37 – Total Registered Frequencies of Birds Observed at the Study Area, Acajutla, June 2014



Source: Own Elaboration 2014.

The state of study site disturbance caused by frequent burning, accidental fires, and land clearance supports the presence of generalist birds tolerant to human activity in the area.

According to the list of threatened species issued by MARN in the year 2015, one species in category of threatened was found: the “catalnica” (Orange-chinned parakeet) *Brotogeris jugularis.*

Photo 5.25 – Species of Puffinus Opisthomelas and Chlidonias Niger Observed at the Study Area, Acajutla, June 2014

A) B)

Source: Consulting Team, 2014

Photo 5.26 – Species Juvenile Frigate and Tyrannus Melancholicus at the Study Area, Acajutla, June, 2014

A) B)

Source: Consulting Team, 2014

5.3.5.3 Mammals

In the sector where the pipeline will be routed from the coast, zones used as corridors for local fauna were identified, by which they obtain access mainly to other adjacent areas to the coast and CEPA facilities. In this area, 9 species of wild mammals were reported, both by direct and indirect observation (Table 5.40), as well as at least 3 species of domestic mammals including the "cat" (*Felis catus*), the "musk mouse" (Unidentified sp.), and the "common rat" (*Rattus rattus*).

On the other hand, in the area of the location of the Thermal Power Plant, the presence of eight species of wild mammals was recorded (Table 5.41). One species less than in the area where the pipelineline will berouted, due to the fact that the species *Mustela freata* is not reported, an isolated case has been documented for the adjacent zone to the pipeline route.

Table 5.41 – Species of Wild Mastofauna, Pipeline Area, Acajutla, June 2014

Order	Family	Scientific Name	Comon Name	State of conservation		
				UICN	CITES	MARN 2015
Lagomorpha	Leporidae	*Oryctolagus cuniculus(*)*	Conejo doméstico (native rabbit)	LC[9]	NL[10]	NL
Rodentia	Sciuridae	*Sciurus variegatoides*	ardilla gris (Variegated Squirrel)	DD	NL	NL
Carnivora	Mephitidae	*Mephitis macroura(*)*	zorrillo rallado (Hooded Skunk)	DD	NL	NL
Carnivora	Canidae	*Urocyon cinereoargenteus(*)*	Zorragris (gray fox)	LC	NL	NL
Didelphimorphia	Didelphidae	*Philander opossum(*)*	zorro cuatro ojos, hurón (Gray Four-eyed Opossum)	LC	NL	NL
Didelphimorphia	Didelphidae	*Didelphis marsupialis(*)*	tacuacín negro (Black-eared Opossum)	LC	NL	NL
Didelphimorphia	Didelphidae	*Didelphis virginiana(**)*	tacuacín blanco (Virginia oposum)	LC	NL	NL
Carnivora	Procyonidae	*Procyon lotor(*)*	Mapache (raccoon)	LC	NL	NL
Carnivora	Mustelidae	*Mustela frenata (**)*	Comadreja (Long-tailed Weasel)	LC	NL	NL

*(*)*Data obtained by direct observations, or identification of traces.
(**) Data obtenained by Com.Per.

Source: Consulting team 2014.

[9]LC= Least Concern, According to the IUCN Red List of Threatened Species.
[10]NL= Not Listed, It does not appear in the CITES Threatened Species Lists or Appendix.

In the case of domestic species for the Thermal Power Plant area, only the presence of two species ("common rat" and "mice") is reported, since it has not been verified that domestic cats access the site, probably due to the high density and competition with other territorial carnivores such as the gray fox (*Urocyon thous*).

Table 5.42 – Species of Wild Mastofauna, Central Thermal Power Plant Area, Acajutla, June 2014

Order	Family	Scientific Name	Common Name	State of conservation		
				UICN	CITES	MARN 2015
Lagomorpha	Leporidae	*Oryctolagus cuniculus (*)*	conejo doméstico (common rabbit)	LC[1]	NL[2]	NL
Rodentia	Sciuridae	*Sciurus variegatoides*	ardilla gris (Variegated Squirrel)	DD	NL	NL
Carnivora	Mephitidae	*Mephitis macroura (*)*	zorrillo rallado (Hooded Skunk)	DD	NL	NL
Carnivora	Canidae	*Urocyon cinereoargenteus (*)*	Zorragris (gray fox)	LC	NL	NL
Didelphimorphia	Didelphidae	*Philander opossum (*)*	zorro cuatro ojos, hurón (Gray Four-eyed Opossum))	LC	NL	NL
Didelphimorphia	Didelphidae	*Didelphis marsupialis (*)*	tacuacín negro (Black-eared Opossum)	LC	NL	NL
Didelphimorphia	Didelphidae	*Didelphis virginiana (**)*	tacuacín blanco (Virginia oposum)	LC	NL	NL
Carnivora	Procyonidae	*Procyon lotor (*)*	Mapache raccoon)	LC	NL	NL

(*) Data obtained by direct observations, or identification of traces
(**) Data obtained by Com.Per.

Source: Own Elaboration 2014.

All the wild species reported in the study, both in the proposed area for the pipeline and the Thermal Power Plant (except for the "comadreja" (weasel) whose presence has only been reported on one occasion), are in a state of conservation of least concern, or insufficient data according to the IUCN Red List (2010). They do not appear in the list of threatened and endangered species of MARN (2015), nor appear in the CITES appendix. (See Tables 5.41 and 5.42).

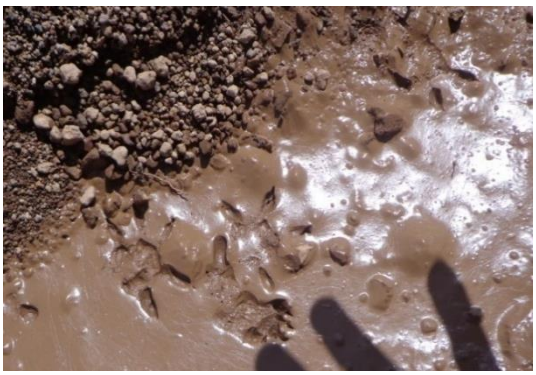
However, these species play important ecological roles for the area, as they contribute to control populations of species considered pests such as rats and mice. They also contribute to the dispersion of seeds of different plant species and constitute the only remnants of wildlife in these confined areas.

It is important to note that most of the species reported in both areas are of generalist habits as mentioned by *Carillo et al.* (2002) *and Reid* (1997) in the description of mammalian species, therefore, the occurrence in areas altered by man and in a state of regeneration is high, a phenomenon observed during the ongoing study.

It is worth mentioning that there was a notable occurrence of *Rattus rattus* "common rat" individuals in the area, which is attributed to the proximity of the areas of warehouses and containers of CEPA, which favor the development and proliferation of this invasive species. However, despite being a non-native and invasive species, *Rattus rattuses* is a fundamental food source for *U. cinereoargenteus* and other native vertebrates in the area.

The presence of *Rattus rattus* and the low diversity of vertebrates found during the study are signs of alterations in the ecosystem, as well as direct anthropogenic disturbances such as noise, influx of people in areas inhabited by animals, deposition of garbage, burning, among other. See photos 5.27, 5.28 and 5.29.

Photo 5.27 – "Rabbit" footprints A) *Oryctolagus Cuniculus* and " tacuazin negro" (Black-eared Opossum) B) Didelphis Marsupialis Found in the Pipeline Area, June 2014 (Photos by: Virna Morán)

A) B) 

Source: photos taken by Consulting Team

Photo 5.28 – Traces and Excreta of "Mapache (raccoon)" (Procyon Lotor) in the Pipe Area, Acajutla, June 2014 (Photos by: Virna Morán and Samuel Álvarez)

Source: Photos taken by Consulting Team

Photo 5.29 – Excreta of A "zorra (fox)" (Urocyon Cinereoargenteus) and B "Tacuazín Común o Negro (Black-eared Opossum)" (Didelphis marsupialis) in the Area of the Thermal Power Plant, Acajutla, June 2014. (Photos by: Virna Morán)

A) **B)**

Source: Photos by Consulting Team

Another relevant aspect of the ecological characteristics of the area in terms of mammal species present, is the habitual contact with people and the use of areas of intense human activity as a consequence of the need of the animals to expand their territories due to the limited dimensions of the areas they use as habitat (Photo 5.30).

Photo 5.30 – Access Exit used by Confined Terrestrial Mammals in the Thermal Power Plant Area, towards the CEPA facilities and Other Surrounding Areas, June, 2014

Source: Photo taken by Consulting Team

The reported mammal species are in a state of conservation of least concern; and therefore, their status as well as their level of commercialization are out of threat or danger of extinction, according to IUCN and CITES respectively.

The qualitative data obtained in this study does not allow to fully evaluate the behavior and status of wild mammal populations in the different areas of study, which is important and necessary to estimate more accurately the environmental goods and services provided by the vertebrate community present in the study area.

The conservation status and the lack of protection of the vegetation of both areas is a determining factor that influences the low diversity and distribution of the wild mastofauna. Human intervention (burning, solid waste disposal) that has altered the structure of the habitat, which has characteristics such as the predominance of invasive vegetation species, the last, take the niche of native species, to which the local fauna has adapted for using as food, rest or other activities necessary for their survival.

5.3.5.4 Description of Fauna by Areas

Each of the areas studied will result in structural modifications of the habitat, however, it should be emphasized that theses areas are already undergoing constant disturbance by activities associated with the the operation of all port facilities, industries, services and transport systems.

During the visits to the area, the two areas of the Project (Pipeline and Thermal Power Plant) were assessed. It is important to emphasize that in the case of reptiles, birds and mammals, it is not possible to limit their location to a specific site, due to the high capacity for movement within the zones they inhabit. For example, in the case of the gray fox (*U. cineroargeneteus*) it is a species that is characterized by having great capacity of movement.

Therefore, it would be inappropriate to limit their presence to any of the three specific areas, due to their proximity and mainly because of the limited size of the existing patches of green areas the species may use for the searching food, nesting, resting, protection and other activities.

Pipeline Area

In the direct and indirect area of influence of the pipeline it was possible to observe different species of the different taxonomic groups, including many species of birds typical of coastal and / or marine areas that flew over the site, due to the pipeline extending to the coast. There are also species with high tolerance to disturbance, including introduced species and species of domestic type.

In the case of amphibians only *Rhinella marinus* "sapo comun" (common toad)" was recorded and in the case of reptiles eight species are recorded, among them only *Ctenosauria similis* "garrobo (spiny tailed iguana)" and *Iguana* "iguana" is recorded as THREATENED according to MARN (2015) *Hemidactylus frenatus* "geko blanco (white geko)" was recored and is an introduced species typical of disturbed areas.

In the case of birds, aquatic species recorded that flew over the site included: *Fregata magnificens* "frigate (magnificent frigatebird)", *Pelecanus occidentalis* "pelicano cafe (brown pelican)", *Egretta tricolor* "Egretta tricolor", *Egretta thula* "snowy heron", *Chlidonias niger* "sea gull". None of them are listed as threatened species according to MARN (2015). Also observed were species indicative of disturbance including *Asian Zenaida* "aliblanca pigeon", *Columba livia* "pigeon of Castile".

As for the mammals, the area was identified as a transit zone of species to move from one vacant lot to another. Excreta traces of *Procyon lotor* "raccoon" and *Urocyon cinereoargenteus* "gray fox" were identified mainly near the coast, as well as at least 3 species of domestic mammals, including the cat (*Felis catus*), the *muskrat* (unidentified spp) and the "common rat" (*Rattus rattus*).
It should be mentioned that the Project activities to be carried out in this area are considerably less impacting for these species since a total clearing of vegetation is not expectd, but only the cutting of some individual plant species that are inside the area that covers the length and the width of the pipeline.

Central Thermal Power Plant Area

In the zone of the Thermal Power Plant, the most direct sightings of terrestrial vertebrates occurred. In the case of amphibians only *Rhinella marinus* "sapo comun (common toad)" was recorded. In the case of reptiles, 15 species were recorded. Among them only five *Ctenosauria similis* "garrobo" and *Iguana* "iguana", *Lampropeltis triangulum* "False coral" *Porthidium ophryomegas* "víbora castellana (Slender Hognose Viper)" and *Leptodrymus pulcherrimus*" bejuquilla de cabeza verde (stroped lowland snake)" are recorded as THREATENED according to the list of threatened species list of MARN (2015).

In the case of birds, there are 43 species, including some species of aquatic birds that flew over the site due to their proximity to the coast, such as *Pelecanus occidentalis* "pelican cafe (brown pelican)", *Pelecanus erythrorhynchus* "pelican (pelican)", *Dendrocygna autumnalis* "pichiche (black-bellied whistling duck)" and *Mycteria American* "cigüeña (stork)". The only species considered to be THREATENED according to MARN (2015) is the "catalnica (Orange-chinned parakeet)" *Brotogeris jugularis*. It is also observed species indicative of disturbance as Asian Zenaida "aliblanca dove", *Quiscalus mexicanus* "clarinero (Great-tailed Grackle)".

As for mammals, species were identified by through excreta traces including for: *Procyon lotor* “mapache (raccoon)” y *Urocyon cinereoargenteus* “zorra gris (gray fox)”, *Mephitis macroura* “zorrillo rallado (Hooded Skunk)”, *Philander oposum* “zorro cuatro ojos (Gray Four-eyed Opossum)”, *Didelphis virginiana* “tacuacín (Virginia opossum)”. Others, as well in abundance included the "common rat" (*Rattus rattus*) are reported.

5.3.6 Areas of Interest within the Project

In the case of the study area, despite including small patches of forests and green areas, it does include sites of biological interest, as these areas contain species of different taxonomic groups and some of them are a state as THREATENED for the country. It is necessary to emphasize that the site is subject to to high anthropogenic impact that favors species such as *Rattus rattus* "common rat" that are present in high population densities that nevertheless can be taken advantage of by opportunistic native species for food..

The study area, which comprises two land areas where the Project is intended to be implemented, with some degree of connectivity between them. This area does not include any fluvial, lacustrine or other type of aquatic ecosystem. The study areas comprise only terrestrial ecosystems, with the exception of the marine-coastal ecosystem that is described in detail separately in another section of the environmental impact study.

The environmental degradation present on the site has been mainly caused by the human activities carried out here. The most important are agriculture, livestock, fishing, industry, port services and tourism, which have resulted in the degradation of natural resources and the absence of fully preserved natural habitats, since even protected natural areas near Acajutla such as Los Cóbanos, present high degrees of degradation and contamination (Rivera 1999 and Alvarenga et al., 2009). Industrial activity is one of the most impactive both in the area surrounding the study area and in the whole municipality of Acajutla. This includes port activities, storage of hydrocarbons by different companies within CEPA facilities, the oil industry (processing and storage), chemical and fertilizer industry, the fats and oils industry, seafood processing, and thermal power generation (Rivera 1996, Alvarenga et al., 2009, SACDEL 2012).

Given the scope of the foregoing study, a survey of all possible sources of industrial pollution in the Acajutla area has not been carried out and only the impacts within the Project's construction areas are considered. However, the activities to be carried out added to the pressure to which the biodiversity and areas of biological interest are exposed in the surroundings of the site.

However, it is worth mentioning that the surrounding site area generates constant pressure and disturbance of resources, resulting from multiple anthropogenic activities. Among them is the discharge of substances from human settlements, pesticide residues and organic compounds of fertilizers that flow into marine waters as a result of runoff from agriculture. Also, is impact of the industrial and artisanal fishing activity that results in exploitation of the marine-coastal resources, including illegal practices of extraction of mollusks and eggs of marine turtles for their commercialization. (Alvarenga et al., 2009).

All of this is combined with the impacts of the industrial zone located along the coast of Acajutla. This results in a risk to the quality of groundwater from industrial activity discharges. Also, the constant dispersion of raw materials and solid wastes coming from ship loading and unloading activities, hydrocarbon spills from on-site vessels, and the threat of accidental spills of toxic substances (hydrocarbons) during port operations (*Alvarenga et al. 2009*)

5.3.7 Conclusions of Terrestrial Biological Study

The foregoing study registers a total of 96 species of flora, of which, 37 are of arboreal type and 56 of shrub and herbaceous type. Regarding the fauna component, one species of amphibian, 16 reptiles, 53 bird species and nine species of mammals were recorded. Most are resident species and many are of the generalist type and typical of the lowlands of El Salvador.

Wildlife species are not limited in there distribution by the different study sites within the forest patches and green areas because of their ease of movement that is associated with their habitat

use needs. Small seasonal ponds were observed in the study area, which favor the development of amphibians and some reptiles such as *Rhinella marinus* "sapo comun (common toad)" and *Rhinoclemmys pulcherrima* "painted turtle (painted wood turtle)". On the other hand, reptiles (serpents, snakes, lizards) such as *Ctenosauria similis* "garrobo (spiny-tailed iguana)", Iguana "iguana" and *Lampropeltis triangulum* "false coral", *Porthidium ophryomegas* "vibora castellana (Slender Hognose Viper)", *Leptodrymus pulcherrimus* "bejuquilla de cabeza verde (Striped Lowland Snake)" are in THREATENED state for MARN (2015).

In the case of birds, according to the vulnerability status of MARN (2009), one species was classified as THREATENED (*Brotogeris jugularis*), and according to IUCN (2011) all species are in the Least Concern status. In the case of mammals, no species in category of risk were identified. The study site represents a place of refuge for many species of birds, which depends on these areas for food and reproduction. This is why there is a presence of resident and migratory species that depend on this ecosystem for its development. As well, the area favors the sighting of aquatic species by its proximity to the ocean.

In the case of mammals, their distribution appears to encompass all green areas and forest patches of the CEPA facilities, because of their ability to move throughout the study area, making use of this habitat as shelter, to eat, and for its development. Although none of the species listed are within the MARN threatened species lists, their populations may be reduced by forest fragmentation and loss of habitat due to accelerated urban growth, industrial development and other human activities: Therefore, the sites represent ecological importance for conservation and actions should be taken to mitigate the impact of the change of land use in the site.

5.3.8 Marine Flora and Fauna

5.3.8.1 Generalities

In Article 5 of the Environmental Law (MARN, 2005), it defines the Coastal Marine Zone as the coastal strip comprised within the first 20 km inland from the coastline, and the marine area comprises open sea from zero to 100 m deep, and where the species of organisms of the seafloor are distributed. There is a coastline of El Salvador with a length of 321 kilometers from the Rio Paz in the border with Guatemala to the Golfo de Fonseca shared with Honduras and Nicaragua.

This coastal zone of the country contains a diversity of marine and terrestrial ecosystems that provide important ecosystem services to the local communities and to the Nation. Among the ecosystems that are characteristic of the buffer zone and influence the Project are: relicts of salty forest at the mouths of the rivers, riverside forest of the Sunzacuapa and Sensunapán rivers, fragmented beach vegetation in isolated patches, estuary, agroecosystems (sugar cane, maize and sorghum), urban and rural areas, soft and rocky reefs, cliffs, sandy and white sandy beaches, rocky

beach, among others. These ecosystems and their resources are of strategic importance for the sustainable development of the country. Activities such as agriculture, fisheries, marine transport, tourism, aquaculture, pollution control, erosion control at the coastline, management of protected marine areas, restoration of mangrove forests, among others, are essential activities to achieve sustainable development of the country and the well-being of its population.

In the natural and physical environment of Acajutla, varied ecosystemic functions of support, provision or sustentation, cultural, and of regulation, are performed. Some examples are natural dwellings for fish, mollusks and crustaceans (mostly rocky reef), flood control, water purification, aquifer recharge, fishery and aquaculture production, carbon dioxide fixation in the form of calcium carbonate "Carbon sinks ", climate regulation, protection and stabilization of the coastline, tourism and scenic beauty, among others. These areas and their resources are of strategic importance for the country's sustainable development. Activities such as fish aggregators, sustainable agriculture on the plains, environmentally friendly fisheries, marine transport, tourism, aquaculture, natural pollution control and erosion at the coastline, restoration of mangrove forests are essential activities for the sustainable development of the country.

The foregoing report focuses on the biophysical and chemical characterization of each site; where there are macrobenthic organisms (organisms present on the seabed greater than 500 micrometers), the ichthyofauna fish communities that frequent these sites of interest.

5.3.8.1.1 General Objective

To characterize the macrobenthic organisms of the muddy, rocky / sandy bottoms and the pelagic organisms of the zone of direct and indirect influence of the Project.

5.3.8.1.2 Specific objectives

- Characterize the different types of biotic communities of benthos, pelagic organisms and rocky / sandy beach organisms in the Project area, taking as a reference frame the Inventory Manual for the study of Biodiversity.
- Determine the marine coastal water quality of the site (pH, salinity, temperature, dissolved oxygen, transparency).
- To facilitate and systematize, based on up-to-date secondary information, the biophysical and ecological conditions of the Project area, its buffer area and influence area, to support the construction and discussion of the matrices (potential impacts) during Process of the Environmental Impact Study (EsIA).

5.3.8.2 Study Methodology

A. For macrobenthos of the sandy and muddy bottoms: The different types of biotic communities of the benthos were characterized by scuba diving samples being extracted in forty-one (41) sites prioritized by the Project. For the extraction of the samples, Scuba diving equipment and 4 inch PVC tubes were used with their respective pressure cover, extracted for each sampling point (10 m2 each), four samples were collected with PVC nucleators of 4 inches and to 30 cm of depth of the seabed. For the benthos samples, it was fixed with 10% formalin, stained with rose of bengal, to facilitate the extraction and taxonomic classification. Each fixed sample is sieved with a 500 µm pore sieve for extraction and counted under a stereoscope microscope.

B. For the other sediment samples, once removed, they were placed in one gallon sealable Glad bags and placed in ice cubes and ice packs for transportation to the certified laboratory for their corresponding physical-chemical analysis.

C. To facilitate diving maneuvers and the extraction of water and sediment samples, 30-foot artisanal boats (2) were used with 40 HP outboard motor. The shallower samples were obtained at six meters' depth and the ones farthest from the 15 m shoreline. The color of the sediment and its consistency are identified to touch and sight.: Rocky, sandy, sandy-loamy and silty-loamy.

D. Characterization of the different types of biotic communities of rocky / sandy intertidal beach. The beach under evaluation comprised 1,600 meters, which was divided into four sampling stations, which depended on the previous zoning. The percentage of coverage was estimated by placing three transects parallel to the beach at each station, with a length of 10 m and spaced from each other by 10 m. The transects were crossed with a quadrant of 1 m^2 of area, divided in 100 cm^2. In each quadrant macroalgae, sand, rock and other organisms were estimated. In the case of macroalgae the families Chlorophyta, Phaeophyta and Rhodophytas were counted, also separating the red algae, the species that form a dense layer of filamentous algae were classified as "turf". For the statistical analysis, averages were calculated and standard deviations of the coverage percentages by depth and between the sampling stations to obtain an average. Non-parametric Kruskall Wallis variance tests were performed to determine differences in depth and inter-site coverage. The vertical profile was made with a transect perpendicular (transversal) to the coast of 100 m long, following a gradient of depth up to 10 meters. Which was crossed with a quadrant of 50 x 50 cm2, every 5 meters in the line of the transect. The data that were taken in each quadrant were: depth and substrate coverage. The profile of the substrate was plotted and the coverage of the main organisms in areas of 20 meters of the transect is presented. Activities were carried out during low tide, with SCUBA

diving equipment or snorkel. The richness that makes up the biotic communities was made through underwater photographs and taxonomic guides.

E. To characterize the demersal and pelagic biota of fish found in the area of interest, three sampling sites were established based on the programmed distribution of each of the sampling points (trawls near the beach line, and the most distant). For each sampling site, six trawls (three bottom and three surface) were made, counting a total of 36 samples. For the catches were used gill nets of different light of maya which are manipulated by the fishermen of the community. Gill nets were manipulated through the bottom-and-bottom and bottom-stationary bottom fishing method, this collection effort will ensure greater species registration. In addition to this effort (Capture by Effort Unit), visual censuses were carried out to identify the fish communities associated with the muddy bottoms of the area. Scuba Diving, Snorkling were carried out, and fishing activities of "tuberos" were followed.
F. In-vitro measurement of the marine coastal water quality of the site (pH, salinity, temperature, dissolved oxygen, transparency) and transfer of water and sediment samples to national certified laboratories; And photographs and videos during and through sampling of water quality, artisanal fishing, rocky and sandy bottoms, animal and plant biota.
G. Sequence of approach: Through discussion groups of the work teams, the various environmental activities and areas were evaluated. For the measurement of the environmental impact that may be generated by the various activities, works or projects by stakeholders interested in their Permit Environmental and to propose alternatives for improvement to these types of construction and operating actions, mainly those that generate negative environmental impacts and propose their environmental measures to be complied by the Holder.

5.3.8.3 Methodology

This study was carried out in three research periods, where the field phase and sample collection were started in August 2014 with twelve (12) sampling points, continued in August 2015 with four (4) additional points, and Finally took 25 sampling points in August 2016 (see Figure 5.38).

The general sampling areas are presented in Figure 5.38 and the zoning of marine biota found after sampling is shown in Figure 5.39, the last is described below.

5.3.8.4 Artisanal Fishing Pier

El Salvador's Government through CENDEPESCA built the Acajutla Artisanal Fishing Pier, located north of the Project, with the objective of supporting the development of artisanal fishing in the area through facilities that provide security (Álvarez & Jimenez 2005). It provides a supply of

drinking water, electricity, fuel, warehouses, transportation and other facilities that the fishermen were not prepared or able to develop.

The Artisanal Pier began operations in June 1986, where it has served a growing population of fishermen, merchants, and transporters.The number of vessels has also increased since 2005. The arrival of tourists to the pier has increased by an average of 2000 a month, making it an important center of development in the city of Acajutla (Álvarez & Jimenez 2005).

5.3.8.5 Characteristics of the Coastal Zone in General

Due to its proximity to the Port and population of Acajutla and to the outlet of the Rio Grande de Sonsonate (Sensunapán), the coastal-marine ecosystems of the area are subject to a constant contribution of anthropogenic source contaminants (ICMARES 2006).
The main sources of pollution are:

- Polluted waters and sediment supply from the Sensunapán River and others which transport municipal discharges and solid wastes (garbage) from the cities of Sonsonate, Acajutla and other towns in the watershed (Juayúa, Salcoatitán, Sonzacate, San Antonio del Monte, Nahuizalco);
- Solid wastes (garbage) and discharges from port activities and merchant ships;
- Discharge from the industrial zone of Puerto Acajutla;
- Wastewater from a sector of the city of Acajutla;
- Accidental oil spills from the Refinery (RASA) in Puerto Acajutla;

In the sector known as Quebrada La Ranfla-Desembocadura Playa Las Flores, it is one of the most critical points of discharges, since most of the companies (FERTICA, PESQUERA DEL SUR, RASA, TEXACO, ARFS, etc.) discharge wastewater at this location. The zone is known as “barra ciega”, it has ubstrates of fine sand mixed with pebbles, where high amounts of sediments and presence of cyanobacteria, evolution of strong odors of sulfur and processes of bacterial decomposition of ethanol are observed.

According to data from the "Environmental Diagnosis in the Marine Coastal Area of the Acajutla zone (RPI 1995)", a residual discharge volume of different origins of 13,247.5 m^3/day was estimated, where the percentage contribution from the different sources was: cooling tower waters (37.3%); Domestic wastewater (28.6); waters of shrimp farms (22.6%); waters of industrial processes (5.6%); industrial wastewater (5.6%); and others (0.3%).

Energía del Pacífico

ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

ÁREA DE MUESTREOS EN MAR / MARINE SAMPLING AREA

FIGURA 5.38 / FIGURE 5.38

- 2014 PUNTOS DE MUESTREO ACAJUTLA / 2014 ACAJUTLA SAMPLING POINTS
- 2015 PUNTOS DE MUESTREO ACAJUTLA / 2015 ACAJUTLA SAMPLING POINTS
- 2016 PUNTOS DE MUESTREO ACAJUTLA / 2016 ACAJUTLA SAMPLING POINTS
- ÁREA DE MUESTREO PECAS / FISH SAMPLING AREA
- MUESTREO PLAYA INTERMAREAL / INTERTIDAL BEACH SAMPLING AREA
- SITIO DEL PROYECTO / PROJECT SITE
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA
- TERRENO PROPIEDA DE CEPA / CEPA PROPERTY

UBICACIÓN DE SITIO / SITE LOCATION

0 100 200 400 m

1:22,000

FUENTE / REFERENCE
VISIÓN DEL MUNDO 2 IMÁGENES DE ALTA RESOLUCIÓN / WORLDVIEW 2 HIGH RESOLUTION IMAGERY (2014-02-12)

MAPA CREADO POR / MAP CREATED BY: PFM/SFG
MAPA REVISADO POR / MAP CHECKED BY: MW
PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONE 16 WGS84

ARCHIVO / FILE:
I:\GIS\163489 Acajutla\GIS\MXDs\Reporting - 2016\5-38 - Marine Sampling Area_.mxd

PROYECTO / PROJECT: 163489
ESTADO / STATUS: FINAL / FINAL
FECHA / DATE: 12/14/2016

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1505000 1504000 1503000 1502000

RÍO SENSUNAPÁN

OCÉANO PACÍFICO / PACIFIC OCEAN

MUNICIPIO DE ACAJUTLA / MUNICIPALITY OF ACAJUTLA

Boulevard 25 de Febrero

Boulevard Coronel Oscar Osorio

Avenida Obando

Carretera a Acajutla

Calle 24 de Octubre Ori

Avenida Las Carabelas

CA12S

Terminal Marítima/ Marine Terminal (FSU, FSRU and LNGC)

Muelle Artesanal / Artisanal Port

Sitio de Acopio Temporal / Laydown Area

Central Térmica / Power Plant Site

Tuberia / Pipeline

Temporary Construction Trestle Option "B"

Temporary Construction Trestle Option "A"

Biota Corales Blandos / Biota Soft Corals

Puerto de Acajutla / Port of Acajutla

Energía del Pacífico

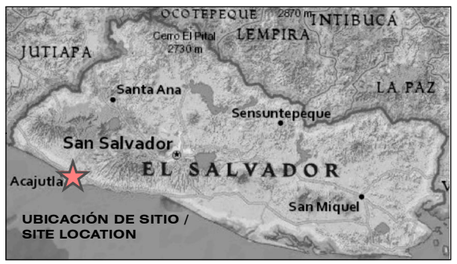
ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

ZONIFICACIÓN DE BIOTA MARINA / ZONING OF MARINE BIOTA

FIGURA 5.39 / FIGURE 5.39

- ZONA DE MACROALGAS / MACRO ALGAE ZONE
- BIOTA CORALES BLANDOS / BIOTA SOFT CORALS
- ÁREA DE OSTRAS/OYSTER AREA
- ROCAS DISPERSAS CON POSIBLES CORALES BLANDOS /DISPERSED ROCKS WITH POSSIBLE SOFT CORALS
- SITIO DEL PROYECTO / PROJECT SITE
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA



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VISIÓN DEL MUNDO 2 IMÁGENES DE ALTA RESOLUCIÓN / WORLDVIEW 2 HIGH RESOLUTION IMAGERY (2014-02-12)

MAPA CREADO POR / MAP CREATED BY: PFM
MAPA REVISADO POR / MAP CHECKED BY: MW
PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONE 16 WGS84

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I:\GIS\163489 Acajutla\GIS\MXDs\Reporting - 2016\5-39 - Marine Biota.mxd

PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL / FINAL
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5.3.8.5.1 Topography

The Coastal Zone of the Municipality of Acajutla is distinguished by presenting several types of topography: sandy, coral reef and rocky. Different types of habitats can be observed: sandy beach with remains of crushed rock, fine grain beach, boulder beach, rocky patches with coral communities, sandy banks, and mangroves. In addition, the coastal plain forms an elevated terrace that breaks into the sea up to more than 18 m (Alvarado et al., 2011). The coastal-marine zone is an environment that is territorially vulnerable to the erosive degradation of the constituent materials of the continental marine shelf. Since the processes that affect them, produces continuous ups and downs in the seabed, contributions and outputs of sand in the marine border (e.g.: waves and coastal currents). Simlarly, hydrographic and meteorological factors (e.g.: wind, rain) and events (e.g.: floods, storms, lunar time change, etc.), which maximize the changes and parameters of the environment (*Pacheco et al*., 2011)

The bathymetry of the area is characterized by an abrupt change of depth in the first 50 meters of seafloor where it is common to find vertical walls of rocky substrate 0 meters or deeper (MARN 2014). Gierloff-Emden (1976) describes that the transition to depths of more than 35 m is made from Punta Remedios to the west at 6 km. The 35 m isobath runs off the coast of lagoons west of Acajutla at a distance of 10 km. In addition, it emphasizes that the underwater soil inside the isobata, of 15 m, is rocky.

5.3.8.5.2 Aquatic Flora

Molina 1984, 1994 and 2004 reported 20 species of macroalgae associated to the reef system; being the dominant species: *Hypnea cervicornis*, *Oscillatoria, Limba spp*, *Lithotamnium spp*, *Padina vickersiae* and *Acanthophora spp* (ICMARES 2006).

Complementarily *Tejada* (2005), reports to Natural Protected Area (NPA) Los Cobanos a total of 81 species of Macroalgaes**,** belonging to the divisions Chlorophyta, Rodophyta, and Phaeophyta. The dominant Division is Rodophyta, with a total of 42 species (Appendix 5O). The macroalgae richness in this reef is superior to that of five rocky beaches located in the Bálsamo mountain range in the department of La Libertad.

5.3.8.5.3 Aquatic fauna

The NPA Los Cobanos is the most diverse site of species at the national level. A total of **1,032 species** are recorded among invertebrates, vertebrates and arboreal vegetation resulting from research in the intertidal zone (ICMARES 2007a).

Corals: Nationally, it is the only natural area with coral reefs. There are **11 species** of corals recorded (Appendix 5P). Within the hard reef-forming corals protruding heads of *Porites lobata* and patches of

Pocillophora spp. All corals are found in CITES Appendix II. Within soft corals it is important to highlight the presence of "black coral" *Anthipathes galapagensis* detected at 30 m in depth (ICMARES 2007a). Other types of colony forming collars called polyps also occur. Recent studies report Los Cobano NPA as one of the sites with the highest octocoral diversity (**13 species**) in the country, with the genus *Muricea spp* (Appendix 5P) (Segovia Prado 2012) standing out for its abundance.

The octocoral communities are a source of larvae for repopulation of other areas, provide food for fish and sea turtles and contribute to the supply of calcium carbonate which makes them an essential element of benthic communities, are also considered bio indicators of environmental conditions (*Segovia Prado* 2012).

Annelids polychaete: is considered the most diverse, abundant and dominant group of seabed around the world; And representative of benthic communities. In AMP Los Cobanos, **14 species** are reported (Appendix 5Q). Standing out for its dominance *Sternaspis scutata, Paraprionospio pinnata, Magelona sp.*[3] (Rivera and Romero 2002).

Echinoderms: 20 species are reported (Appendix 5R), are very important organisms in the ecosystems since they participate in the decomposition of orgaic metria. *Astropecten armatus* and *Phataria unifascialis* are the most abundant in soft and rocky bottoms, respectively. There is a high abundance of *Echinometra vanbrunti* on intertidal and shallow rocky reefs. It is estimated that the most abundant holoturoid in shallow intertidal rocky areas is *Holoturia kefersteini* (ICMARES 2007a).

Mollusks: According to the inventory of the Ministry of Environment and Natural Resources (MARN), **239 species** are reported on the Los Cóbanos reef (Appendix 5S); Highlighting the banks of *Abalone Spondylus limbiatus* known as S. calcifer and snail *Strombus galeatus* species of high commercial value and 11 species belonging to the *Muricidae* Family, standing out the *Hexaplex* and *Muricanthus* genus. Very appreciated for their value as a producer of natural ink, which is why there is an international interest in occupying it in the textile industry.

Polyplacophora (chitons): 8 species: *Chaetopleura lurida, dispar Ischnochiton Stenoplax limaciformis, Callistochiton Express, Ceratozona angusta, Acantochitona arragonites, Acantochitona hirudiniformis* and *Chiton stokesii*, being this last one very abundant in the mesolittoral (ICMARES 2007).

In addition, **15 species of marine slugs** (*Opistobranchios*) are reported for the area of Los Cóbanos (Barraza 2009, cited by ICMARES 2007a) (Appendix 5T).

The o*pisthobranchs* inhabit marine ecosystems, on either rocky or soft bottoms and some swim freely or associate with floating objects in pelagic environments.

Crustaceans: only **14 species** are reported in Los Cobanos NPA and **4 in Acajutla**. Of particular interest, *Panulirus penicillatus* (red lobster) and *Panulirus inflatus* (blue lobster) are the last rare occurrences within the country's fisheries (*López and Pineda 2008*).

Fish: In Los Cóbanos NPA, a total of **163 species** are recorded in intertidal pools, open waters and estuarine-riverine habitats. The *Pomacentridae, Serranidae* and *Lujanidae* families stand out being the last two groups of high commercial value**.**

In the area of artisanal fisheries, fish are reported from 9 families, 14 genus and **16 species** of commercial importance: *Lutjanus peru* "pargo"(pacific red snapper), *L. guttatus* "guachinango" (opah), *L. argentiventris* "pargueta" (red snapper), *Hoplopagrus guentherii* "Sardo" (Mexican barred snapper), *Euthinnus lineatus* "atún negro" (Black tuna), *Katsuwonus pelamis* "barrillete" (skipjack), *Scomberomorus sierra* "macarela" (mackerel), *Haemulon flaviguttatum* "naguilla" (Yellowspotted Grunt), *Anisotremus interruptus* "berruguete" (burrito grunt), *Balistes polylepis* "tunco" (finescale triggerfish), *Caranx caninus* "quinoa" (Pacific crevalle jack), *Elagatis bipinnulata* "salmón" (salmon), *Sectator ocyurus* "Pichel" (bluestriped chub), *pinnimaculatus* "bagre" (catfish), *Coryphaena hippurus* "dorado" (dolphinfish), *Pseudupeneus grandiquamis* "salmonete" (goatfish) (*Hernández Rodríguez* 2006).

Censuses of fish made in the period 2008-2013 by MARN in the reef area obtained **63 species** (Appendix 5U); Among which the *Pomacentridae, Labridae and Haemulidae* families stand out. Emphasis on its dominance *Chromis atrilobata, Halichoeres dispilus, Herichthys steindachner, Stegastes acapulcoensis, Stegastes acapulcoensis, Anisotremus caesius, Stegastes flavilatus*

5.3.8.6 Types of Rocky / Sandy Intertidal Beach Biotic Communities

The coastline has medium-height cliffs where the rock extends into the sea, and contains small beaches of less than 500 m in length (Photo 5.31). The sectors named as Rocky and Rocky Substrate have between 0 and 5 m depth, while Rocky Substrate with Octocorals presence has between 4 and 10 m.

Photo 5.31 – Coastline Overview

Source: Photo taken by Consulting Team

5.3.8.7 Rocky Substratum Sector

For rocky environments, the information was recorded in August 2014, where it is observed that this sector is typical of cliff environment (Photos 5.32: a, b and c), where "galleries" of sea urchin are observed (Photo 5.32: d) with clear presence of calcareous algae and green algae (Photos 5.33). In addition, shallow organisms are observed in the intertidal area, such as "chitons" and "marine slugs" (Photo 5.34). The richness of associated species was as follows:

Filo Echinodermata:

- Echinometra vanbrunti; and
- Holothuria inornata.

Filo Molluca:

- Elysia diamedea; and
- Dolabrifera dolabrifera.

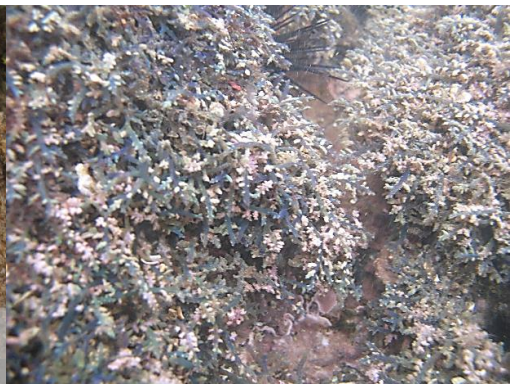
Photo 5.32 – Cliff Environments

a. b.

c. d.

Source: Consulting Team, 2014

Photo 5.33 – Chlorophyta, Phaeophyta and Rhodophytas Divisions

a.  b.

c. d.

Source: Consulting Team, 2014

Photo 5.34 – Organisms in the intertidal Area

a. b.

c.

Source: Consulting Team, 2014

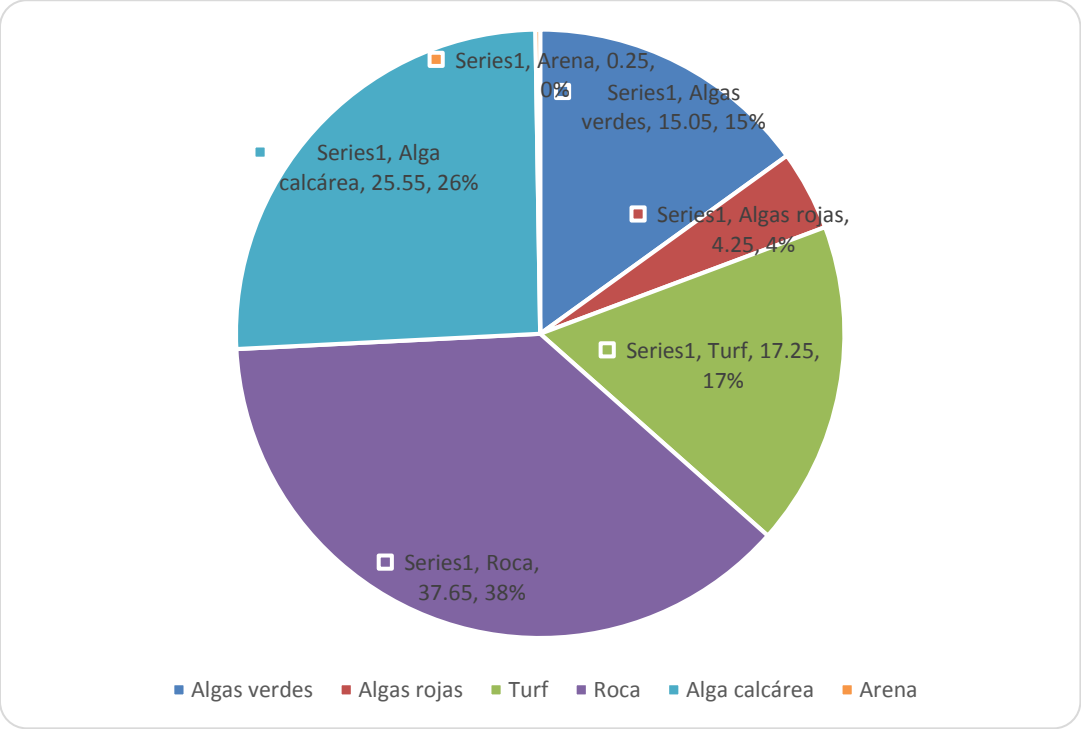
5.3.8.8 Vertical Profile

The vertical profile showed rock, calcareous algae and turf coverages with higher percentages of coverage with 38%, 26% and 17%, respectively. The opposite of algae cover, where the green and red algae have a lower register, with 15% and 4% respectively (Figure 5.40).

When comparing the means of coverage percentages of the different depths along the vertical profile, significant differences were observed (p = 8.12x10-8, Kruskal-Wallis test). The highest percentage of green algae cover was observed at 80 m (22% ± 10.3) and 40 m (13% ± 12.4) from the coast, and the lowest percentage was observed at 60 m (3% ± 2.5). Red algae were only observed 80 m from the coast (21% ± 10.9).

The highest percentage of turf coverage was obtained at 40m (35% ± 11.9) and 60m (25% ± 8.66), decreasing to 60m (6% ± 6.25) and failing to find from 80m. The rocky substratum was the most abundant along the profile, its highest percentages were found at 40 m (44% ± 2.18), 60 m (40% ± 15.81) and 80 m (40% ± 12.24). The highest calcareous seaweed cover was observed at 60 m (32.5 ± 10.3) and 20 m from the coast (32% ± 23.55). The presence of sand was only observed from 100 m in a low percentage (1% ± 6.25) (Table 5.43).

Figure 5.40 – Percentage of Substratum Coverage in the Vertical Profile



algas verdes = green algae,algas rojas = red algae,roca= rock, alga calcárea = Calcareous algae, arena = sand

Source: Consulting Team, 2014

Table 5.43 – Average Percentage of Coverage in Vertical Profile						
Depth (m)	**Green algae (%)**	**Red algae (%)**	**Turf (%)**	**Rock (%)**	**Calcareous algae (%)**	**Sand (%)**
20	13	0	20	36	32	0
40	13	0	35	44	9	0
60	3	0	25	40	33	0
80	23	21	6	40	10	0
100	10	0	0	19	17	1

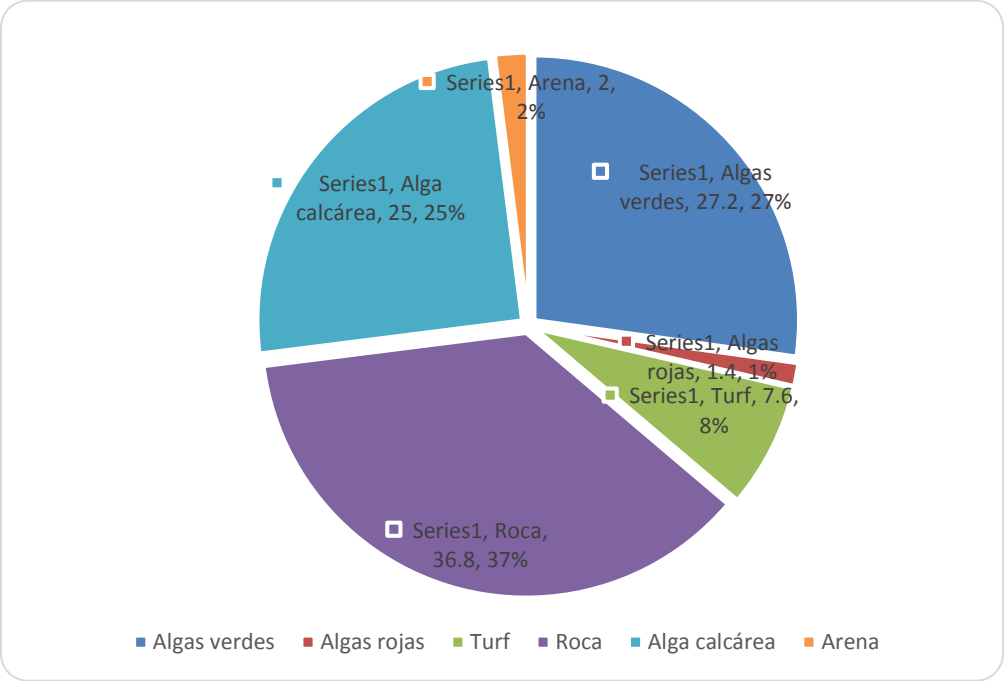
Source: Consulting Team, 2014

5.3.8.9 Horizontal profile

The substratum of rock, green algae and calcareous algae have the highest percentages of coverage with 37%, 27% and 25% respectively. On the contrary, turf, sand and red algae are less (Figure 5.41).

When comparing the means of the coverage percentages of the different transects traced along the horizontal profile, significant differences were observed ($p = 9.07x10\text{-}17$, Kruskal-Wallis test). The highest percentage of green algae cover was observed in the first 10 m (52 ± 8) and 30 m (40 ± 8.94) of the coast, and the lowest percentage at 20 m (2 ± 2). Red algae were only observed at 20 m and 50 m (20 ± 4), the latter being the highest percentage. The highest turf coverage was obtained at 50 (20 ± 12) and 20 m (22 ± 5.15), being absent at 10 and 30 m. The rocky substrate cover presented the highest coverage percentages, the highest being 50 m (70 ± 51), 20 m (47 ± 10.8) and 40 m (34 ± 13.3). The highest calcareous seaweed cover was observed at 30 m (38 ± 5.8) and 40 m (28 ± 8.6) from the coast. The presence of sand cover was very low, finding the highest percentage at 50 m (20 ± 5) (Table 5.44).

Figure 5.41 – Percentage of Substratum Coverage in the Horizontal Profile



algas verdes = green algae, algas rojas = red algae,roca= rock, alga calcárea = Calcareous algae, arena = sand. Source: Consulting Team, 2014.

Table 5.44 – Average Percentage of Coverage in the Horizontal Profile

Distance (m)	Green algaes (%)	Red alages (%)	Turf (%)	Rock (%)	Calcareous algae (%)	Sand (%)
T1	52 ± 8	0	0	30±4.47	16+2.4	2±2
T2	2±2	3±3	22±5.15	47±10.8	23±12	3±2
T3	40±8.94	0	0	22±3.74	38±5.8	0
T4	34±8.71	0	4±4	34±13.3	28±8.6	0
T5	30±8	20±4	20±12	70±51	50±20	20±5

Source: Own elaboration 2014.

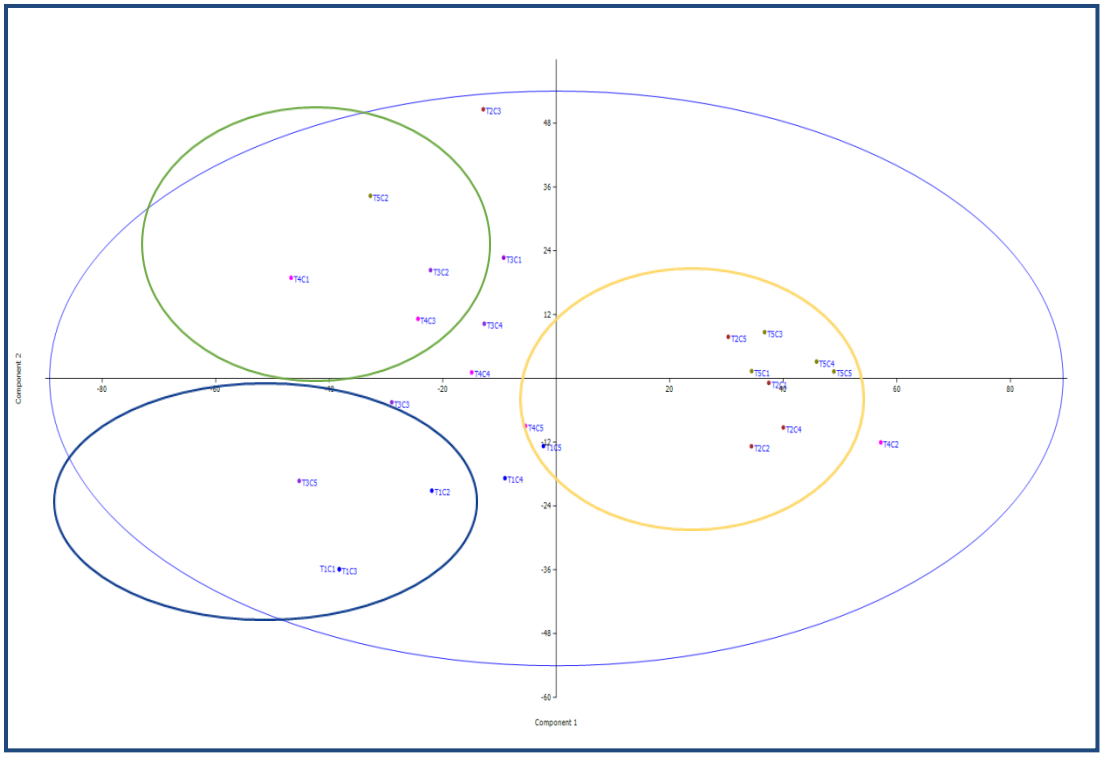
The zoning with the values recorded in the transects made parallel to the coast show a first area dominated under rock cover (blue color) and then two zones between mixed ones, where in one of them there are observed higher percentages of turf (orange color) And in the other higher percentage of green algae (green color) (Table 5.45).

Table 5.45 – Average Percentage of Coverage in the Horizontal Profile				
Distance (m)	**Red algae (%)**	**Rock (%)**	**Calcareous algae (%)**	**Sand (%)**
T1C1	T1C2	T1C3	T1C4	T1C5
T2C1	T2C2	T2C3	T2C4	T2C5
T3C1	T3C2	T3C3	T3C4	T3C5
T4C1	T4C2	T4C3	T4C4	T4C5
T5C1	T5C2	T5C3	T5C4	T5C5

Source: Consulting Team, 2014

The grouping was performed with the aid of a Principal Component Analysis (PCA), a tool that allows the ordering with the use of the Bray Curtis dissimilarity index using the quadrants made in each transect (Figure 5.42).

Figure 5.42 – Groupings with PCA with a Percentage of Grouped Variance of 82.9% and a Elipse of 95%



Source: Consulting Team, 2014

5.3.8.10 Sandy Substratum Sector

The sandy substratum of the area is combined with small rock headlands both on the coastline separating small lengths of beach (Photos 5.35, a and b), and submerged. On the beach anemones and zoanthids were observed in the cracks of the rock (Photo 5.35, c). Shallow and higher altitude rocks

were found to have greater evidence of algal richness (Photos 5.36, a) than those observed at depths of 5.7 meters (Photo 5.36, b). In this sector, we find several vestiges of sunken ships that have been used by organisms for protection and substrate (Photo 5.37). The species richness observed:

Filo Cnidaria:

- *Carijoa multiflora.*

Filo Annelida:

- *Bispira* sp.

Filo Artrópoda:

- *Calappa convexa.*

Filo Artrópoda:

- *Daira americana; y*
- *Eriphides hispida.*

Filo Echinodermata:

- *Astropyga pulvinata.*

Photo 5.35 – Sandy-Rocky Coastline Sector

a.

b.

c.

Source: Consulting Team, 2014

Photo 5.36 – Algal Environment Sector at Different Depths

a) **b)**

Source: Consulting Team, 2014

Photo 5.37– Species Associated with Sinked Boats in the Sandy-Rocky Substratum Sector

Source: Consulting Team, 2014

5.3.8.11 Rocky Substratum Sector with Presence of Octocorals

The rocky substratum of this sector does not present continuously in the background, they are small promontories surrounded by sandy areas. However, the presence of the group of octocorals makes this environment different compared to the rocky substrate closest to the shore. The organisms in this sector are subject to constant degradation because they are impacted by fishing gear such as the lobster network (Photo 5.38). The richness of octocoral species observed in the site are from the Filo Cnidaria, Muricea fructicosa var. Miser, Leptogorgia alba, Pacifigorgia sp.

Photo 5.38 – Impact of Net on Octocoral Species

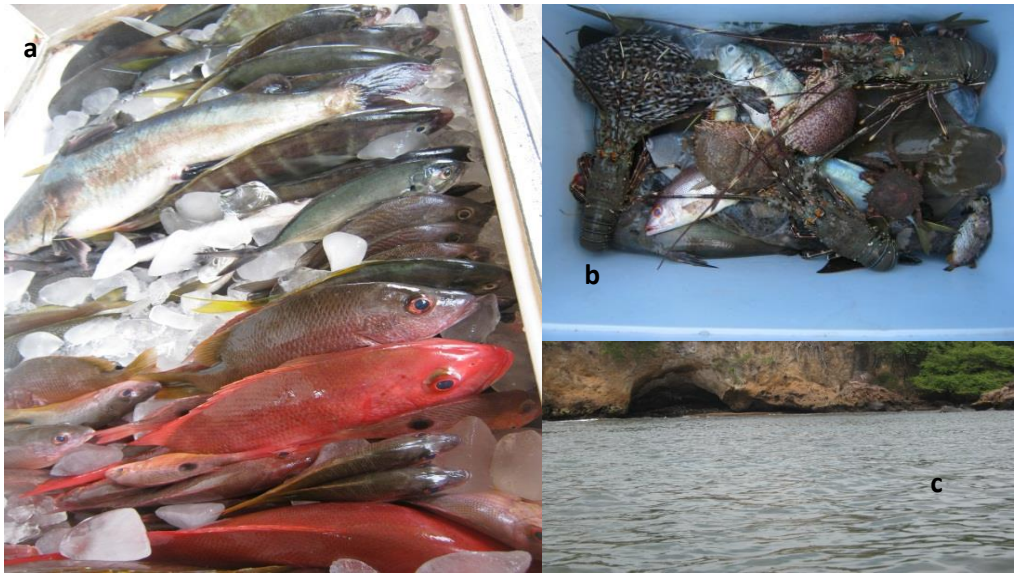
Source: Consulting team, 2014

5.3.8.12 Characterization of Demersal and Pelagic Fish Biota

Currently, there are more than 23,000 artisanal fishermen (OSPESCA 2010). In the particular case of the Port of Acajutla, one of the main economic activities is the extraction, consumption, and sale of fish, mollusks, and crustaceans as the basis of a socio-economic system (USAID / SACDEL 2012). Fishing takes place from 0 to 70 miles offshore. Usually the fishing activities are carried out by young men and adults, while women participate in local marketing and preparation of food (SACDEL 2012). However, there is a greater predominance of workers in the service and commercial sector than of fishermen (JICA 2002).

In 2003, a total of 753,150 kg of marine products were reported in the municipality, among them fish such as pargo (snapper), guachinango (opah), pargueta, among others (Photo 5.38 a), as well as other commercially important taxonomic groups such as oysters, Lobsters, crabs, shrimp and others (Photo 5.39); generating in the local economy an approximate of $ 936,423.

Photo 5.39 – a) Fish with Commercial Importance Disembarked in the Port of Acajutla b) Mollusks and Crustaceans Captured in the Study Area, c) Sampling Point Within the Study Area



Source: Consulting Team, 2014

The main disembarking centers and small craft wharves of the study area and adjacent areas are located in the artisanal port of Acajutla, Los Cobanos, Metalío and Costa Azul. At these sites, the main fish species are composed of snapper, shark, catfish, corvina, mackerel and crustaceans (CENDEPESCA 2006). For the year 2002 alone, in the Port of Acajutla, fishing generated $686,064 USD and for Los Cobanos $ 164, 039 USD; The same data is reflected for the year 2006 (Table 5.46).

Table 5.46 – Fisheries Production in the Study Area and Adjacent Sites for the Years 2002 and 2006

Ports of Landing	2002		2006	
	Value ($)	Weight (kg)	Value ($)	Weight (kg)
Acajutla	686,064	521,799	740,544	469,850
Los Cóbanos	164,039	79,994	297,332	137,131
Metalío	71,302	103,268	254,892	218,527
Costa Azul	38,889	56,330	139,032	119,196
Zone Total:	960,294	761,391	1,431,800	944,704
National Total:	14,755,382	12,007,479	18,422,594	12,683,557

Source: CENDEPESCA 2002, 2006

During the sampling period of August 2014, a diversity of **34 species** of fish were identified, which are part of 20 families. Of this total, 29 species were bony fish and two cartilaginous species. Most of the recorded species are marine habitats associated with rocky reefs, such as snappers (*Lutjanus guttatus, L. argentiventris and L. peru*), as well as reef species such as balloonfish *(Diodon hlocanthus and D. hystrix)* and grouper (*Epinephelus analogus*), the last one of commercial importance.

For study area of August 2015 Survey, the same species (11) are reported, with similar sizes to 2014, where few families were found, being a typical behavior of muddy marine ecosystems with high fishing pressure, these zones are frequented by “rederos” and local artisanal fishers. Of the 11 species of fish identified, the most abundant were the commercial species Lutjanus guttatus "lunarejo" with 13 individuals of average sizes of 10 +/- 2 cm in length, followed by the inedible species Diodon holocanthus "fox" with 11 specimens with sizes ranging from five to 10 cm in length. The rest of the species presented low abundance that varied between 4 to 6 individuals each.

Fishing effort intensified in August 2016, where catching records varied in terms of species richness, and coupled with this larger fishing effort, other factors such as the breadth of the net, number of sets, conditions physical and chemical characteristics of water, tides, normal or temporary rainfall. It also varies by species migration according to the time of year which favors the presence or absence of fish suitable and optimal for fishing. That is why various fishing gear is used in the area, as well as daytime and nighttime fishing.

During the three sampling times, 48 species of fish were identified, comprising 26 families. Of these, 45 species were bony fish and three cartilaginous species (Table 1). Most of the recorded species are marine habitats associated with rocky reefs, such as snappers (*Lutjanus guttatus*) and "papelillo" (*Chloroscombrus orqueta*). (Table 5.47).

Table 5.47 – Composition of species of the catches in the area of influence of the project

N°	Family	Common name	Species
Ariidae	*Cathorops fuerthii*	“soropo” (congo sea catfish)	Freshwater / Estuarine / Marine
	Arius sp	“bagre blanco” (white catsfish)	Freshwater / Estuarine / Marine
Batrachoidae	*Batrachoides waltersi*	“sapamiche” (toadfish)	Freshwater / Estuarine / Marine
Belonidae	*Tylosurus crocodilus*	"carao" (hound needlefish)	Marine
Carangidae	*Caranx caballus*	“quinoa” (big eye jacks)	Estuarine / Marine
	Caranx caninus	“pelón" "jurel" (Pacific crevalle jack)	Estuarine / Marine
	Chloroscombrus orqueta	“alma seca”	Estuarine / Marine
	Hemicaranx leucurus	(yellowfin jack)	Estuarine / Marine

Table 5.47 – Composition of species of the catches in the area of influence of the project			
N°	**Family**	**Common name**	**Species**
	Oligoplites altus	“tamalito”(long jaw)	Marine / Arrecifal
	Oligoplites refulgens	“pez sierra” (Shortjaw Leatherjack)	Marine
	Selene peruviana	“caballo” “papelillo”(moonfish)	Marine
Centropomidae	*Centropomus robalito*	"robalo blanco" (little snook)	Estuarine / Marine
	Centropomus medius	“paleton” "robalo manchado" (blackfin sook)	Estuarine / Marine
Chaetodontidae	*Johnrandallia nigrirostris*	Bandera amarilla (Barberfish)	Marino/Arrecifal
Chanidae	*Chanos chanos*	“sabalo”	Estuarine / Marine
Clupeidae	*Opisthonema libertate*	“arengue” "sardina" (deepbody thread herring)	Estuarine / Marine
Dasyatidae	*Dasyatis sp*	“raya” (common stingray)	Marine
Diodontidae	*Diodon holocanthus*	“zorro” "zorro espin" (longspined porcupinefish)	Marine / Arrecifal
	Diodon hystrix	“zorro” (ballonfish)	Marine / Arrecifal
Engraulidae	*Anchovia macrolepidota*	“sardina gueguecha” (Bigscale Anchovy)	Marine / Arrecifal
	Anchoa starksi	“benjua” (Starks's Anchovy)	Estuarine / Marine
Gerreidae	*Diapterus brevirrostris*	“salpucana”	Freshwater / Estuarine / Marine
	Diapterus peruvianus	“Viejita”(peruvina mojarra)	
	Eucinostomus currani	“pichincha” "pampana" (Pacific Flagfin Mojarra)	Freshwater / Estuarine / Marine
Haemulidae	*Anisotremus pacifici*	“Chopa”(carruco grunt)	Estuarine/Marine/Arrecifal
	Haemulopsis leusiscus	“roche” (Raucous grunt)	Marine / Arrecifal
Lutjanidae	*Lutjanus colorado*	“guachinango” (Colorado snapper)	Marine / Arrecifal
	Lutjanus guttatus	“pargo lunarejo” (rose snapper)	Estuarine/Marine/Arrecifal
	Lutjanus argentiventris	“pargueta” (Amarillo snapper)	Marine / Arrecifal
Mugilidae	*Mugil curema*	“chimbera” "mugil"(white mullet)	Estuarine / Marine
Myliobatidae	*Mobula sp*	“raya”(eagle rays)	Marine
Narcinidae	*Narcine vermiculatus*	(Vermiculate Electric Ray)	Marine
Nematistiidae	*Nemastistius pectoralis*	“pez gallo” (Roosterfish)	Estuarine / Marine

Table 5.47 – Composition of species of the catches in the area of influence of the project			
N°	**Family**	**Common name**	**Species**
Paralichthyidae	*Cyclopsetta querna*	"lenguado" "caite"(Toothed flounder)	Estuarine / Marine
Polynemidae	*Polydactylus approximans*	"barbuda" barbona blanca" (Pacific threadfin)	Estuarine / Marine
	Polydactylus opercularis	"barbuda amarilla" (yellow bobo)	Estuarine / Marine
Pomacentridae	*Abudefduf concolor*	"burrita" (Dusky seargent, Night sergeant)	Marine / Arrecifal
	Pomacanthus zonipectus	"burrita" (Cortez angelfish)	Marine / Arrecifal
Pristigasteridae	*Opisthopterus dovii*	"sardina" (Dove's Longfin Herring)	Estuarine / Marine
Sciaenidae	*Cynoscion reticulatus*	"curvina" (Striped corvina, Striped weakfish)	Estuarine / Marine
	Isopisthus remifer	"peseta" (Bigeye corvina)	Estuarine / Marine
	Larimus argenteus	"panchita" (silver drum)	Marine
	Micropogonias altipini	"curvina pinta" (Golden croaker)	Marine
	Ophioscion simulus	"pancha raton" (Snub-nosed Croaker)	Estuarine / Marine
	Nebris occidentalis	"lola" (Pacific smalleye croaker)	Estuarine / Marine
Serranidae	*Epinephelus analogus*	"mero"	Marine / Arrecifal
Serranidae	*Epinephelus labriformis*	"cabrilla" (cabrilla)	Marine / Arrecifal
Sphyraenidae	*Sphyraena ensis*	"picuda"	Estuarine / Marine

Source: Own elaboration 2014, 2015 y 2016.

The high diversity of species found in the study area demonstrates the ecological importance of this ecosystem. Since the rocky reefs serve as breeding and spawning grounds for breeding and care of many species of mollusks and crustaceans of ecological importance and (*Galván-Villa* et al., 2011), which agrees with local fishermen who claim that most registered species are used for trade and self-consumption.

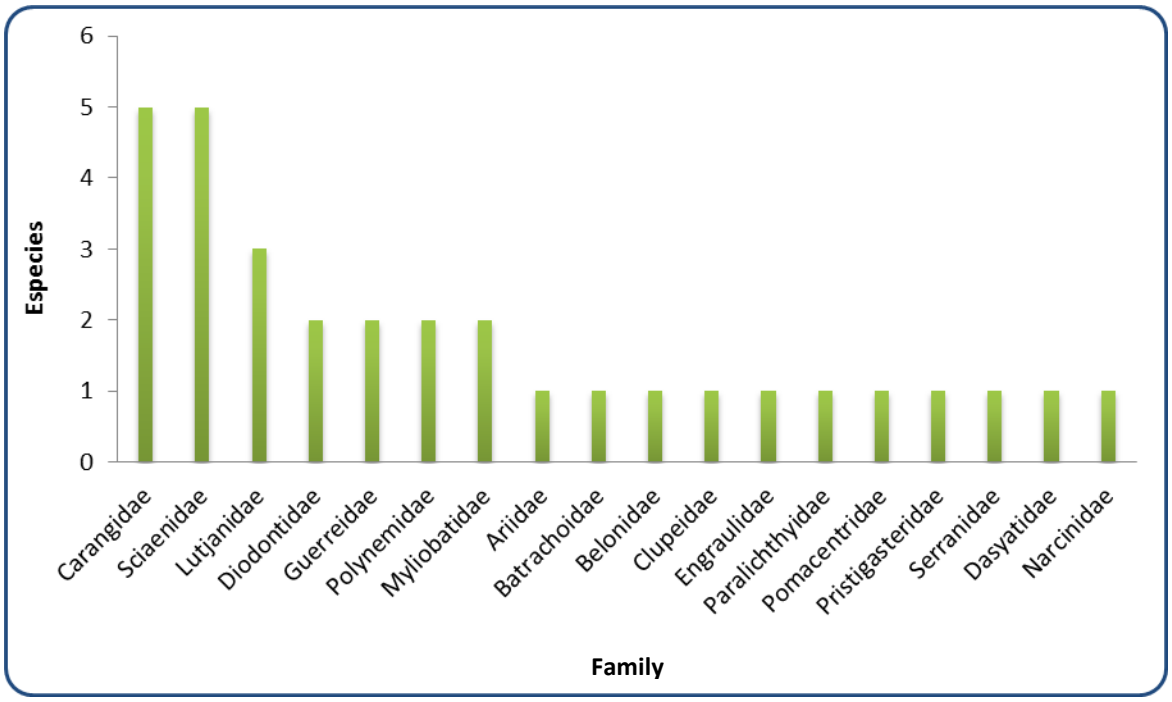
Many of the recorded species are associated with rocky bottoms, such as *Johnrandallia nigrirostris*, *Pomacanthus zonipectus, Epinephelus labriformis, Diodon holocanthus*, among others (Photos 5.40), which are very common in Los Cobanos Natural Protected Area, the only coral reef ecosystem with coral formation in the country (ICMARES 2007b)

Photo 5.40 – Sub-Aquatic Photographs showing Typical Rocky Ground Fish. A) *Johnrandallia Nigrirostris*, b) *Pomacanthus Zonipectus*, c) *Epinephelus Labriformis* and d) *Diodon Holocanthus*

Source: Consulting Team, 2014

The families with the highest diversity of species were Carangidae with seven species and Sciaenidae with six species each. The remaining families recorded three or fewer species, many of them typical of reef, estuarine and marine environments (Figure 5.43). Finding few families with many species is a characteristic of marine ecosystems, where few families have a high dominance in a site, which is associated with typical behaviors of each group, such as feeding areas, high predator levels, areas with adequate climatic conditions, among others (Rodríguez & Reul 2011). The rest of the families found are composed mostly of species of rocky reef ecosystems and pelagic environments.

Figure 5.43 – Species Reported by Family within Acajutla's Artisanal Fishing Area



Source: Consulting Team 2014-2016.

None of the above fish species are found in MARN's (Agreement No.74 of 2015) threatened or Endangered categories. The high richness and representativeness of the species found demonstrates the socioeconomic and ecological importance of these ecosystems, since rocky reefs, river mouths, and muddy bottoms serve as sites for reproduction and spawning, rearing and care of many species of mollusks and crustaceans with ecological and economic importance, which can be verified in fishing yearbooks and supported by resource users.

Table 5.48 shows the sizes and weights recorded in the three study times, where Epinephelus analogus "mero" presented one of the largest sizes. Considering the entire population captured, an average size of 18.45 +/- 5.72 cm was recorded with a weight that varied between 383 +/- 254 gr.

Table 5.48 – Sizes and Weights of Fish Captured in Trawl nets and Floating Nets . Acajutla, August 2014, 2015 and 2016

N°	Species	Common Name	Size (cm)	Weight (gr)
1	*Cathorops fuerthii*	"soropo" (congo sea catfish)	16	200
2	*Arius sp*	"bagre blanco" (white catsfish)	21	400
3	*Batrachoides waltersi*	"sapamiche" (toadfish)	20	420
4	*Tylosurus crocodilus*	"carao" (hound needlefish)	25	454

Table 5.48 – Sizes and Weights of Fish Captured in Trawl nets and Floating Nets . Acajutla, August 2014, 2015 and 2016

N°	Species	Common Name	Size (cm)	Weight (gr)
5	*Caranx caballus*	“quinoa” (big eye jacks)	14	220
6	*Caranx caninus*	“pelón" "jurel"(Pacific crevalle jack)	13	225
7	*Chloroscombrus orqueta*	“alma seca” (yellowfin jack)	16	250
8	*Hemicaranx leucurus*	"tamal"	12	120
9	*Oligoplites altus*	“tamalito” (long jaw)	13	130
10	*Oligoplites refulgens*	“pez sierra” (Shortjaw Leatherjack)	22	810
11	*Selene peruviana*	“caballo” “papelillo” (moonfish)	14	250
12	*Centropomus robalito*	"robalo blanco"(little snook)	23	900
13	*Centropomus medius*	“paleton” "robalo manchado"(blackfin sook)	27	920
14	*Johnrandallia nigrirostris*	Bandera amarilla(Barberfish)	16	260
15	*Chanos chanos*	“sabalo”	18	246
16	*Opisthonema libertate*	“arengue” "sardina"	10	60
17	*Dasyatis sp*	“raya”(common stingray)	25	462
18	*Diodon holocanthus*	“zorro” "zorro espin" (longspined porcupinefish)	18	372
19	*Diodon hystrix*	“zorro” (ballonfish)	21	365
20	*Anchovia macrolepidota*	“sardina gueguecha” (Bigscale Anchovy)	18	450
21	*Anchoa starksi*	“benjua” (Starks's Anchovy)	12	250
22	*Diapterus brevirrostris*	“salpucana”	15	186
23	*Diapterus peruvianus*	“viejita” (peruvina mojarra)	18	210
24	*Eucinostomus currani*	“pichincha” "pampana"(Pacific Flagfin Mojarra)	18	200
25	*Anisotremus pacifici*	“chopa” (carruco grunt)	20	426
26	*Haemulopsis leusiscus*	“roche” (Raucous grunt)	28	468
27	*Lutjanus Colorado*	“guachinango” (Colorado snapper)	22	438
28	*Lutjanus guttatus*	“pargo lunarejo” (rose snapper)	21	400
29	*Lutjanus argentiventris*	“pargueta” (Amarillo snapper)	21	800
30	*Mugil curema*	“chimbera” "mugil"(white mullet)	15	290
31	*Mobula sp*	“raya” (eagle rays)	22	560
32	*Narcine vermiculatus*		18	220
33	*Nemastistius pectoralis*	“pez gallo” (Roosterfish)	16	260
34	*Cyclopsetta querna*	“lenguado” “caite” (Toothed	28	480

Table 5.48 – Sizes and Weights of Fish Captured in Trawl nets and Floating Nets . Acajutla, August 2014, 2015 and 2016				
N°	**Species**	**Common Name**	**Size (cm)**	**Weight (gr)**
		flounder)		
35	*Polydactylus approximans*	“barbuda” barbona blanca"(Pacific threadfin)	16	450
36	*Polydactylus opercularis*	“barbuda amarilla” (yellow bobo)	21	400
37	*Abudefduf concolor*	“burrita” (Dusky seargent, Night sergeant)	17	460
38	*Pomacanthus zonipectus*	“burrita” (Cortez angelfish)	15	420
39	*Opisthopterus dovii*	“sardina” (Dove's Longfin Herring)	16	250
40	*Cynoscion reticulatus*	“curvina” (Striped corvina, Striped weakfish)	25	840
41	*Isopisthus remifer*	“peseta” (Bigeye corvina)	16	105
42	*Larimus argenteus*	“panchita” (silver drum)	12	100
43	*Micropogonias altipini*	“curvina pinta” (Golden croaker)	15	100
44	*Ophioscion stimulus*	“pancha raton” (Snub-nosed Croaker)	13	250
45	*Nebris occidentalis*	“lola” (Pacific smalleye croaker)	14	110
46	*Epinephelus analogus*	“mero”	40	1250
47	*Epinephelus labriformis*	“cabrilla”	10	150
48	*Sphyraena ensis*	"picuda"	9	70
		AVERAGE	18.45	384.2
		DEVIATION	5.7250461	252.90541
		MAXIMUM	40	1250
		MINIMUM	9	60

Source: Own elaboration 2014-2016.

Of the 48 species of fish recorded, the most abundant are, Selene peruvian "horse" "papelillo" (Pacific moonfish) and Lutjanus gutattus (snapper), (Figure 5.43). The latter presented low sizes of 21 cm when their maximum size is 80 cm, as was the corvina (C. reticulatus) which was shown to an average size of 25 cm, when its maximum size is 90 cm.

When using "hook" hand line, which is considered an environmentally friendly fishing, better sizes and weights are obtained, as shown in the following pictures 5.41, 5.42, 5.43 and 5.44.

Photo 5.41 – Minimum and Maximum Sizes of Rose Snapper (Lutjanus Guttatus). Captured with Hand Line

Lunarejos de dos unidades por libra, de un largo promedio de 21 cm y altura de 9 cm

Lunarejos of two units per pound of an average of 21cm long and 9 cm height

Las mayores tallas de lunarejos registrado, con un largo de 35 cm y altura de 15 cm.

The largest sizes of Rose snappers registered a length of 35cm and a height of 15cm

Source: Consulting Team, 2014

Photo 5.42 – Minimum and maximum sizes of horse mackerel (Caranx Ccaninus). Captured with Hand Line

Jurel de dos unidades por libra, de un largo promedio de 13 cm y altura de 7 cm

Horse mackerel of two units per pound, of an average of 13cm long and 7cm of height

Jurel de cinco libras de un largo promedio de 35 cm y altura de 15 cm

Five-pound horse mackerel with an average length of 35 cm and a height of 15 cm

Source: Consulting TEam, 2014

Photo 5.43 – Most Common Captured Fish Miscellanea

Tallas más frecuentes encontradas en sitios de muestreo: de 10 a 15 cm de largo con 5 a 8 cm de altura

Most frequent sizes found at sampling sites 10 to 15 cm long with 5 to 8 cm in height

Papelillo, Especie más abundante registradas en el sitio del proyecto. Especie no alimenticia ni comercial

Papelillo, most abundant species registered at the project site. Non-commercial non-ediblespecies

Source: Consulting Team, 2014

Photo 5.44 – Commercial Species that are Disembarked at the Artisanal Port of Acajutla

Peces de dos unidades por libra, de una unidad por libra y de dos libras cada una como máximo

Fish of two units per pound, one unit per pound and two pounds each as maximum

Source: Consulting Team, 2014

The study area includes isolated rocky bottoms, of rock size varying from 20 to 40 cm in diameter, with a height of 10 to 30 cm. this provides breeding areas where a high abundance of fish converges in juvenile states, as Lowe-McConnell (1987) believes , those ecosystems with similar characteristics are important sites for the reproduction of fish.

The sampled fishing sites had a low "Catch Per Unit of Effort (CPU)" of 1.4, similar to the additional stations EA1-EA4 with a CPUE of 1.3 kg / hr (these stations are equivalent to the M5-M8 of the current study). In comparison to the other study sites away from the Project area, this sites have much higher volumes of capture, ranging from 13.7 kg / hr, in Old Craft Dock followed by areas Bocana and La Draga with 8.9 kg / hr each. This low CPUE of 1.4 and 1.3 kg / hr, is similar to the area opposite the Industrial Pier which presented a low value with 2.7 Kg / hr. With respect to equity (uniformity), it can be mentioned that the fishing zones near the EDP Project, the fish species are not represented with similar number of individuals (J '= 0.2) and that it is dominated by the non commercial species " "Horse" Selene peruviana and the "quinoa" Caranx caballus, third or low-priced commercial species that range from $ 0.25, when abundant and $ 0.50 per pound, when scarce (Table 5.49).

Table 5.49 – Characterization of CPUE (Kg/hr), Species Richness and Ecological Index of the Project Area and Influence Area of the Project. Acajutla, August 2014, 2015 and 2016

Fishing area	CPUE (Kg/hr)	Species Richness	Shannon-Wiener (H´)	Simpson (D´)	Equity (J´)
Sites M1 to M25	1.4	48	1.3	0.64	0.2
Additional Sites EA1 – EA4	1.3	11	1.1	0.62	0.2
Antique Artisanal Pier	13.67	16	2.4	0.87	0.8
In Front of Bocana	8.9	16	2.4	0.86	0.8
In Front of Industrial Pier	2.73	3	0.99	0.59	0.2
La Draga	8.9	7	1.82	0.81	0.3

Source: Own Elaboration 2014, 2015 y 2016

5.3.8.13 Benthos

For benthic invertebrate organisms it was dominated by Phylum Annelida (21 species), Mollusca (6) and Echinodermata (6). The Phylum that presented less species was Porifera with a species. The taxonomic listing is presented below:

Filo Annelida
- Polychaeta Class
  - Family Ampharetidae
    - Isolda bipinnata (Fauchald, 1977)
  - Family Aphroditidae
    - Aphrodita sp. (Linnaeus, 1758)
  - Family Capitellidae

Capitella capitata (Fabricius, 1780)
Decamastus gracilis (Hartman, 1963)
Mediomastus setosus (Hartman-Schroder, 1959)
Family Cirratulidae
Tharyx multifilis (Moore, 1909)
Cirratulus sp (Lamarck, 1801)
Family Eunicidae
Eunice sp.
Nematonereis unicornis (Grube, 1840)
Family Glyceridae
Glycinde armígera (Moore 1911)
Family Lumbrineridae
Lumbrinereis sp (Blainville 1828)
Family Nereidae
Ceratonereis mirabilis (Kinberg, 1866)
Neanthes galetae (Fauchald, 1977)
Pseudonereis variegata (Fauchald, 1977)
Family Phyllodocidae
Eulalia myriacyclum (Schmarda, 1861)
Eteone sp (Hartman, 1936)
Family Spionidae
Polydora ciliata (Johnston, 1838)
Family Sabellidae
Bispira sp.
Chone sp. (Kroyer, 1856)
Family Spionidae
Prionospio cirrifera (Wirén, 1883)
Family Syllidae
Odontosyllis sp. (Claparèrede 1863)

Filo Mollusca
Gastropoda Class
Order Sacoglossa
Family Elysiidae
Elysia diomedea (Bergh, 1894)
Order

Family
Lobatus peruvianus (Swainson, 1823)
Bivalvia Class
Order Mesogastropoda
Family Vermetidae
Serpulorbis margaritaceus (Chenu, 1844).
Family ostridae
Striostrea prismatica (Gray, 1825)
(known as Ostrea iridescens Hanley, 1854)
Polyplacophora Class
Order Neoloricata
Family Chitonidae
Chiton stokesii (Broderip, 1832)
Group: Babosas marinas
Order
Family
Dolobrifera dolobrifera (Rang, 1828)
Filo Echinodermata
Echinoidea Class
Orden Echinoidermata
Family Echinometridae
Echinometra vanbrunti (Agassiz, 1863)
Famiya Diadematidae
Astropyga pulvinata (Lamarck, 1816)
Diadema mexicanum (A. Agassiz, 1863)
Ophiurodea Class
Order
Group: Estrella frágil
Ophiocoma alexandri (Lyman,1860)
Holothuroidea Class
Order Aspidochirotida
Family Holothuriidae
Holothuria inornata Semper, 1868
Isistichopus fuscus (Ludwig, 1875)

Filo Artrópoda
Malacostraca Class
Order Decapoda

Family Palinuridae
Panulirus gracilis (Streets 1871)
Family Calappidae
Calappa convexa (Saussure, 1853)
Family Dairidae
Daira americana (Stimpson,1860)
Family Eriphiidae
Eriphides hispida (Stimpson, 1860)
Class
Order
Family
Tetraclita sp. (Schumacher, 1817)
Filo Cnidaria
Octocorallia Subclass
Order Alcyonacea
Family Plexauridae
Muricea fructicosa var. Miser Verrill, 1869
Order Telestacea
Family Clavulariidae
Carijoa multiflora Laackman, 1909
Filo Porifera
Class
Order
Group: Esponjas
Axinella sp (Schmidt,1862)

Of the species recorded previously, only four (4) of them are in the category of threatened and are the following:

Filo Echinodermata (all species whith occurance in El Salvador "sea cucumbers")
Holothuroidea Class
Order Aspidochirotida
Family Holothuriidae (Close to the sample M 01)
Holothuria inornata Semper, 1868
Isistichopus fuscus (Ludwig, 1875)

Filo Cnidaria
Octocorallia Subclass (coral Gandalf)

Order Alcyonacea
Family Plexauridae "rudas de mar" (in sites M02 y M03 and near M01)
Muricea fructicosa var. Miser Verrill, 1869
Order Telestacea
Family Clavulariidae "rudas de mar" (in sites M2 and near M01)
Carijoa multiflora Laackman, 1909

These last were located at sites M1, M3 and M3 of the 2016 sampling, in areas where there are no permanent elements of the Project. (See appendix 5V Benthos database)

5.3.8.14 Sea Turtles

Of the eight species of sea turtles found worldwide, four occur and nest on the coast of El Salvador: *Lepidochelys olivacea* "turtle" (Olive ridley sea turtle), *Chelonia mydas* "tortuga negra o prieta", (black or brown turtle), *Eretmochelys imbricata*, "Tortuga carey" (hawksbill turtle), and *Dermochelys coriacea* "tortuga baule" (leatherback sea turtle). Internationally, it has been defined that the populations of the Tortuga Golfina (ridley sea turtle) are vulnerable, the Black turtle in danger of extinction, whereas the hawksbill turtle and the leatherback sea turtle are in imminent danger of extinction in all the Eastern Pacific.

Different anthropic and natural factors have contributed to the reduction of their populations, among which are: industrial and artisanal incidental fisheries, contamination of various types of industrial and domestic activities, chemical contamination such as pesticides, metals, hydrocarbons and cargo Organic. Others, factors such as overexploitation of eggs for consumption and alteration of habitat (*Vásquez, et al., 2009*).

In the field of marine turtle conservation, during the past three decades, several conservation efforts have taken place on a variety of beaches, particularly with the implementation of sea turtle egg incubation pens.

According to the Beaches Inventory (2009), Acajutla is within Zone I (Z-I), which includes from Garita Palmera to Toluca beach. Covering a total of 43 beaches corresponding to 82.6 km. Particularly Acajutla, and consequently its buffer zone, which includes Playa Metalío, Sensunapan River mouth, Acajutla pocket and sandy beaches, and Los Cóbanos Arrecifal System including Barra Salada, all live the problematic species mentioned in the previous paragraphs. The Beaches Inventory (*Vásquez et al. 2009*) reflects for Zone I, nesting and frequency mainly of ridley sea turtle (Lepidochelys olivácea) especially on the beaches of: El Suncita, Los Cóbanos, Metalío and Barra Salada. Likewise, there are immersed "pockets beaches" where there have been sporadic nesting of Lepidochelys olivacea. Occasional

sightings of hawksbill *Eretmochelys imbricata* have also been reported on these beaches (Vásquez com.pers 2014.)

Marine turtle conservation has focused primarily on the management of egg incubation pens, mostly funded by the El Salvador Initiative Fund for the Americas (FIAES) or international cooperation. Incubation pens are a small enclosed area on the beach (about 10 x 10 meters) where the keeper buries the eggs collected by the tortugueros from the natural nests. The keeper guarantees the incubation of the eggs and helps the turtle pups to the sea.

As far as the Acajutla Industrial Complex is concerned, no conservation effort is directed towards the species mentioned. However, it is important to mention that both the Los Cobanos Arrecifal system and the mangrove-estuary system of Barra de Santiago (zone of influence) are emblematic sites in terms of sea turtle conservation. In the case of Los Cobanos, this marine protected area, along with the Bay of Jiquilisco, both house one of the last populations of nesting females and in turn is a site of foraging (feeding) of adults and young of hawksbill turtle *Eretmochelys imbricata* at national level and Regional development of the Eastern Pacific Ocean (*Gaos et al.*, 2010).

This situation deserves special attention due to the strong interaction between the different discharges of the Acajutla Industrial Complex and its impact on hawksbill turtles. Investigations carried out using satellite transmitters executed in the 2008-2009 period (Photographs 5.45 and 5.46) show that adult hawksbill populations circulate between the Salvadoran and Nicaraguan coast (Estero de Padre Ramos), Los Cobanos, Jiquilisco Bay and Gulf of Fonseca are outlined as the main foraging sites of this species.

Photo 5.45 – a) Adult Female "Tortuga Carey" (hawksbill sea turtle) *Eretmochelys Imbricata* Laying Eggs in the AMP Beach Los Cóbanos and b) Exemplary Tortuga Carey (hawksbill sea turtle) with Satellite Transmitter

a)

b)

Source: www.hawksbill.org.

Photo 5.46 – Spawning Footprint of "Tortuga Baule" (leatherback sea turtle), in Texaco Beach, Acajutla Industrial Zone. January 24, 2015

Source: www.hawksbill.org.

Through artisanal freehand catches, ridley turtles were captured and in vitro carapaces sizes were measured in high seas (three specimens), where the sizes obtained were of 45/-4 cm with in females and 54/- 2 cm with in males, and length of the carapace between 62/- 4 cm in males and 54 /- 2 in females.

Photo 5.47 – Width of the Carapace of a Male Tortuga Golfina (olive ridley turtle) Captured in High Seas. October 9, 2016. Open sea of Acajutla.

Source: Consulting Team, 2016

Photo 5.48 – Length of the carapace of a male Tortuga Golfina (olive ridley turtle) captured in high sea. 9th of October of 2016. Open Sea of Acajutla.

Source: Consulting Team, 2016

5.3.8.15 Marine Mammals

The two groups of mammals that can inhabit or circulate in tropical areas, such as El Salvador, are the cetaceans and pinnipeds. The first are represented by dolphins and whales, the second by seals and sea lions. In the country, there is no research on cetaceans in the area, although on the basis of distribution ranges it is believed that at least 23 species may temporarily circulate in national waters.

Regarding marine mammals, it is important to mention that during the periods of the dry season between the second week of December and January, transiently associated with the Marine Protected Area Los Cobanos, there have been reported sightings of "ballenas jorobadas"(humpback whales) *Megaptera novaeangliae* in the category as Threatened (MARN 2015), and specifically in the Port of Acajutla "leones marinos" (sea lions) *Zalophus californienensis* have been accidentally caught.

According to Barraza 2014, MARN maintains records of stranded mammals at the level of the national coasts, some of which are registered in the Project's area of influence (Table 5.50).

Table 5.50 – Stranded Marine Mammals in the Port of Acajutla Area of Influence

FAMILY	SCIENTIFIC NAME	COMMON NAME	PLACE AND DATE OF STRANDING	STATUS MARN 2015 CITES 2013
DELFINIDAE	*Peponocephala electra*	Orca enana (melon-headed whale)	Metalío, 2011	Appendix II
	Tursiops truncatus	delfín gris (bottlenose dolphin)	Los Cóbanos, 2005	Threatened
	Stenella coeruleoalba	delfín rayado (blue-white dolphin)	Los Cóbanos, 2011	Threatened
	Stenella longirostris	delfín tornillo (spinner dolphin)	Metalio,2011, 2013	Appendix II
	Stenella attenuata	delfín manchado (pantropical spotted dolphin)	Los Cóbanos, 2013	Threatened
ZIPHIDAE	*Zifius cavirostris*	ballenato de Cuvie (goose-beaked whale)	Los Cóbanos, 2013	
KOGIIDAE	*Kogia sp.*	cachalote	Los Cóbanos, 2014	

Source: Consulting Team, 2014

Photo 5.49 – Specimens of Dolphins Sighted at AMP Los Cóbanos a) *Tursiops Truncatus* b) *Stenella Coeruleoalba* c) *Stenella Longirostris*

Source: www.fundacionketo.org.

In the Project area, dolphins have been observed in small groups of three individuals: two adults and one juvenile. The last one of about 30 cm of height and with a length of 1.5 m. All species of dolphins that visit our coasts are in the category of Threatened (MARN, 2015). In addition, in the buoys of RASA-PUMA and frequently in the buoys near the sampling point "M10", two sea lions can be found, of sizes larger than 30 cm wide and 2 m long.

Photo 5.50 – Sighting of Sea Lion on RASA-PUMA Buoys. October 9, 2016

Source: Consulting Team, 2016

Photo 5.51 – Sighting of Sea Lion on Rasa-Puma Buoys. October 9, 2016

Source: Consulting Team, 2016

5.3.8.16 Bank of Oysters

5.3.8.16.1 Geographic distribution and habitat for stone oyster

Oysters generally are typical inhabitants of the estuaries, river mouths, lagoons, coastal and coastal formations that are subject to continental marine waters, resulting in appropriate salinity and of course

the prerequisite is a suitable substrate for larvae to be fixed and develop to adults. The geographical distribution of Crassostrea iridescens covers from the coasts of Baja California to the North of Peru. With respect habitat, it is adhered mainly to rocky substrates exposed to direct influences of the water from the open sea and in rocky areas subject to breaking waves. the depths in which varying from 0 - up to 15 m. Maximum sizes of 25 cm (or more) are possible, but it is common to find them up to 15 cm (Castle O & a. Garcia, 1984;) (FAO, 1995).

5.3.8.16.2 Biological cycle and reproduction

Reproductive activity of mollusks occurs throughout the year. Reproduction habits may vary among some of their species; however, most of these organisms have differentiated sexes at the time of spawning, although sex may vary between one and the other time of spawning, meaning they may spawn one year as a female and the other male. In the case of some species of the genus *Crassostrea* that are oviparous, fertilization is external and is performed in the surrounding water. Other species that are larviparous, after fertilization the larvae are incubated within their parents for almost half of their Planktonic life, while others spend their entire larval stage as plankton (*Castillo O, García A. 1984; Hernández, 2005*).

In the case of *Crassostrea iridescens*, it has been observed that the peak of gonadal maturity is higher during the month of May when higher averages of temperatures (30.6ºC) and salinities (36.9 ups) are recorded, whereas in the month of July the gonadic maturity Is lower and the lower values of salinity (35.0 ups) and temperatures (30.1ºC) respectively were also found (*Galdámez*, 2004).

For the site of the Acajutla LNG Power Project the following considerations can be taken:

1. The greatest extraction of these mollusks occurs in the dry season, because it reduces the tributaries of the rivers to the sea increasing visibility, which allows the oysters to be identified. in the oyster banks;
2. No record was found about the state of the main oyster extraction banks, which are in place, that allows us to compare their distribution and densities in these rocky sites.However, sizes of 9 +/- 1 cm were considered very small by local oysters (5) and outsiders of the Port of La Libertad (25). With regard to the fishing effort, it was reported that 10 years ago, in six hours, 30 dozen at least 15 cm in size were extracted from the oyster bank site near the Project and now they extract a maximum of 4 dozen (3.5 + - 0.5) with maximum sizes of 10 cm. The densities currently found in these stones are 1.5 +/- 0.5 units / m^2; and
3. The availability of this resource is being reduced. In addition to the pressure of use, there are other factors that influence and stress on this resource. The currents, tidal action and the rivers, mainly the River Sensunapán, which displaces sand and sediments deposited on the oyster banks forming muddy sand beaches and causing them to die.

5.3.9 Marine Water Quality

5.3.9.1 Marine Water Quality

The quality of marine water is an aspect of great importance for the preservation of the marine environment and coastal areas of the country, which in recent years have experienced a significant deterioration due to incidents of human activity. In order to determine the water quality of the Project area, and the influence of discharges from the Acajutla Industrial Complex, three marine water quality monitoring programs were conducted for three consecutive years, namely: 2014, 2015 and 2016 respectively, for which the main physical-chemical indicators were analyzed.

In the 2014 program, 12 sampling stations were established, along the route of the pipeline, where a jetty was previously planned. In 2015, 4 sampling stations where the pier was to be located. Finally in 2016, 25 sampling stations, at the breakwater/marine terminal location site and in the larger area where sediment dispersal as a result of dredging activity is possible. The location of each of the sampling points in the different sampling programs can be observed in Figure 5.38, where the sampling of benthic fauna was carried out. In Tables 5.51, 5.52 and 5.53, the location coordinates of each of the sea water sampling points are shown.

Table 5.51 – Sampling points, 2014 Campaign. Acajutla, Sonsonate, 2014

Point	Length	Latitude
1	408443.249	273691.396
2	408543.249	273691.396
3	408643.249	273691.396
4	408743.249	273691.396
5	408843.249	273691.396
6	408943.249	273691.396
7	409043.249	273691.396
8	409143.249	273691.396
9	409243.249	273691.396
10	409343.249	273691.396
11	409443.249	273691.396
12	409543.249	273691.396

Source: Consulting Team 2014.

Table 5.52 – Sampling points, 2015 Campaign. Acajutla, Sonsonate, 2015		
Point	**Latitude**	**Length**
M1	13°35'3.10"N	89°50'42.35"O
M2	13°35'1.49"N	89°50'42.19"O
M3	13°34'58.13"N	89°50'41.85"O
M4	13°34'56.44"N	89°50'41.68"O

Source: Consulting Team 2015.

Table 5.53 – Sampling points, 2016 Campaign. Acajutla, Sonsonate, 2016		
Point	**Latitude**	**Length**
M1	13°34'50.73"N	89°50'11.15"O
M2	13°34'19.26"N	89°50'30.62"O
M3	13°34'24.12"N	89°50'57.49"O
M4	13°34'50.79"N	89°51'11.17"O
M5	13°34'53.84"N	89°50'50.68"O
M6	13°34'58.19"N	89°50'55.02"O
M7	13°35'4.93"N	89°50'48.49"O
M8	13°35'0.67"N	89°50'43.95"O
M9	13°35'5.07"N	89°50'28.31"O
M10	13°35'14.00"N	89°50'57.79"O
M11	13°35'17.76"N	89°51'24.98"O
M12	13°35'28.50"N	89°51'3.26"O
M13	13°35'49.00"N	89°50'53.43"O
M14	13°35'43.63"N	89°51'8.84"O
M15	13°35'58.54"N	89°51'14.31"O
M16	13°35'57.28"N	89°51'37.31"O
M17	13°36'13.55"N	89°51'19.96"O
M18	13°36'29.06"N	89°52'1.33"O
M19	13°36'52.73"N	89°52'7.46"O
M20	13°36'34.70"N	89°51'31.54"O
M21	13°35'47.97"N	89°50'24.56"O
M22	13°35'23.05"N	89°50'36.01"O
M23	13°34'45.72"N	89°50'25.81"O
M24	13°35'12.75"N	89°50'11.87"O
M25	13°35'29.53"N	89°50'10.50"O

Source: Consulting Team 2016.

5.3.9.2 Laboratory Analysis of Surface Water Samples

For the analysis of the chemical quality of the marine environment samples of sea water were taken in situ at the surface level, which were transported to laboratories for their respective analysis. The results of the analysis of said samples, for each of the sampling periods, are reported in the following Tables, from Table 5.54 to Table 5.61.

It is important to mention that the analysis of permissible limits has been generated based on the available information. For the evaluation of the data obtained, the El Salvadoran Standard CONACYT NSO 13. 49. 01:09 was taken into consideration.

Table 5.54 – Physical-Chemical Parameters of Surface Waters of the Marine Coastal Zone of Acajutla. 2014 Campaign

SAMPLING STATIONS	PH	Salinity (0/00)	Dissolved oxygen O2(mg/lt)	Turbidity (cm)	Temperature (˚C)
E-1-2	7.3	32.5	6.3	2.1	29.2
E-3-4	7.4	32.7	6.3	2.42	29.1
E-7-8	7.3	33.1	6.9	3.1	29.2
E-10	7.4	33.1	7.3	2.5	28.5
E-11	7.3	33.2	7.6	3.5	28.3
E-12	7.3	33.2	7.6	3.5	28.5
Average	**7.33**	**32.97**	**7.00**	**2.85**	**28.80**
Deviation	**0.05**	**0.27**	**0.55**	**0.54**	**0.37**

Source: Consulting Team, 2014

Table 5.55 – Reported Values of the Physical-Chemical Parameters of the Acajutla Marine Coastal Zone 2014

SAMPLING STATIONS	Chemical Demand of Oxygen (mg/lt)	Phenolic compounds (mg/lt)	Sulphides	Chlorides	Residual chlorine	Total Chlorine
E1	1540	0.44	<0.8	18500	0	0
E2	1560	0.32	<0.8	19000	0	0
E3	1560	0.40	<0.8	19000	0	0
E4	1560	0.28	<0.8	20300	0	0
E5	1460	0.28	<0.8	22700	0	0
E6	1360	0.38	<0.8	20800	0	0
E7	1560	0.34	<0.8	18000	0	0
E8	1480	0.24	<0.8	23200	0	0
E9	1480	0.22	<0.8	21300	0	0

Table 5.55 – Reported Values of the Physical-Chemical Parameters of the Acajutla Marine Coastal Zone 2014						
SAMPLING STATIONS	**Chemical Demand of Oxygen (mg/lt)**	**Phenolic compounds (mg/lt)**	**Sulphides**	**Chlorides**	**Residual chlorine**	**Total Chlorine**
E10	1420	0.22	<0.8	18200	0	0
E11	1420	0.20	<0.8	20700	0	0
E12	1440	0.20	<0.8	21000	0	0
Promedio	**1487**	**0.29**	<0.8	**20225**	0	0
Desviación	**68.63**	**0.08**	--	**1,714**	0	0

Source: Consulting Team, 2014

Table 5.56 – Other Parameters Analyzed in Surface Waters of the Coastal Marine Zone of Acajutla. 2015 Campaign

PARAMETERS	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	AVERAGE	STANDARD DEVIATION
DBO (Biochemical Oxygen Demand)	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.005	0.007	0.007	< 0.005	0.006	0.012	**0.01**	**0.00**
Arsenic mg/L	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25		
Copper mg / L	< 0.001	0.06	< 0.001	< 0.001	0.007	0.007	< 0.001	0.009	< 0.001	< 0.001	0.001	0.001	**0.01**	**0.02**
Mercury mg / L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1		
Settleable solids mg/L	584	480	564	640	520	584	560	460	900	552	592	572	**584.00**	**110.98**
Total Suspended Solids mg/L	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5		
Oils and fats mg/L	110	130	83	330	520	780	390	460	580	620	900	23	**410.50**	**285.48**
Total count of heterotrophic bacteria CFU / ml (10-3 dilution) 5000 cfu / 100 ml	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	2.6	**2.60**	
Total coliforms NMP / 100mL	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1		
Fecal coliforms NMP / 100mL	113.4	111.3	113.4	113.4	111.3	113.4	113.4	113.4	111.3	111.3	111.3	111.3	**112.35**	**1.10**
Alkalinity mg / L	0.44	0.32	0.4	0.28	0.28	0.38	0.34	0.24	0.22	0.22	0.2	0.2	**0.29**	**0.08**
Phenolic compounds mg / L	18,500	19,000	19,000	20,300	22,700	20,800	18,000	23,200	21,300	18,200	20,700	21,000	**20,225.00**	**1,714.18**
Cadmium mg / L	393	379	371	377	369	365	377	373	373	370.8	373	381	**375.15**	**7.17**
Calcium mg / L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		
Chromium mg / L	6066.6	5894.1	5894.1	6027.3	5860.8	5794.2	5994	5777.6	5810.9	5877.5	5794.2	6027	**5,901.53**	**102.83**
Total Hardness CaCO3 mg/L	0.005	0.014	0.005	0.013	< 0.005	0.009	< 0.005	< 0.005	< 0.005	< 0.005	0.017	< 0.005	**0.01**	**0.00**
Nickel mg / L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005		
Lead mg / L	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8		
Sulfates mg / L	34563	34563	33923	33283	34563	33923	34563	33283	34563	33283	33283	32643	**33,869.67**	**693.52**
Sodium mg / L	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5		
Zinc mg/L														

Source: Laboratory Analysis,2014

Table 5.57 – Physical-Chemical Parameters of Surface Waters of the Marine Coastal Zone of Acajutla. 2015 Campaign					
SAMPLING STATIONS	**PH**	**Salinity (0/00)**	**Dissolved oxygen O2 (mg/lt)**	**Turbidity (m)**	**Temperature (˚C)**
EA1	7.3	33.2	7.6	3.0	30
EA2	7.3	33.2	7.6	3.0	30
EA3	7.4	33.2	7.5	3.3	30
EA4	7.4	33.2	7.5	3.3	30
Average	**7.35**	**33.2**	**7.55**	**3.15**	**30**
Deviation	**0.05**	**0.00**	**0.05**	**0.17**	**0.0**

Source: Laboratory Analysis, 2015.

Table 5.58 – Reported Values of the Physical-Chemical Parameters of the Coastal Marine Zone of Acajutla 2015						
SAMPLING STATIONS	**Chemical demand of oxygen (mg/lt)**	**Phenolic compounds (mg/lt)**	**Sulphides**	**Chlorides**	**Residual chlorine**	**Total Chlorine**
E1	1,680	<0.025	<0.025	179	0	0
E2	1,350	<0.025	<0.025	181	0	0
E3	1,280	<0.025	<0.021	186	0	0
E4	1,480	<0.025	<0.021	202	0	0
Average	**1,447.5**	**<0.025**	**<0.023**	**187**	0	0
Deviation	**152.21**	**0**	**0.002**	**9.02**	0	0

Source: Laboratory Analysis, 2015

Table 5.59 – Other Parameters Analyzed in Surface Waters of the Coastal Marine Zone of Acajutla. 2015 Campaign						
PARAMETERS	**E1**	**E2**	**E3**	**E4**	**AVERAGE**	**STANDARD DEVIATION**
Settleable solids mg/L	<0.1	<0.1	<0.1	<0.1		
Total Suspended Solids mg/L	652	576	600	660	**622.00**	**40.60**
Oils and fats mg/L	<2.5	<2.5	<2.5	<2.5		
Total coliforms NMP/100mL	16	1.1	5.1	16	**9.55**	**7.62**
Fecal coliforms NMP/100mL	9.2	1.1	3.6	16	**7.48**	**6.62**
Phenolic compounds mg/L	<0.025	<0.025	<0.025	<0.025		

Source: Laboratory Analysis, 2015

Table 5.60 – Physical-Chemical Parameters of Surface Waters of the Marine Coastal Zone of Acajutla. 2016 Campaign					
Sampling Station	**PH**	**Salinity (0/00)**	**Dissolved oxygen O2 (mg/lt)**	**Turbidity (m)**	**Temperature (˚C)**
M01	8.09	33	7.4	3.2	33
M03	8.15	32	6.2	3.8	32
M03	8.18	34	6.2	5.1	31
M04	8.3	33	6.4	4	31
M05	8.11	32	7.1	3.7	31
M06	8.12	32	7.1	4	31
M07	8.11	34	7.1	3.7	31
M08	8.12	34	7.1	3.8	31
M09	8.11	34	7.1	3	33
M10	8.11	32	7.2	3.6	31
M11	8.32	32	6.4	5	31
M12	8.33	32	7.3	4	31
M13	8.30	32	7.3	5	31
M14	8.30	32	7.3	4	31
M15	8.13	32	7.5	1	32
M16	8.20	27	6.4	1	31
M17	8.16	29	7.4	1	32
M18	8.27	34	7.3	1	31
M19	8.25	33	7.5	1	31
M20	8.15	31	7.6	1	33
M21	8.01	29	7.5	1	33
M22	8.27	32	7.3	1	30
M23	8.28	32	7.2	5	32
M24	8.20	33	7.6	1	30
M25	8.26	32	7.5	1	30
Average	**8.19**	**32.02**	**7.12**	**2.84**	**31.36**
Deviation	**0.09**	**1.68**	**0.44**	**1.61**	**0.91**

Source: Laboratory Analysis, 2016.

During the 2016 sampling program, in addition to the physico-chemical parameters, other parameters such as Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD) and some metals were also analyzed, the results are provided in Table 5.61.

5.3.9.3 Comments on results of laboratory analysis

5.3.9.3.1 Hydrogen Potential (PH)

PH is the concentration of hydrogen ions in the water which expresses the acidity or alkalinity depending on whether its value is between 0.0 and 7.0 or 7.0 and 14. The value 7.0 is indicative of a neutral medium. The PH that is not directly fatal to the fish is from 5 to 9. The average determined for Acajutla in 2014 is 7.33 ± 0.05, 7.35 ± 0.05 for 2015 and 8.19 ± 0.09 for 2016. This result is congruent with that reported by Salazar 2008. For different stations in the Bay of Jiquilisco and adjacent waters external to it, reporting values of 7.74 maximum, while 7.29 minimum. Despite the slight increase in 2016, this parameter is considered to be normal for marine life.

5.3.9.3.2 Salinity

The average salinity for the marine coastal zone of Acajutla was 32.9 0/00 ± 0.27 for 2014, 33.2 0/00 for 2015 and 32.08 0/00 for 2016.

According to NORAD / UNDP / FAO (1988), the characteristics of the Salvadoran territorial sea are determined by the equatorial counter current with salinities below 34.0 0/00.

The marine saline structure in El Salvador according to Brenes et al (2000) indicate that the surface salinity in front of Acajutla and the Gulf of Fonseca is lower at the end of the rainy season. With regard to the vertical distribution of salinity is characterized by a maximum near 35 ppm that starts at 60 m depth and extends to the bottom.

According to Currie (1995), analysis of salinity in the Bahía of La Union-Golfo de Fonseca, during August of 1995, it was detected that the stations closer to the Bahía de La Union were the less salty and those located in the intermediate zones presented higher values.

Therefore, it is important to mention that the salinity registered in Acajutla is adequate for the maintenance of the marine biota.

5.3.9.3.3 Dissolved Oxygen (mg/l)

Dissolved oxygen had an average value of 7.0 with a deviation of ± 0.55 for 2014, 7.55 with a deviation of ± 0.05 for 2015 and 7.12 with a deviation of 0.44 for 2016. When the dissolved oxygen level falls below 5 mg / Lt aquatic life is put under stress, the lower the concentration the higher the stress. Oxygen levels that remain below 1-2 mg / lt for a few hours can lead to large fish mortalities.

Table 5.61 – Other Parameters Analyzed in Surface Waters of the Coastal Marine Zone of Acajutla. 2016 Campaign

PARAMETERS	M01	M02	M03	M04	M05	M06	M07	M08	M09	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24	M25	AVERAGE	STANDARD DEVIATION
DQO (Chemical oxygen demand)	250	200	930	470	830	960	900	1,06	970	900	470	250	380	430	1	290	190	210	610	920	870	630	970	610	250	**562.13**	**316.29**
DBO (Biochemical Oxygen Demand)	153	126	257	104	399	290	213	241	235	268	104	71	148	109	301	142	98	109	306	241	257	317	870	306	126	**231.64**	**160.09**
Arsenic mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Copper mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		
Mercury mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Settleable solids mg/L	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<0.02	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	**0.10**	
Total Suspended Solids mg/L	87	115	121	166	241	229	252	291	225	244	163	97	108	135	224	205	163	249	237	214	219	242	105	131	176	**185.56**	**59.63**
Oils and fats mg/L	22	22	16	4	13	12	17	26	17	17	1	2	1	4	11	0.7	0.4	1.4	7	1	2	10	2	5	4	**8.74**	**7.99**
Total count of heterotrophic bacteria CFU / ml (10-3 dilution) 5000 cfu / 100 ml	2000	10	50	60	2,000	<1	<1	1,000	30	20	100	80	100	180	540	250	1,200	150	170	20	80	390	<1	340	280	**411.36**	**599.28**
Total coliforms NMP/100mL	2	4.5	170	49	280	14	170	240	11	49	34	7.8	1,100	13	4,800	9,200	24000	540	920	350	7.8	920	6.8	350	920	**1,766.36**	**5,042.18**
Fecal coliforms NMP/100mL	2	4.5	40	17	49	14	70	240	4.5	33	21	7.8	700	13	4000	1400	1500	540	350	280	7.8	170	6.8	170	170	**392.42**	**853.87**
Alkalinity mg/L	120	120	120	120	100	120	120	120	120	140	100	120	120	120	120	120	120	120	120	120	120	120	120	120	120	**119.20**	**7.02**
Phenolic compounds mg/L	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025		
Chlorides mg/L	7,390	7,410	7,800	7,450	7,080	7,510	7,680	7,590	7,410	7,380	7,040	7,020	7,201	7,400	7,022	7,210	7,100	7,315	7,400	7,350	7,320	7,420	7,370	7,442	7,280	**7,346.25**	**200.50**
Residual chlorine mg/L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
Total Chlorine mg/L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
Cadmio mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002		
1.1.1.1.1.1.1 Calcium mg/L	480	500	422	450	420	410	442	460	470	465	461	475	570	670	460	460	440	425	490	475	480	450	460	462	454	**470.04**	**52.16**
1.1.1.1.1.1.2 Chrome mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Total hardness CaCO3 mg/L	6000	6000	6000	4,200	6000	5000	5,300	5000	6000	5,500	6,500	6000	5,600	6,500	5000	5,500	6000	6,700	6,400	8,600	4,500	7,100	7000	6,700	6000	**5,964.00**	**917.82**
Nickel mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		
Lead mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002		
Sulphides mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		
Sulfates mg/L	608.34	802.62	439.35	626.73	606.42	521.4	525.2	211.21	514.77	514.77	555	480.2	557.58	563.89	761.18	536.73	526.2	558.68	530.4	540.02	654.71	508.74	673.92	559.23	537.28	**556.58**	**109.06**
Salinity % (lab)	32.6	32.6	32.6	32.6	32.6	32.5	32.6	32.5	32.7	32.6	32.5	32.4	29.5	32.4	28.2	28.5	28.2	32.5	32.3	32.2	32.7	32.6	32.7	32.4	32.6	**31.90**	**1.49**
Sodium mg/L	4,314	4,320	4,415	4,400	4,385	4,470	4,380	4,590	4,350	4,380	4,310	4,080	4,250	4,110	4,080	4,320	4,221	4,330	4,250	4,320	4,310	4,300	4,120	4,500	4,150	**4,306.20**	**128.99**
Zinc mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		

Source: Laboratory Analysis, 2016.

Rubio (1985) in the rainy season from July to October 2005 determined low levels of dissolved oxygen in surface waters of the beaches of Acajutla, Metalío, Los Cobanos, Atami and La Libertad, reporting values of up to 2.0 ppm (Puerto de la Libertad) Being the natural oxygen range dissolved in these waters of 6.0 - 7.0 ppm. The same author attributes this event due to the excessive concentration of algal biomass present during those moments that just coincided with a phenomenon of "red tide".

The dissolved oxygen reported by Currie (1995) showed that the water at the bay mouth of La Unión was less oxygenated than the deeper waters within the Gulf of Fonseca, with values of 4.4 and 5.7 mg/lt respectively.

According to PROGOLFO (1997) the reported values of dissolved oxygen in the Bay of La Union are between 3.0-4.4 mg/lt, and in the Bocana of 5.0 and 6.0 mg/lt.

In relation to the Bay of Jiquilisco, the values of dissolved oxygen in the main channel, are of 5.97 mg/lt (Salazar, 2008). When comparing the results of the authors mentioned above with those obtained in Acajutla, it is obvious that the last, has better dissolved oxygen conditions, probably due to better swell patterns and tides. The values obtained in this study specifically for the coastal zone of Acajutla are in the normal range for the survival of marine life.

5.3.9.3.4 Turbidity

The turbidity with the use of the Secchi disk is a measure of the different areas of turbidity either of marine coastal zones or continental bodies of water. For the specific case of the coastal zone of Acajutla, transparency was 2.8 mm ± 0.54 mm in the 2014 season, in the additional seasons it was 3.15 ± 0.17 m in 2015, and 2.84 ± 1.61 m in the 2016 season. As such, the values are within the normal range for aquatic life.

5.3.9.3.5 Temperature (°C)

The temperature of the water affects its density, viscosity, the solubility of the gases and in particular of the oxygen, as well as the speed of the chemical and biochemical reactions. Temperature variations can kill some aquatic species.

The marine thermal structure in El Salvador, considering transepts in front of Acajutla and Golfo de Fonseca, was slightly warmer in the rainy season (July-October), which concurs with a longer photo period during this time. At different stations located in the interior and outside of the Jaltepeque estuary, temperatures of 29.1°C were determined, which is suitable for tropical aquatic organisms (Currie, 1995).

Brenes et al. (2000) recorded surface temperatures of 25 and 28°C in the southeast of the Nicaraguan Pacific, in waters adjacent to the Golfo de Fonseca.
According to Salazar 2008, for the Bay of Jiquilisco, the reported average temperatures are 29.9˚C ± 0.5˚C. The average value of the temperature in the analysis performed on water samples was 28.8 °C ± 0.37 in 2014, the average temperature value for 2015 was 30.00°C ± 0.0, and for 2016 the average value of the temperature for Acajutla was 31.36 °C ± 0.91. This is considered adequate for the normal habitat of marine species.

In general terms and according to the results obtained in the sampling of water quality it is possible to establish that the physical-chemical parameters of the marine coastal waters of the zone of Acajutla are within the acceptable values for the aquatic life, since, according to the JICA (2006) should be: PH between 6.5 and 7.5, dissolved oxygen (5.0 mg/lt), temperature between 20 and 30°C.

5.3.9.3.6 Chemical Oxygen Demand (COD)

The Chemical Oxygen Demand, Is the amount of oxygen that is needed to oxidize all the amount of organic matter present in the water. The value obtained is always higher than the Biochemical Oxygen Demand (BOD), approximately twice as much, since non-biodegradable sutures are also oxidized by this method. The relationship of the two parameters is indicative of the water quality. In industrial waters there may be a higher concentration of non-biodegradable compounds (Salazar, 2008).

The average concentration of (COD) for the marine coastal zone of Acajutla was 1487 mg / lt ± 68.93 for 2014; 1447 ± 175 for 2015; And 566 for 2016., Considering these values, according to the norm NSO 13.49. 01:09 CONACYT, the results are above the allowable limits (COD = 600 mg / lt) in the first two seasons, which is considered adverse conditions for the maintenance of marine life.

In the case of Jiquilisco Bay, an average COD of 716.68 mg / lt is reported, which differs from Acajutla's result (Salazar, 2008).

5.3.9.3.7 Phenolic compounds

Phenolic compounds are organic compounds in which molecular structures contain at least one phenol group, having at least one aromatic nucleus in its developed structural formula. Many are classified as secondary metabolites of plants, in this case they may be present by leachate of seeds that are transported in the port of Acajutla, as well as by trawling of the surrounding rivers or by biosynthesis of Clorophyta type algae. The values found in The sampling in all the stations in the 2015 and 2016 programs, are less than 0.025 mg / L, having as average range 0.5 mg / L according to the Panamanian standard. Chlorophyta algae may be included within total suspended solids.

In 2014, the highest concentrations were detected in Stations E1 and E3 (0.4 mg / lt), with the lowest concentrations reported for Stations E4, E5, E8, E9, E10, E11 and E12 with a value of 0.2 mg / lt). The average of the stations was of 0.29 for 2014.

According to the results and comparing with the maximum permissible limits established by the Cuban Standard for phenolic compounds (0.50mg / lt), the coastal zone of Acajutla is within the permissible limits.

5.3.9.3.8 Sulphides

All analyzed stations (E1-E12) were lower than (0.8 mg / lt) for the 2014 season. In 2015, the minimum concentration was <0.021 mg / l reported in Stations No. EA3-EA4 and the highest of 0.025 mg / l in Stations No. EA1-EA2 respectively. All the analyzed stations registered values below those stipulated by the Mexican Standards, which indicates as a maximum allowable limit 0.4 mg / l of daily average. This situation is probably due to discharges from activities in the Port of Acajutla. The Mexican Standards are taken in this case since the El Salvador regulations do not reflect this fact.

In 2016 the concentration in all samples is less than 0.021 mg / l.

An important point of this information is that, at these sulphide contamination thresholds, the corrosion time for iron infrastructures in seawater with this characteristic can be considered to be maintained at a rate of 0.12 µm / year.

5.3.9.3.9 Chlorides

In 2014, the highest concentration was found at E5 (22,700 mg / lt), the lowest concentration at E7 (18,000 mg / lt). The average of the stations for the zone of Acajutla was of 20,000 mg/lt ± 17.14. In 2016, the values obtained were a minimum of 7.020 mg/L and a maximum of 7,800 mg/L respectively. Which is normal for salt water, there is no data available for the standards used for the analysis.

5.3.9.3.10 Residual and Total Chlorine

None of the samples studied, reported residual and total chlorine concentrations.

In general terms, the values reported for COD are outside the maximum limits allowed by the Salvadoran standard. In the other hand, phenolic compounds were detected at low limits. See Appendix 5W.

5.3.9.3.11 Chemical Comparison Parameters

Of the analysis of marine waters during 2014 at stations E1-E12 on pesticides, heavy metals, fats and oils, suspended solid and bacteriological solids, the majority of parameters are within the Salvadoran

Standard NSO: 13.49.01: 09 (CONACYT 2009); with the exception of suspended solids with minimum values of 460 mg / l and 900 mg / l recorded at Station No. 8 and No , respectively. The maximum permissible limit is 200 mg / lt.

In 2015, most of the parameters are within the Salvadoran Standard NSO: 13.49.01: 09 (CONACYT 2009), except suspended solids with minimum values of 576 mg / l and maximum of 660 mg/l registered in Station EA2 and EA4 respectively, with a maximum permissible limit of 200 mg / lt.

In 2016, the majority of parameters are within the Salvadoran Standard NSO: 13.49.01: 09 (CONACYT 2009), with the exception of suspended solids having a minimum value higher than the 205 mg/l maximum of 291 mg/l registered In samples M05 to M10, M15, M16, M18 to M22, their maximum permissible limit being 200 mg / lt.

Total suspended solids (TSS) indirectly reflect the load of different salts dissolved in water and the presence of inorganic discharges. Their values are increased by substrate entrainment from the surface water network framed in the Sensunapan-Ceniza water basin, where the entire Acajutla Complex is immersed in this Hydrographic region. In 2014 we have average values of 584 mg / L; And 622 mg / L in 2015. Despite the values above the standard of these samples in 2016, they are much lower than those registered in the sampling campaign of 2015, where they reached values higher than 500 mg / L, product of the drag of fluvial material after periods of rain.

In relation to sulfates, in 2014 the minimum concentration in 2014 was 2680 mg / l reported in Station No.6 and the highest of 2950 mg / l in Station No.12. All the analyzed stations registered values higher than those stipulated by the El Salvadoran Standard of CONACYT, which indicates as maximum permissible limit 1000 mg / l. This situation is probably due to discharges from agricultural and agroindustrial activities in the Sensunapan Basin, Ceniza-Banderas, in addition to the entire Acajutla Complex. In 2016 however, we have an average value of 556.58 mg / L, which is below the standard.

5.3.9.3.12 Biological Comparison Parameters

Total Coliforms:

In 2014, the values found are less than 1.1 nmp/100 ml except for point number 12 that present 2.6 nmp/100 ml this increase may be due to the fact that it is the closest point to the industrial port of Acajutla. Allowed values 1000 nmp / 100 ml. In 2015, the values found ranged from 1.1 nmp / 100 ml to a maximum of 16 nmp / 100 ml. Allowed values 10,000 nmp / 100 ml. If we compare the current values with those obtained in the year 2014, we have that there is a significant increase but that does not surpass the permissible limits, giving a good quality of water.

In 2016, the values found ranged from 2 nmp / 100 ml to a maximum of 24,000 nmp / 100 ml in sample M17. No other sample, except M17, exceeds the allowed values of 10,000 nmp / 100 ml. However, if we compare the current values with those obtained in the previous sampling we have that there is a significant increase but that does not surpass the permissible limits.

Fecal Coliforms:
In 2014, values found on average less than 1.1 nmp / 100 ml. Allowed values are 1000 nmp / 100 ml;

In 2015, values found the minimum 1.1 nmp / 100 ml to maximum of 16 nmp / 100 ml; The maximum value allowed is 1000 nmp / 100 ml; giving a good quality of water. In 2016, values found the minimum 2 nmp / 100 ml to maximum of 4,000 nmp / 100 ml corresponding to sample M15. The maximum value allowed is 1000 nmp / 100 ml giving a good water quality with the exception of sample M15.

Heterotrophic Bacteria:
In 2014, although values ranging from 23 CFU / ml for point 12 and 83 CFU / ml at point 3 of sampling up to 900 CFU / ml are kept well below the permissible levels 5000 CFU / ml. In 2016 the analysis performed on samples M01 to M25 are within the recommended value (5000 nmp / 100ml).

5.3.9.3.13 Organophosphorus Pesticides

Pesticides analyzed in this group included: DDVP, Diaznison, Chlorpyrifos, Methyl Paration, Malation, Etion, Triazophos, Pirimiphos Methyl, and Ethyl Paration; at the level of water analysis the complete absence of this type of substances is advisable. In the 2014 and 2015 programs, although most are in quantities that can be purified even by the seawater system, there are three of them that should be given more attention due to the quantities in the which were very close to the maximum permissible and due to their range of toxicity.

- Chlorpyrifos: average value found 0.081 mg / L, the maximum permissible value being 0.1 mg / L. This pesticide has acute toxicity in greater amounts and has neurological effects on the fetus and children, even in very small quantities. For acute effects, EPA classifies chlorpyrifos as Class II: Moderately Toxic. Recent research indicates that children exposed to chlorpyrifos in the uterus are at increased risk of mental and motor developmental delays by age 3 and an increased incidence of generalized developmental disorders such as ADHD in adults can cause tachycardias and in moderate doses heart attack. At the level of marine life is toxic for vertebrate fauna and invertebrate;
- Etion: with an average value of 0.052 mg / L the closer it is to the coast, with a permitted value of 0.1 mg / L. Level 3 pesticide, capable of causing severe temporary or residual damage, is extremely toxic to marine and freshwater fish and invertebrates (crustaceans, insects and zooplankton). It is light to moderately toxic to molluscs. It is not phytotoxic, damage to species of medium-sized birds; and

- Pirimiphos Methyl: average value 0.060 mg / L, maximum permissible value 0.1 mg / L. Level of toxicity II, cause fainting irritations in the skin and in water bodies is toxic to fish. Very toxic to aquatic invertebrates. Toxic to algae. Amount harmful for large fish 1mg.

5.3.9.3.14 Organochlorine Pesticides

In the case of this type of pesticides the analyzed parameters included: alpha HCH, Beta HCH, HCH range, Delta-HCH, heptachlor, Aldrin, Heptaclor Epoxido, Endosulfan Alfa, pp´DDE, Dieldrin, Endrin, Endosulfan Beta, pp´DDD, Endrin Aldehido, Endosulfan sulfate, pp´DDT, Endrin ketone, Metoxiclor, toluene and Ethilbenceno. Most are way below the limits permissible of 0.05 mg /L.

In conclusion, it can be said that, despite having traces of organophosphorus pesticides, organochlorines and carbamates diluted in the coastal marine water of Acajutla, practically all the parameters of organochlorine pesticides analyzed in the 2014 and 2015 programs are below the water quality standards.

However, in spite of these results , measures must be taken to prevent such traces from increasing in the environment. Also, small increase in trace amounts of petroleum hydrocarbons can affect in the long-run the population of Acajutla as well as marine organisms.

In case of classifying water quality on the basis of the six ranges (bad, very bad, bad, good, very good and excellent), the water of the sample points of Acajutla can be classified as very good.

5.3.10 Marine Sediment Analysis

At the same water sampling points, marine sediment sampling was performed to characterize the area.

The samples for 2014 survey were analyzed for hydrocarbons and other pollutants, which were not analyzed in 2016, since they were not found in any of the points analyzed. The results of the sampling is presented in the Appendix 5 X.

In the case of metals, analysed were eight metals in 2014 and 2015, and additional metals in 2016. The results of the complete analysis are presented in the Table 5.62. In 2016, samples taken at depth were also analysed from geotechnical studies, in the "bore hole 14" at depths between 1.25-1.85, 2.35 to 2.40 and 4.00 to 5.00 m.

To evaluate the hazards of metals, the results were compared to the values developed by the United States National Oceanic and Atmospheric Administration (NOAA), which are widely used in this type of analysis. The evaluation carried out by DILLON is presented in appendix 5Y, for the year 2016. The

analysis carried out in 2014 and 2015 are also compared and are presented below. There is no local standard.

The marine SedQBs NOAA specifically used were the NOAA (1999) Effects Range Means (ERM). The ERM correspond to the median or percentile 50 values of effects of sediments compiled and validated. These SedQBs are widely recognized as highly conservative values that are most commonly used and accepted worldwide as indicators of the potential toxicity of marine sediments.

For years, it has been established in the scientific and regulatory literature, that the overcoming similar values of ERMs and SedQBs is a more reliable indicator of potential sediment toxicity (or an increase in the probability of decay of the benthic community) compared to SedQBs of Effects of Low Range.

Table 5.62 – Analysis of Heavy Metals in Marine Sediments, 2014, 2015 and 2016

Date	No	Lead mg/Kg	Mercury mg/Kg	Cadmium mg/Kg	Arsenic mg/Kg	Copper mg/Kg	Nickel mg/Kg	Total Chrome mg/Kg	Zinc mg/Kg	Iron mg/Kg
Aug-16	M1	3.09	0.00956	0.163	17.10	7.80	5.48	7.26	32.50	22,000
Aug-16	M2	6.23	0.02770	0.121	15.00	21.00	5.93	8.47	62.60	33,700
Aug-16	M3	7.11	0.04470	0.117	9.83	33.20	5.58	6.59	69.00	37,200
Aug-16	M4	7.04	0.03740	0.129	9.53	33.90	4.76	4.34	70.70	35,700
Aug-16	M5	5.52	0.02460	0.136	7.64	27.90	5.52	4.99	67.20	39,000
Aug-16	M6	6.05	0.03420	0.104	7.04	31.80	4.53	4.02	64.10	37,000
Aug-16	M7	6.68	0.03220	0.094	7.59	32.90	5.03	4.54	70.40	39,100
Aug-16	M8	6.86	0.03670	0.0899	8.61	31.50	5.57	5.34	72.50	41,000
Aug-16	M9	1.15	0.02120	0.035	7.07	8.68	3.42	3.82	17.70	16,300
Aug-16	M10	4.58	0.01740	0.822	5.17	26.30	5.22	3.84	61.20	33,800
Aug-16	M11	5.07	0.01840	0.090	5.89	31.30	4.71	3.46	64.50	35,500
Aug-16	M12	4.17	0.02010	0.051	4.11	26.00	5.39	3.29	58.40	35,600
Aug-16	M13	4.38	0.01400	0.087	3.07	32.80	4.95	3.33	57.60	33,400
Aug-16	M14	3.61	0.01970	0.058	3.51	25.90	5.90	3.71	59.10	34,700
Aug-16	M15	4.97	0.02340	0.163	5.21	40.40	4.45	3.61	63.00	31,700
Aug-16	M16	5.20	0.02540	0.147	5.01	38.40	4.32	3.40	60.90	28,600
Aug-16	M17	5.43	0.02240	0.111	5.27	38.60	4.22	3.38	67.20	30,100
Aug-16	M18	3.86	0.02120	0.074	5.03	25.30	4.92	3.90	58.00	35,100
Aug-16	M19	2.66	0.00977	0.044	5.11	13.00	6.18	2.83	43.20	30,100
Aug-16	M20	7.24	0.01080	<0.24	4.25	19.10	6.33	4.73	47.60	35,300
Aug-16	M21	4.02	<0.0236	0.0489	3.54	14.50	7.82	4.07	52.10	34,700
Aug-16	M22	4.94	0.02370	<0.266	4.53	26.30	6.15	4.49	63.30	40,400
Aug-16	M23	12.10	0.02980	0.125	10.20	38.00	4.91	6.38	80.50	39,700
Aug-16	M24	1.19	<0.019	<0.168	6.66	15.50	2.99	2.17	22.10	17,600
Aug-16	M25	2.89	<0.0218	<0.184	3.88	14.60	8.55	4.26	57.00	42,200
	BH 14-	2.69	<0.0247	<0.268	0.65	68.50	2.18	1.10	36.90	32,500

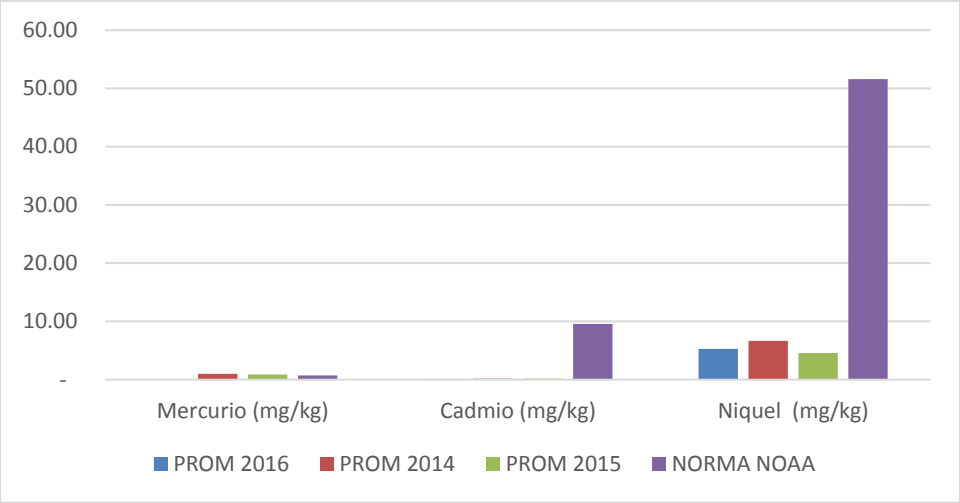
Table 5.62 – Analysis of Heavy Metals in Marine Sediments, 2014, 2015 and 2016										
Date	**No**	**Lead mg/Kg**	**Mercury mg/Kg**	**Cadmium mg/Kg**	**Arsenic mg/Kg**	**Copper mg/Kg**	**Nickel mg/Kg**	**Total Chrome mg/Kg**	**Zinc mg/Kg**	**Iron mg/Kg**
	1.25-1.85									
Aug-16	BH 14 2.35-2.4	3.54	0.0702	0.0892	0.79	56.60	5.09	6.79	56.30	27,400
Aug-16	BH14 4.00-5.00	3.65	<0.0249	<0.284	0.84	30.70	8.46	13.30	47.60	37,500
Average 2016			**4.85**	**0.03**	**0.13**	**6.15**	**28.95**	**5.31**	**4.69**	**36,460**
Aug-15	E1	6.70	0.60000	< 0.2	7.90	18.40	6.30	6.50	64.70	
Aug-15	E2	6.50	< 0.5	< 0.2	15.70	25.50	7.00	7.80	69.40	
Aug-15	E3	6.40	< 0.5	< 0.2	11.50	25.10	5.10	5.60	66.70	
Aug-15	E4	5.70	0.76000	< 0.2	8.70	22.50	5.80	5.80	64.00	
Aug-15	E5	6.80	< 0.5	< 0.2	18.90	28.20	5.80	9.60	68.00	
Aug-15	E6	11.30	< 0.5	< 0.2	22.00	41.70	7.20	12.60	82.00	
Aug-15	E7	12.40	0.67000	< 0.2	21.20	37.20	8.40	9.80	74.30	
Aug-15	E8	10.40	0.73000	< 0.2	20.50	44.60	7.20	11.80	79.50	
Aug-15	E9	10.20	0.83000	< 0.2	16.70	38.80	6.30	10.00	68.60	
Aug-15	E10	8.80	< 0.5	< 0.2	23.80	43.60	8.00	12.00	113.60	
Aug-15	E11	10.40	0.50000	< 0.2	21.60	43.60	6.10	10.80	76.40	
Aug-15	E12	12.20	2.80000	< 0.2	17.90	46.60	6.60	9.40	72.30	
AVERAGE 2015		**8.98**	**0.98**	**< 0.2**	**17.20**	**34.65**	**6.65**	**9.31**	**74.96**	
Aug-14	E1	10.70	1.40000	<0.2	8.80	25.40	3.80	5.30	68.70	
Aug-14	E2	11.70	0.14000	< 0.2	9.20	27.00	4.40	6.10	72.70	
Aug-14	E3	12.10	<0.1	< 0.2	8.20	20.50	5.90	5.90	72.60	
Aug-14	E4	13.10	1.20000	< 0.2	8.60	26.10	4.30	7.20	74.40	
AVERAGE 2014		**11.90**	**0.91**	**< 0.2**	**8.70**	**24.75**	**4.60**	**6.13**	**72.10**	
NOAA STANDARD		**218.00**	**0.71**	**9.60**	**70.00**	**270.00**	**51.60**	**370.00**	**410.00**	

Source: Own Elaboration 2016

Of the eight metals being analyzed for sediment, all concentrations of metals are within the NOAA Sediment Standard (1999). Mercury was found above the standard values, in three points, two of which will not be disturbed, because they are outside the areas where works will be installed. The third is a point on the route of the pipeline, where the disturbance will be only for a short time.

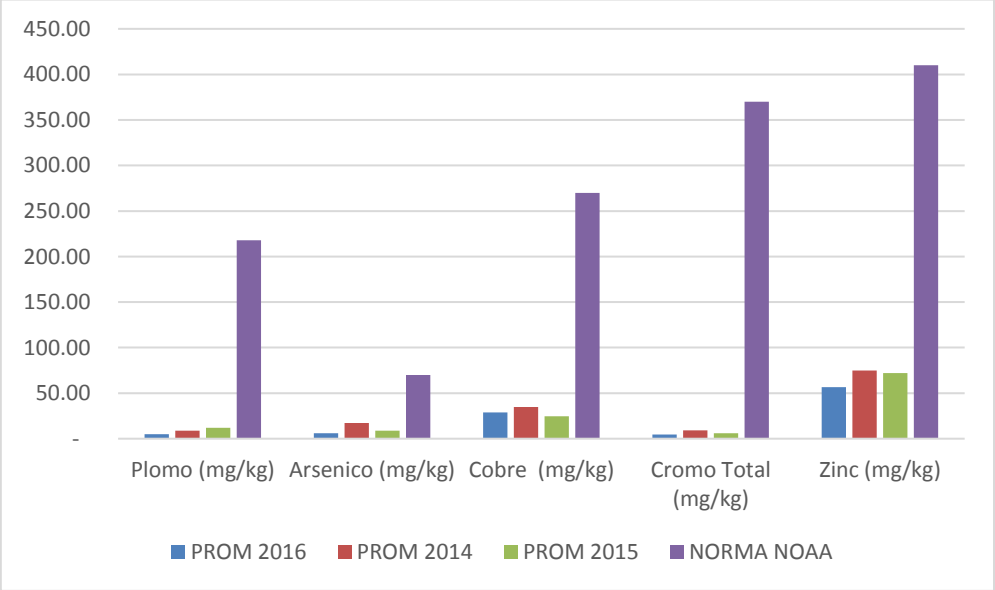
The results are summarized in Figures 5.44 and 5.45 below.

Figure 5.44 – Comparison of analysis made with reference standards for mercury, cadmium and nickel



Source: Own Elaboration 2016

Figure 5.45 – Comparison of analysis made with reference standards, to lead, arsenic, copper, total chromium and zinc



Source: Own elaboration 2016

5.3.11 Vector-borne diseases

Vector-borne diseases include those acquired through the bite of an infected arthropod, such as a mosquito, a tick or a flea, which carries pathogens from one host to another. Vector-borne diseases through the bite of a mosquito are particularly critical because they are bacterial and viral, contributing

to epidemics in humans and animals. Table 5.63 identifies the status of diseases transmitted by key vectors with relevance to the Project.

Table 5.63 – Endemic Vector-Borne Diseases in El Salvador Relevant to the Project

Disease	Estimated Number of Estimated Cases at National Level	Vector and Mobility Range
Zica	The suspected cases of zika registered in El Salvador since the virus entered the country in November 2015 reached 11,321. At the end of October 2016, of which 420 are in pregnant women, according to the Epidemiological Bulletin of the Ministry of Health of El Salvador (MINSAL), cases recorded between January 1 and October 29 totaled 7,485 which are added to the 3,836 of 2015.	The main vectors in El Salvador are *Aedes Aegypti and Aedes albopictus*. Mobility range from point of origin is 200 m.
Chikungunya	Chikungunya first appeared in El Salvador in June 2014, and by 09 2014, almost 30,000 cases had been reported.	The main vectors in El Salvador are *Aedes Aegypti and Aedes albopictus*. Mobility range from point of origin is 200 m.
Dengue Fever / Hemorrhagic Dengue	Dengue Fever and Dengue Hemorrhagic fever is the fastest-growing vector-borne disease in the world. In El Salvador, the incidence of classic dengue fever has fluctuated since 2008 and 2013, with its highest peak reported in 2012 with 41,793 cases. In 2014, there were 27,074 cases reported nationwide resulting in 1 fatality. Hemorrhagic Dengue included 1,920 cases in 2012 and 429 cases in 2013. While cases of dengue have occurred throughout El Salvador, it is a risk in Sonsonate (according to the International Society of Infectious Diseases September 2014). Dengue is also the eighth leading cause of the disease affecting children of 1-4 years of age.	The main vectors in El Salvador are *Aedes Aegypti* and *Aedes albopictus.* Mobility range from point of origin is 200 m.

Table 5.63 – Endemic Vector-Borne Diseases in El Salvador Relevant to the Project		
Disease	**Estimated Number of Estimated Cases at National Level**	**Vector and Mobility Range**
Malaria	The incidence of malaria has been low (11 cases in 2013) in El Salvador, five of them in the municipality of Acajutla (Metalío). Cases of malaria have been reported between May and October. The incidents have been limited to the rural areas of Santa Ana, Ahuachapán and La Unión, on the Guatemalan border. Malaria is not a risk in Sonsonate (according to the International Society of Infectious Diseases September 2014).	The main vectors in El Salvador are *Anopheles albimanus* y *An. pseudopunctipennis*. Mobility range from point of origin is 4.5 km.

Source: Statistics obtained from Infectious Diseases and Global Epidemiology Network (Gideon) Computing. Consulted on September 2, 2014. Symptoms and transmission of information from the Centers for Disease Control and Prevention. The results illustrate that dengue affects the Sonsonate region.

5.4 Socioeconomic and Cultural Environment

5.4.1 Stakeholders

The main social groups and their activities within the Project's areas of influence were identified. A more detailed report on the social environment within the Project's area of influence and the completed public consultation process is described in Chapter 8.

In the city of Acajutla the communities are represented by Associations of Community Development (ADESCO's). Theseassocaitions in the area of the Project were identified. Also identified were : Non-governmental organizations, associations and cooperatives of fishermen, school directors and health units, among others as explained in detail in Chapter 8.

5.4.2 Socioeconomic Conditions

Socio-economic conditions in the sourounding area of the project were organized on the basis of indicators The representative indicators are detailed below.

5.4.2.1 Population and Demography

In terms of demographic information for the Municipality of Acajutla, as well as the department of Sonsonate, population increases are recoreded as shown in Table 5.64.

Table 5.64 – Population Municipality of Acajutla			
INDICATORS	**CENSUS**		
	1971	**1992**	**2007**
Total population	28,659	47,678	52,359
Absolute population growth	n.d.	19,019	8,681
Average annual population growth rate	n.d.	2.4	1.9
Population Density	172	286	338
COMPOSITION BY SEX			
Male	14,679	23,853	25,561
Female	13,980	23,825	26,798
Masculinity Index	1.05	1	0.95
BY AREA OF RESIDENCE			
Urban	10,255	18,008	25,237
Rural	18,404	26,670	27,122
Urban Percentage %	35.78	37.77	48.2

Source: Own elaboration based on population censuses, 2014.

The relationship that is indicated with more recent data, regarding the census of 1992 to the most recent of 2007, indicate the increase of the population with certain tendencies, in general terms in a period of 15 years an increased percentage of the Population in urban areas, and an increase in the percentage of female population. Urban-city migrations are related to factors such as population growth and the search for better opportunities for study or employment and income for rural families, but the percentage of rural population prevails.

In relation to the growth of the population of the Department of Sonsonate in 2007, with a total of 438,960 inhabitants, Acajutla houses 11.93% of this total. Sonsonate is the fourth most populous Department with 7.60% of the national population and Acajutla is in the 27th place of population, from a total of 262 municipalities.

With regard to the rate of growth, the Municipality of Acajutla is growing at a rate of 1.9% which is quite similar to the 1.99% for Sonsontate. However, this is well below the rate of San Salvador which is the department with the highest growth with a 3.47%. The average national growth rate is 1.02 per cent below the rate of Acajutla.

Based on the population projections of the Ministry of Economy document: "REPÚBLICA DE EL SALVADOR ESTIMATES AND PROJECTIONS OF THE POPULATION 1950 - 2050" of July 2009, factors such as: mortality rates, birth rate, growth in base of censuses between 1950 and 2007 are taken into account. Generally for the population of El Salvador, an approximation of the Population growth by sex between 2010 and 2005 is shown in Table 5.65.

Table 5.65 – Projection of Population Municipality of Acajutla			
YEARS OF PROJECTION	**QUANTITIES (inhabitants)**		
	TOTAL	**MEN**	**WOMEN**
2010	53,504	25,906	27,598
2015	55,108	26,527	28,581
2020	57,111	27,392	29,720
2025	59,492	28,497	30,995
2030	61,885	29,653	32,232
2035	55,288	21,900	33,388
2040	66,288	31,865	34,423
2045	68,186	32,858	35,328
2050	69,883	33,775	36,108

Source: Own elaboration based on population projections of the Ministry of Economy

In comparison, for the projected growth in El Salvador, there is the same tendency of increase of older population and decrease of the young population, maintaining the almost equitable relation of men and women. The country had a population of 6,183,002 inhabitants in the year 2010, and is projectd to grow to 6,876,816 by 2025. This is an increase of 10.09%. and for the year 2050, the population is expected to grow to 8,076,090 which is a growth rate of 23.44% s compated to the base year of 2010. The same approximate trend is projected for the Municipality of Acajutla that will increase its total population in 2010 of 53,504 to a projection of 69,883 inhabitants in 2050(a 30% increase over this 40 years period).

Another important factor within the socioeconomic parameters is the proportion of household headship indicated in Table 5.66.

Table 5.66 – Projection of Population Municipality of Acajutla			
MUNICIPALITY	**HEAD OF HOUSEHOLD**		
	TOTAL HOUSEHOLDS	**HEAD OF HOUSEHOLD(m)**	**HEAD OF HOUSEHOLD(f)**
Santo Domingo de Guzmán	1,563	71.72%	28.28%
Sonsonate	17,762	66.59%	33.41%
Acajutla	12,473	69.01	30.99%
Nahuilingo	2,498	68.65%	31.35%
San Antonio del Monte	6,458	68.36%	31.64%
TOTAL	**40,754**	**27,686**	**13,068**
average%	100	68%	32%

Source: Own elaboration, based on population censuses, 2007

Acajutla is very close to the average of the surrounding municipalities, however, compared to Sonsontate, it has a higher percentage for male heads of household with 69.01%, 2.42% more than in Sonsonate.

5.4.2.1.1 Age ranges

Other population indicators include age ranges of the VI Population Census and V housing 2007, of the Ministry of Economy and the General Directorate of Statistics and Censuses, where the population stands out in the range of 7 to 17 years representing 28.63% of the total population of the municipality in a range of 10 years, and that almost half of the population is below 18 years, ie a trend of young population.See Table 5.67.

Table 5.67 – Population by Age, Municipality of Acajutla and Average of the Country, 2007 Census

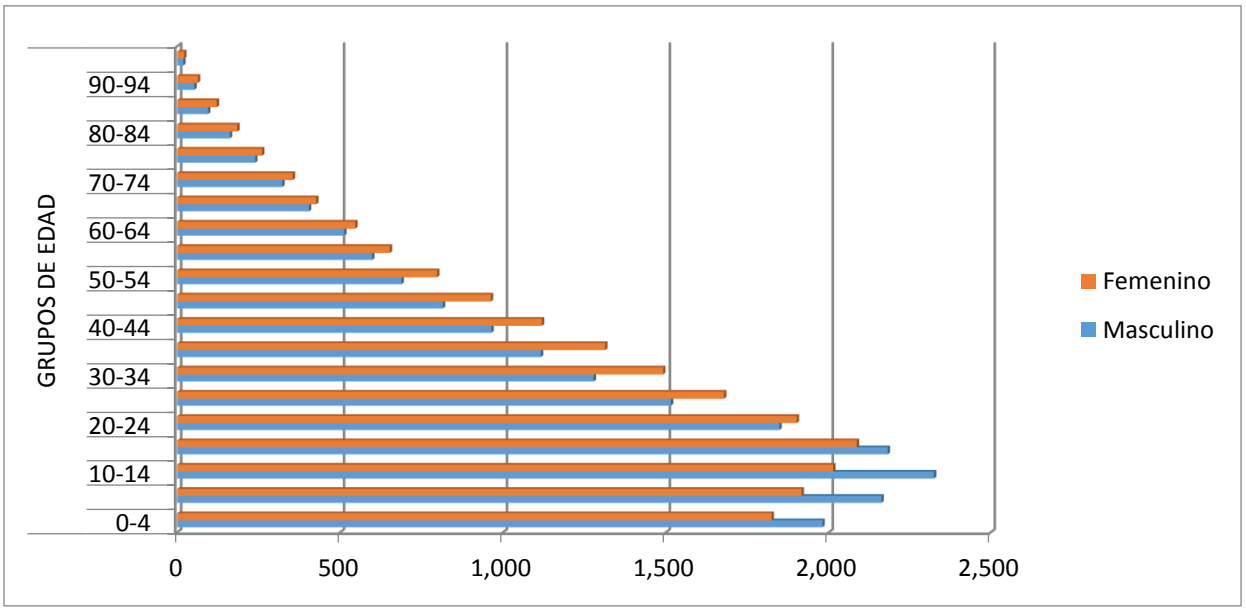
MUNICIPALITY	TOTAL	SELECTED AGE BRACKETS				
		0 - 3	4 - 6	7 - 17	18 - 59	60 o MÁS
ACAJUTLA	52,359	4,064	3,687	14,991	25,283	4,334
Average (%)	100	7.76	7.04	28.63	48.29	8.28
Average percentage of the country	100	7.07	10.8	26.41	46.21	9.43

Source: Ownelaboration, based on population censuses, 2007

In the previous Table the average age of the population is presented for the country. The age ranges for Acajutla are compared which show some variations between the ages of 4 to 6 which are greater at the national level and also a small difference of approximately 2 percentage points for the ages of 7 to 17 and of 18 to 59.

Diustribitions of male and female populations by age bracket for the municipality is presented in Figure 5.46. It shows a greater proportion of males below 20 years of age and a greater proportion of females above 20 years of age.

Figure 5.46 – Population Projection Table



Source: Census 2007

5.4.2.1.2 Education

Within the municipality of Acajutla, there are 42 schools with an enrollment of 15,133 students and 357 teachers. Compared with other nearby municipalities, Acajutla has more schools than Nahuilingo, San Antonio de el Monte and Santo Domingo de Guzmán. In comparison, Sonsonate has 81 education centers with a total of 57,592 students and 1,760 teachers.

Within the area of influence of the Project the main school centers are: Centro Escolar "Comunidad Alvarado" and Colegio Católico de Acajutla (see Figure 5.55), the second being the closest to the Project.

Education levels are another indicative factor of the population, the average of schooling of the municipality is 4.6 years. In the urban area, an average of 5.4 years and 3.9 years of schooling were recorded. Regarding the levels of schooling by sex, there are 4.9 years for men and 4.4 years for women. See Table 5.68.

Table 5.68 – Education by Age, Municipality of Acajutla

Education level	School Ages						Percentage
	0 - 5	6 - 12	13 -18	19 - 25	26 +	TOTAL	
Nursery education	411	1,143	14	14	36	1,618	3.09%
Elementary or Basic	-	7,404	6,168	3,787	12,464	29,823	56.96%
Middle Education	-	-	887	1,532	1,985	4,404	8.41%
Short career after 6th grade	-	-	-	-	39	39	0.07%
Higher non-university	-	-	12	95	179	286	0.55%

Table 5.68 – Education by Age, Municipality of Acajutla							
Education level	**School Ages**						**Percentage**
	0 - 5	**6 - 12**	**13 -18**	**19 - 25**	**26 +**	**TOTAL**	
University Technical	-	-	5	65	80	150	0.29%
Higher University Education	-	-	18	145	295	458	0.87%
Masters	-	-	-	1	2	3	0.006%
Doctorate	-	-	-	-	1	1	0.002%
Total	411	8,547	7,104	5,639	15,081	36,782	70.25%

Source: USAID/SACDEL 2012

At the national level, 82.22% of the population has some education,, which surpasses 70.25% of the Municipality of Acajutla.

5.4.2.1.3 Literacy

With regard to the adult literacy (over 15 years old), for the 2007, a rate of 77.9% is recorded, which indicates that more than one fifth part of the adult population (22.1%) could not read or write. The urban area registered a rate of 84.2% and in the rural area the rate is 71.6%. When segmenting adult literacy by sex, men report a rate of 82.1% and women 74.1% (more than a quarter of the female population is illiterate), as reflected in the following Table 5.69.

Table 5.69 – Adult Literacy in the Municipality of Acajutla and National Average.		
Zone	**Acajutla Literacy Rate**	**El Salvador Literacy Rate**
Urban	84.2%	86.64%
Rural	71.6%	71.58%
Male	82.1%	82.69%
Female	74.1%	79.58%
TOTAL	77.9%	81.09

Source: USAID/SACDEL 2012.

In relation to the average for the country, the rate for Acajutla is about 3 % below with the largest difference being in female literacy.

5.4.2.1.4 Housing

In El Salvador, there are several forms of tenancy which are summarized in Table 5.70. Sonsonate data is presented, because it was not possible to obtain specific data for Acajutla.

Table 5.70 – Tenement of Housing at National Level and in the Department of Sonsonate							
Department and Housing Tenure	**Total**		**% Of Households**	**Urban**		**Rural**	
	Homes	**Population**		**Homes**	**Population**	**Homes**	**Population**
NATIONAL TOTAL	**1406,485**	**5723,150**	**100**	**925,306**	**3579,532**	**481,179**	**2143,618**
Own	921,201	3871,455	65.50	552,375	2204,369	368,826	1667,086
Own Paying in installments to public institution	68,611	256,919	4.88	66,910	249,391	1,701	7,528
Own Paying in installments to private institution	55,718	220,201	3.96	50,982	198,592	4,736	21,609
Own Paying in installments to NGO	3,950	16,437	0.28	3,393	13,834	557	2,603
Rented	188,872	685,735	13.43	170,396	609,232	18,476	76,503
Free Occupant	150,530	600,640	10.70	71,561	267,324	78,969	333,316
Other Tenure	17,603	71,763	1.25	9,689	36,790	7,914	34,973
TOTAL SONSONATE	**102,357**	**437,862**	**100**	**63,791**	**260,477**	**38,566**	**177,385**
Own	68,739	300,429	67.16	41,504	173,993	27,235	126,436
Own Paying in installments to public institution	1,917	7,521	1.87	1,784	6,908	133	613
Own Paying in installments to private institution	4,309	17,853	4.21	3,658	14,919	651	2,934
Own Paying in installments to NGO	344	1,479	0.34	281	1,180	63	299
Rented	9,992	37,553	9.76	9,333	34,707	659	2,846
Free Occupant	15,604	66,808	15.24	6,753	26,942	8,851	39,866
Other Tenure	1,452	6,219	1.42	478	1,828	974	4,391

Source: Census of population and housing, 2007

It can be observed that there are some difference for the Department of Sonsonate as compared to the national total,in particular there is a higher percentage of free occupations in Sonsonate and a lower percentage of rented housing, which indicates a better tenure status of the houses in the Department of Sonsonate.

According to data collected by DIGESTYC for the 2004 Poverty Map, 63.3% of the households have predominantly concrete or mixed walls (Table 5.71); 68.3% of the floors are cement or cement brick; and 80.6% of the ceilings are of sheet metal or asbestos sheet. There are informal homes that also use these materials.

Table 5.71 – Constructive Materials of Housing in the Municipality of Acajutla									
MUNICIPALITY	Percentage of Households by Predominant Material in Housing Walls								
	Concrete or mixed	Bahareque	Adobe	Wood	metal sheet	Straw or palm	Waste materials	Others	Total
Acajutla	63.3	1.3	19.8	3.4	9.2	1.9	0.3	0.7	100

Source: Census of population and housing, 2007

The percentages are very similar to national averages.

5.4.2.2 Cultural Characteristics

5.4.2.2.1 Religion

Eventhough, the municipality is mainly known for its activity as a port and industrial zone, it has varied religious and cultural traditions. Most of the inhabitants profess the Catholic faith and are therefore, have a calendarization of festive religious traditions and activities. For example, the Holy Week, which is closely attached to the Catholic religion, emphasized by the religious influence from the town of Sonsonate where these customs are alsocarried out in a profound way. On May 3rd, celebrations of the day of the Cross are held, having altars in all households, with paper decorations, flowers and fruits, for adoration of the Cross.

Another religious observances of great relevance are the patron saint's festivities on May 23[11]. offered to the “Holy Trinity”. The festivities also commemorate the date when a mass ordered by Don Pedro de Alvaradoto was officiated in his honor, to celebrate the completion of the contruction of the ships intended for his planned expedition to the Maluku Islands. The celebrations are organized by the local authorities, companies of the industrial zone and notable people of the community, with contests like the "tunco encebado" and the "palo encebado". In addition, gala dances were performed with disguises and street dances with masked people, called "los viejos", who danced in the streets of the town with marimba music.

Nowadays there are parties lit up with "alboradas" (fireworks), band music and gunpowder burning. The so-called "desfile del correo", which announces the beginning of the festivities, band music and gunpowder burning; the carriage ride of the queen of the festivities and the crowning ball of the same. There is also the holding of a fair with rides, the parades with the queens of barrios and colonias and popular dances.

[11] Acajutla Municipaliy, RTI International, COMURES & USAID. Strategic Plan…Opc. Cit., p. 8.

Another local fiesta is celebrated on the 24th of October, dedicated to San Rafael Archangel, patron saint of fishermen of Acajutla. According to the tradition, he is the protector of the guild by having miraculously restored his sight to a blind man, with a remedy extracted from a fish. The most traditional act of this day is a nocturnal procession of boats in the sea, carrying the image of the saint in one of them, adorned with flowers and colorful lights. The celebration culminates with a mass and fireworks. By this, they seeks to obtain the blessing of the waters from which they draw their sustenance and protection from all dangers. During the day a regatta and a children's party are organized for the children of the fishermen.

5.4.2.2.2 Ethnic composition

In the department of Sonsonate, according to the 2007 census, 63,033 people were recognized as mestizo (88%); 7357 as white (10%); And 202 from another ethnic group (0.02%), including 63 nahua pipiles; While 31 were recognized black race which is not really pure African. The same percentages may be applicable to the ethical composition of the municipality of Acajutla, which does not vary significantly.

Within the municipality of Acajutla there are no indigenous concentrations. Indigenous peoples within the department of Sonsonate that are Nahua pipil, descendants of Nahua tribes from the central zone of Mexico and that constitute the greater number of indigenous population in El Salvador are recognized.

5.4.2.3 Economic activities

Acajutla plays a very important role in the the Salvadoran economy, because it is located next to the main port of the country.

The predominant economic activities are:

- Agricultural and livestock: production of basic grains and sugar cane, in addition to cattle breeding, artisanal fishing;
- Industrial: there is an industrial complex composed of large companies that constitute an important source of income and employment for the national economy;
- Commerce: The area trade is varied and is basically located around the Central Market of the city. Also, the tourism trade is developed, which is basically located near the beaches of the city;
- Fishing: Fishing is mainly carried out in local businesses and distributed in restaurants and local food businesses; and
- Transport, Storage, and Communications services: These are important in generating employment and income in the locality. This happens because in the municipality is located the most important and modern port of the country.

The following Table (Table 5.72) shows the percentage of the population (male and female) that are involved in different economic activities in the municipality.

Table 5.72 – Composition by Sex of the Economically Active Population, according to the Economic Activity Branch, Municipality of Acajutla, Department of Sonsonate, 2004

Branch of activity	Total		Male		Female	
	N º	%	N º	%	N º	%
1 . Agriculture and Livestock	4 ,918	23 .4	4 ,666	34 .5	252	3 .4
2 . Fishing and related to the commercialization of fish	777	3 .7	740	5 .5	37	0 .5
3 . Mining and quarrying	37	0 .2	37	0 .3	n.d.	n.d.
4 . Manufacturing industry	1 ,553	7 .4	773	5 .7	780	10 .5
5 . Basic services	16	0 .1	16	0 .1	n.d.	n.d.
6 . Construction	1 ,338	6 .4	1 ,338	9 .9	n.d.	n.d.
7 . Commerce	6 ,370	30 .4	2 ,071	15 .3	4 ,299	57 .6
8. Transport, storage and communications	1 ,259	6 .0	1 ,243	9 .2	16	0 .2
9 . Financial and real estate services	547	2 .6	515	3 .8	32	0 .4
10. Public sector	963	4 .6	678	5 .0	285	3 .8
11 . Other services	3 ,203	15 .3	1 ,441	10 .7	1 ,762	23 .6
TOTAL	20 ,984		13 ,520		7 ,464	

n.d. = no data.

Source: Ministry of Economy, General Directorate of Statistics and Censuses. Multiple Purpose Household Survey 2004. Poverty Map. Electronic database.

The highest concentration of the labour force is involved in agricultural and livestock activities and trade, along with other services, many of them informal. Despite having a large concentration of industries in the area, this industry requires few operational personnel and does not generate many jobs. Some of these industries use local labor force, but also have many personnel coming from outside even from San Salvador or Santa Ana.

Acajutla has a population trained at different technical and professional levels that can be used for the EDP Power Generation Project with many are employed in other industries nearby. The 2007 census establishes a total of 25,283 inhabitants in the municipality of Acajutla, aged between 18 and 60 years, the working force age group extends to both extremes of age, especially in Agricultural activities, informal employment and fishing. This corresponds to 48% of the population that can be considered economically active.

As shown in Table 5.72, there was a total of 20,984 jobs in 2004). In the same year, there were 23,895 inhabitants of the economically active population, that is, 48.3%, with a percentage of unemployment of 12.18% and

According to the ECLAC study, there was a 10.2% unemployment rate at the national level in 2004 and in 2014, the percentage of unemployment was 6.6% of the economically active population.

Table 5.73 shows that the highest income is in the services sector: transportation, storage and communications, as well as real estate services. commerce also reflects better incomes.

Table 5.73 – Average Per Capita Monthly Income by Economic Activity and by Sex, Municipality of Acajutla, 2004

Activity Branch	Total ($)	Male ($)	Female ($)
Agriculture and Livestock	92.84	93.75	71.12
Fishing and related to the commercialization of fish	255.06	255.06	n.d.
Mining and quarrying	600.10	600.10	n.d.
Manufacturing industry	153.56	229.42	99.02
Basic services	n.d.	n.d.	n.d.
Construction	180.66	180.66	n.d.
Commerce	179.40	180.59	178.85
Transport, storage and communications	370.02	370.02	n.d.
Financial and real estate services	252.23	199.08	620.96
Public sector	270.13	249.95	278.45
Other services	140.93	160.40	106.07
General	178.19	186.66	162.63

Source: USAID/SACDEL 2012.

5.4.2.3.1 Population receiving remittances

are Remittances received from abroad by the population provide part of the family economy. Table 5.74 summarizes the population of the Sonsonate Pacific territory:

Table 5.74 – Population Receiving Remittances

Municipality	Total	N/A	YES	NO
	Population	Population	Population	Population
Santo Domingo de Guzmán	7,055	1,802	297	4,956
Sonsonate	71,541	14,544	5,630	51,367
Acajutla	52,359	11,928	3,367	37,064
San Antonio del Monte	26,902	6,159	1,360	19,383
Nahuilingo	10,417	2,340	850	7,227

Table 5.74 – Population Receiving Remittances				
Municipality	Total Population	N/A Population	YES Population	NO Population
TOTAL	**168,274**	**36,773**	**11,504**	**119,997**
		22	7	71

Source: Territorios de Progreso, 2013.

In general, the Sonsonate Pacific area does not have much access to remittances from abroad as can be seen in Table 5.74. Only 6.43% of the population receives family remittances compared to the national average of 22.6%. This is probably due to the fact that this area was not as affected during the armed conflict, where in other area the population fled outside the country as well as due to the presence of the port and surrounding industries, which are a source of employment.

5.4.2.3.2 Industries

There are more than 27 industries, which are located in the area around the Port of Acajutla, near the Project site, these operate in different activities such as:

- Three for the storage, mixing and distribution of petroleum products.
- Nine that are dedicated to the storage, mixing and commercialization of agrochemicals.
- Three destined to the commercialization of oils and fats.
- Two that are in charge of power generation.
- Four shrimp industries that process and market their products abroad.
- Two for storage and distribution of food and basic grains. (ICMARES 2007)

Most of these industries are located along the highway towards the Port, being more concentrated in the surrounding area of the Port in industrial land use areas. These are located to the South and East of the EDP Project site. A large percentage of the population earns economic income by being employed in the previous activities. The location of industrial areas can be seen in Figure 5.54.The following industries have their operations headquarters in Acajutla: CEL, RASA, CEPA, FERTICA, TEXACO, METASA, DUKE ENERGY, PUMA, etc. See photo 5.52.

Photo 5.52 – Industries located in Acajutla

Soure: www.verfotosde.org/el-salvador/imagenes-de-Acajutla

5.4.2.3.3 Fishing

In Acajutla, an area of primary economic importance is the extraction of fish, mollusks and sea crustaceans, whose relevance varies by canton and hamlet, depending on how close human settlement areas are to the marine resource base. There are organizations related to this activity, such as the Asociación Cooperativa de Producción Pesquera del Puerto de Acajutla de R.L. (ACOOPPAC DE R.L.) and the Cooperativa de Productividad Pesquera Rederos de Acajutla, de R.L. These associations are organized and registered within the Municipality.

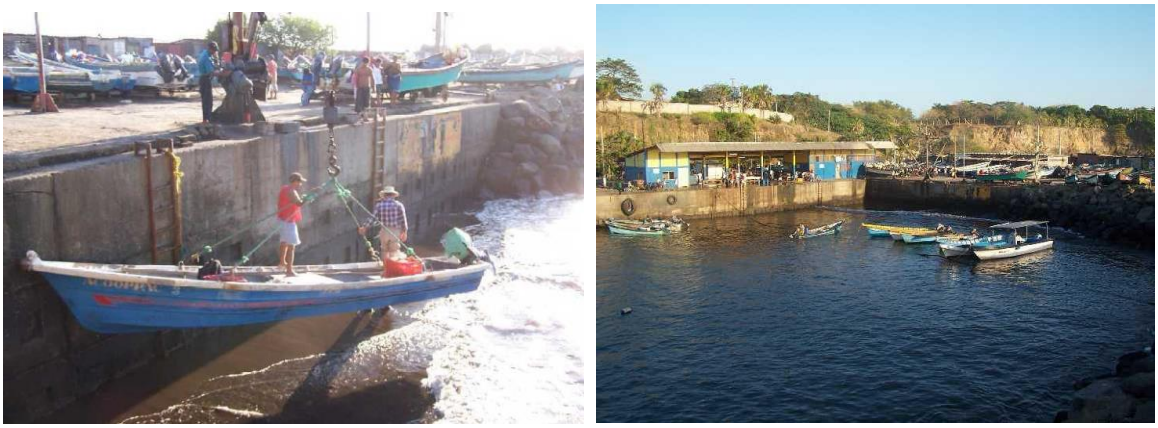
Low-income people living in coastal areas of the country, carry out traditionally small-scale fishing, know as artisanal fishing. This produces 50% of the national total. The majority of the fishermen are dedicated to fishing several days of the week which depend on the meteorological conditions, with an average of 3 days of work per week for Acajutla.

Although there are large industries present in the area, Acajutla has an unemployment rate above the national average. It is a place where job opportunities are very scarce. Therefore, a percentage of the Inhabitants are engaged in artisanal fisheries and their commercialization (Table 5.73) (approximately 3.8% of existing jobs). The location of the activities of the cooperatives is the craft pier of Acajutla, which was built by the effort of fishermen without specialized machinery.

There are several issues affecting artisanal fishing, such as the deterioration of environmental conditions, the red tide, rising fuel prices, exploitation of resources and difficulty in selling the products obtained.

According to the study *"Development of Artisanal Fishing in El Salvador"*[12], this sector suffers from underdevelopment in techniques used, control of fishing, processing of products, and organization of fishermen. There are many problems that will affect the future of this activity. See photo 5.53.

Photo 5.53 –View of Artisanal Fishing Activity



Source: http://acajutlateespera.blogspot.com.

Due to difficulties in fishing, and the proximity of the Port of Acajutla, fishermen due attempt to fish in the restricted areas of the Port and are continuously withdrawn by CEPA port security.

According to the security department of the Port of Acajutla (CEPA), fishermen are removed from this area daily, although there are no conerns with them passing through the area to other fishing areas.

Fishermen fear that once the Project is built they will have to increase the speed of the boats to reach the fishing zones and are concerned with the reduction in fishing areas.

A detailed report on artisanal fisheries in the Project area is presented in Appendix 5Z.

a.) **Cooperativa de Rederos y Langosteros (ACPPRA DE R.L.).** The cooperative is primarily engaged in net fishing, especially lobster fishing. It is smaller and has a lower level of organization than ACOOPPAC. They currently have 29 associates, working 6 days a week, with average daily income of $ 15.00, which generates a weekly income of $ 90.00 per partner.

b.) **Cooperativa de Pescadores (ACOOPPAC).** It is one of the oldest cooperatives of Acajutla, formally constituted on May 27, 1971. The cooperative is made up of 34 associates, who work 3 days a week, with average daily income of $ 15.00, which generates a weekly income of $ 45.00 per partner. Currently, they have several fishing areas, one of them is the area known as "El

[12] Prepared by the Japan International Cooperation Agency (JICA), in collaboration with the Ministry of Agriculture and Livestock and its Center for Fisheries and Aquaculture Development, September 2002.

Pedrero", as they commonly call the place where the path of the pipeline is projected, despite being a restricted area for fishing.

c.) **Asociación Cooperativa de Producción Pesquera Tiburoneros de Alta Mar (ACPETAMAR).** ACPETAMAR de R.L. was established on March 9, 2006. Its members are people engaged in fishing. Currently in addition to the fish extraction, they have a plant for the processing fishery products. The cooperative currently has 29 registered members. The cooperative partners started marine fishing with shark, but nowadays they have incorporated dorado and tuna into the catch, which is why they are also known as "Doraderos", since among its main products it is found The fish known as dorado (Mahi mahi).

d.) **Asociación Cooperativa De Producción Agropecuaria Y Pesquera Camaroneros De Acajutla (ACOOPESCA).** This is the most recent cooperative created in July 2015. Currently, it has 16 members officially registered. Like the ACOOPAC and ACCPRA cooperatives, they maintain quite similar characteristics for fishing, as well as fishing routes. However, ACOOPESCA's main fishing product is shrimp, which are marketed in the locality or have buyers waiting for them when carrying the product.

Fishing areas are under pressure from industrial growth and the conditions previously mentioned. Through field research, current fishing zones were determined which are described in more detail in Appendix 5Z.

Open sea fishing generally takes place far from the coastline, in an area ranging from the coastline to the area of the current port, as shown in Figure 5.47. In the area where the Project will be located, there is fishing by boat, as well as lobsters and oysters. The latter is done without a boat.

There are so-called "tuberos" who use pneumatic floats and swim up to 3 km offshore to obtain products mainly oysters and lobsters manually. They are active in the area near the Project, so their activities could be affected by it. The following were identified:

- 6 oyster fishermen, working in the near-shore areas swimming / shallow diving; and
- 51 "Tuberos" fishermen use floats as a means of fishing up to a few kilometers from the coast. The Tuberos, as they are known, have the habit of swimming to the nearby buoys (such as the Cenergica buoys), where they can tie and fish.

During the consultations with people in the community, other workers from the fishing sector were regarding the Artisanal Fishing Sector. These areas are shown in Figure 5.48.

5.4.2.3.4 Agriculture and Livestock

Agriculture and livestock, as a whole, are the second greatest source of employment and income generation in the town of Acajutla. In proportional terms, about one in four people of working age (23.4%), were engaged or employed in food production or processing activities.. Of the total of those working in agriculture, 4,666 were men and 252 were women. This unbalanced composition indicates an implicit division of labor by sex in the family nuclei.

It can be noted that for this activity, the lowest levels of income are recorded in the municipality, with $92.84 dollars average per month for day laborers, slightly more than half of the average incomce of $178.19..

The production of basic grains in the Municipality and in comparison with others are summarized in the following Table 5.75.

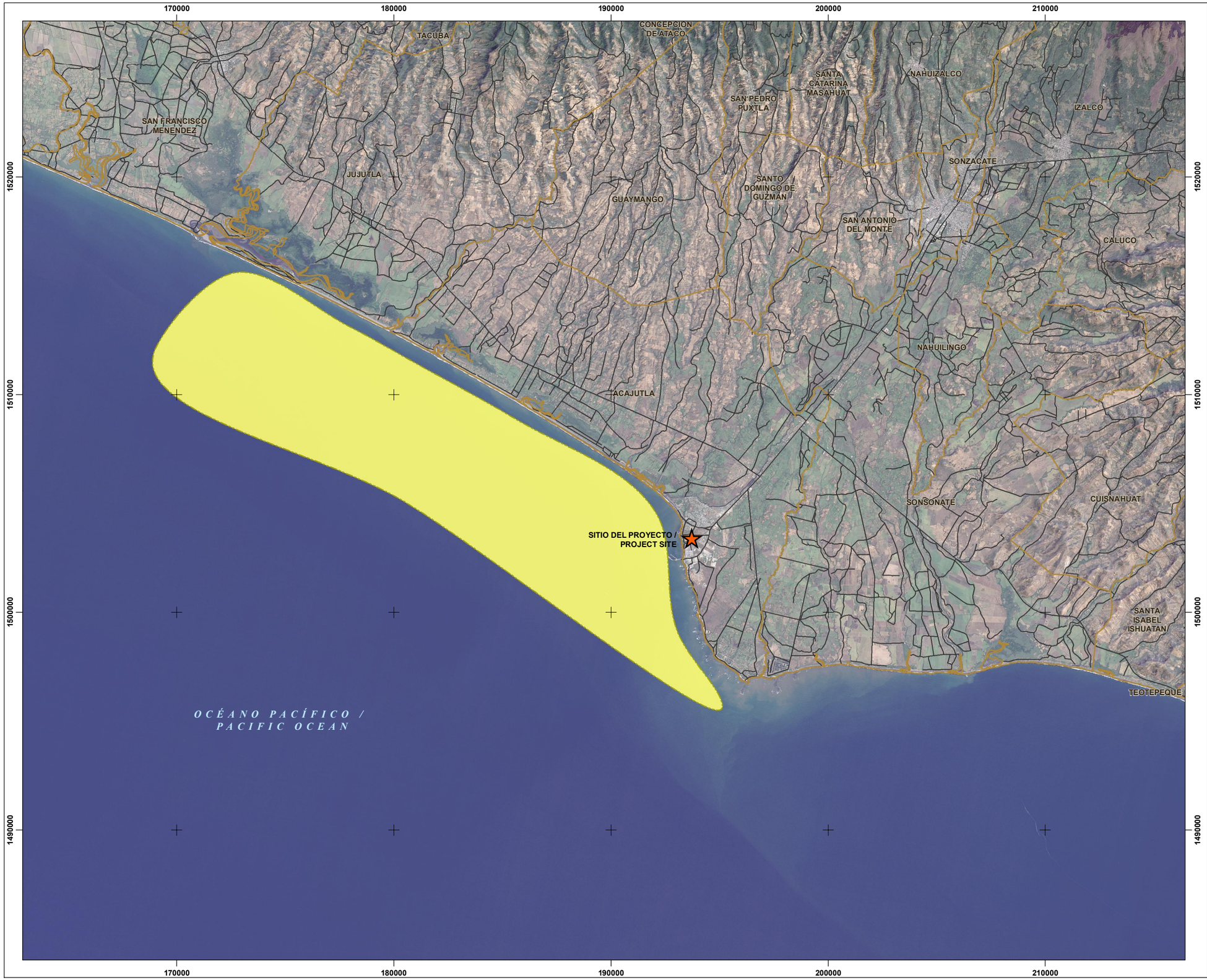
Table 5.75 – Basic Grain Production in Sonsonate Pacific Territories

Municipality	Corn		Beans		Sorghum		Rice	
	Production (QQ)	MZ	Production (QQ)	MZ	Production (QQ)	MZ	Production (QQ)	MZ
Santo Domingo de Guzmán	37,050	843	132	11	18,165	655		
Sonsonate	103,198	2,527	1,436	145	25,647	1,140	857	13
Acajutla	104,870	2,707	256	24	47,701	1,984	147	2
San Antonio del Monte	30,526	723	214	25	11,729	470		
Nahuilingo	19,028	517	482	45	3,802	173	50	1

Source: IV Censo Agropecuario 2008

The municipality of Acajutla stands out for its greater production of corn and sorghum in the territory. And is second place in rice production and the third place in bean production, positioning itself in one of the highest global national place of basic grains production.

As presented in Table 5.76. Acajutla has little production of sugar cane but has a high production of fruit trees in the Pacific territory of Sonsonate as also shown in Table 5.76.



Energía del Pacífico

ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

ZONAS DE PESCA GENERALES / GENERAL FISHING AREAS

FIGURA 5.47 / FIGURE 5.47

- SITIO DEL PROYECTO / PROJECT SITE
- VIAS / ROADS
- ZONAS DE PESCA GENERALES / GENERAL FISHING AREAS
- LÍMITES MUNICIPALES / MUNICIPAL BOUNDARIES

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FUENTE / REFERENCE
MISIÓN DE MAPEO / MAPPING MISSION (SRTM)
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MAPA CREADO POR / MAP CREATED BY: PFM
MAPA REVISADO POR / MAP CHECKED BY: MW
PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONE 16 WGS84

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PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL / FINAL
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RÍO SENSUNAPÁN

MUNICIPIO DE ACAJUTLA / MUNICIPALITY OF ACAJUTLA

Boulevard 25 de Febrero

Boulevard Coronel Oscar Osorio

Avenida Obando

Carretera a Acajutla

Calle 24 de Octubre Ori

Avenida Las Carabelas

CA12S

Terminal Marítima/ Marine Terminal (FSU, FSRU and LNGC)

Pesqueria de Ostras / Oyster Fishing Area

1.99 ha

Pesqueria con Redes / Net Fishing Area

42.8 ha

Muelle Artesanal / Artisanal Port

Sitio de Acopio Temporal / Laydown Area

3.68 ha

Aprox. / Approx. 1,550 m

Tuberia / Pipeline

Temporary Construction Trestle Option "B"

Temporary Construction Trestle Option "A"

Pesqueria de Langostas / Lobster Fishing Area

Puerto de Acajutla / Port of Acajutla

Central Térmica / Power Plant Site

Central Térmica Duke / Duke Power Plant

OCÉANO PACÍFICO / PACIFIC OCEAN

Energía del Pacífico

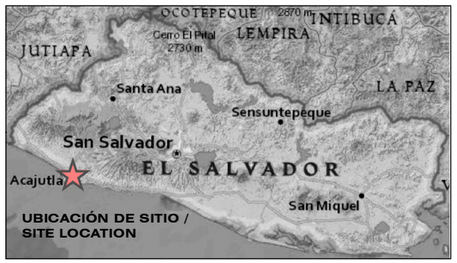
ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

AREA DE PESCA APROXIMADA PARA REDEROS, LANGOSTEROS Y OSTREROS / APPROXIMATE FISHING AREAS FOR NETTERS, LOBSTERS AND OYSTERCATCHERS

FIGURA 5.48 / FIGURE 5.48

- RUTA ACTUAL PARA PESCA / ACTUAL FISHING ROUTE
- PESQUERIA CON REDES / NET FISHING AREA
- PESQUERIA DE OSTRAS / OYSTER FISHING AREA
- PESQUERIA DE LANGOSTAS / LOBSTER FISHING AREA
- SITIO DEL PROYECTO / PROJECT SITE
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA



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FUENTE / REFERENCE
VISIÓN DEL MUNDO 2 IMÁGENES DE ALTA RESOLUCIÓN / WORLDVIEW 2 HIGH RESOLUTION IMAGERY (2014-02-12)

MAPA CREADO POR / MAP CREATED BY: PFM
MAPA REVISADO POR / MAP CHECKED BY: JF
PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONE 16 WGS84

ARCHIVO / FILE:
I:\GIS\163489 Acajutla\GIS\MXDs\Reporting - 2016\5-48 - Fishing Areas.mxd

PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL / FINAL
FECHA / DATE: 12/7/2016

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Table 5.76 – Production of sugar cane and fruit trees				
Municipality	Sugar Cane		Fruit trees	
	Production (ton)	MZ	Production (QQ)	MZ
Santo Domingo de Guzmán	1,200	20		
Sonsonate	462,508	6,047	26,064	144
Acajutla	28,991	371	36,678	276
San Antonio del Monte	7,220	83	3,456	12
Nahuilingo	122,864	1,860	2,377	65

Source: IV Censo Agropecuario 2008

Acajutla has the largest number of birds and is second place for cattle, pigs and rabbits production, as shown in Table 5.77.

Table 5.77 – Livestock production in the Sonsonate Pacific territory				
Municipality	Birds	Cattle	Pigs	Rabbits
	Units	Units	Units	Units
Santo Domingo de Guzmán	1,292	2,032	210	27
Sonsonate	18,802	20,203	4,201	288
Acajutla	343,198	16,191	3,953	67
San Antonio del Monte	8,849	1,534	2,425	
Nahuilingo	3,815	4,837	161	

Source: IV Censo Agropecuario 2008

5.4.2.3.5 Port of Acajutla

The Port of Acajutla, also known as "La Puerta del Pacífico", is one of the most modern ports in the Pacific Ocean. It is one of the most important trade and industry points in the country today being the point of embarkation and disembarkation to destinations such as the United States, Europe, Asia, and other countries.

The Port of Acajutla consists of an access pier and three jetties called A, B and C. Along the access pier and jetty B, specialized equipment for bulk cargo are installed. It has a loading and unloading unit and a Conveyor belt for import and export. See photo 5.44. It also has a buoy system used for mooring tankers, that supplies fuel terminals, capable of serving ships of 12 meters' draft. The port has a total land area of 110.16 Ha., consisting of:

1. Docks:
    - Dock A;
    - Dock B; and
    - Dock C.

2. Storage areas:
    - storage;
    - Storage for import / export solid bulk;
    - Vehicle yard; and
    - Container yard.

3. Scales:
    - Mechanical floor scales and 5 rolling machines; and
    - Digital bridge scales.

Photo 5.54 – Puerto de Acajutla

Source: www.verfotosde.org/el-salvador/imagenes-de-Acajutla

The port receives between 58 and 70 ships per month, having had an average of 65.16 ships per month in 2013. The land owned by CEPA is used for the temporary storage of the different goods that pass by. Inside the grounds are fuel and lubricant terminals, storage of grains, parking of drags and trucks, among others.

The areas of the Port of Acajutla in the sea that are used for the operations of the port are presented in Figure 5.49, which shows its location in relation to the location of the elements of the Project at sea. The elements are described:

1. Roadstead of the Acajutla Port: This is an area established around a landing buoy from which a radius of 1000 m is drawn for the delimitation of this area.
2. Waterway Access Channel: This area is consitutye in the union of the port of the port with the diameter of the operational dock with a width of 330 m
3. Operational dock: consisted of the projection of springs A, B and C to intercept with a radius dock of 165 m located with the coordinates X = 408900.234 Y = 273402.736.
4. Maritime shelter: The maritime shelter is part of the projection of the land of the port precinct on land projected until it intersects with the junction of the access channel to the

basin and the tangent of the dock of r = 165 m to the north and with the limit of Area of circulation that links the docks A and B to the south.

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1505000 1504000 1503000 1502000 1501000

RÍO SENSUNAPÁN

MUNICIPIO DE ACAJUTLA / MUNICIPALITY OF ACAJUTLA

Boulevard 25 de Febrero

Boulevard Coronel Oscar Osorio

Avenida Obando

Calle 24 de Octubre Ori

CA12S

Área Restringida de Boyas (ConexiónTuberia) / Mooring Restricted Area (Pipeline Connection)

Terminal Marítima/ Marine Terminal (FSU, FSRU and LNGC)

Tuberia / Pipeline

Muelle Artesanal / Artisanal Port

Sitio de Acopio Temporal / Laydown Area

Central Térmica / Power Plant Site

Rada de Puerto de Acajutla / Port of Acajutla Maneuvering Area

Canal de Acceso a la Dársena / Channel Access to Port

Temporary Construction Trestle Option "B"

Temporary Construction Trestle Option "A"

Resguardo Marítimo / Shelter Area

Terreno Propieda de CEPA / CEPA Property

Port Exclusion Area

Puerto de Acajutla / Port of Acajutla

Área de Separacion Requerida Puerto de Acajutla / Acajutla Port Restriction Area

Cerpa Dársena Operativa / Port Operational Area

OCÉANO PACÍFICO / PACIFIC OCEAN

Energía del Pacífico

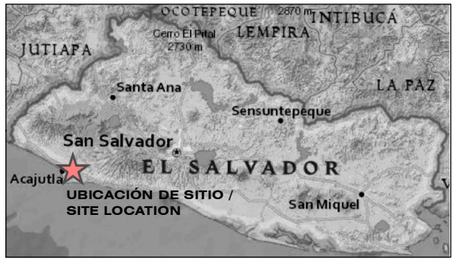
ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

ELEMENTOS MARÍTIMOS (ACTUAL) (OPERACIONES) / MARITIME ELEMENTS (EXISTING)

FIGURA 5.49 / FIGURE 5.49

- TUBERIA ACTUAL / PIPELINE EXISTING
- ÁREA DE SEPARACION REQUERIDA PUERTO DE ACAJUTLA / ACAJUTLA PORT RESTRICTION AREA
- ÁREA RESTRINGIDA DE BOYAS (CONEXIÓN TUBERIA) / MOORING RESTRICTED AREA (PIPELINE CONNECTION)
- TERRENO PROPIEDAD DE CEPA / CEPA PROPERTY
- CANAL DE ACCESO A LA DÁRSENA / CHANNEL ACCESS TO DOCK
- RADA DE PUERTO DE ACAJUTLA / PORT OF ACAJUTLA MANEUVERING AREA
- RESGUARDO MARÍTIMO / MARITIME SHELTER
- CERPA DÁRSENA OPERATIVA / PORT OPERATIONAL AREA
- SITIO DEL PROYECTO / PROJECT SITE
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA



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PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONE 16 WGS84

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PROYECTO / PROJECT: 14-9114
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FECHA / DATE: 12/8/2016

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5.4.2.3.6 Human Development Index:

The 3 indicators that measure the dimensions that make up the Human Development index for the Municipality of Acajutla for 2009 are:

- Life expectancy of 70.50 years;
- Literacy rate with 77.9%; and
- a per capita GDP of US $ 6,364.70

Based on the above indicators, a Human Development Index (HDI) of 0.717 is obtained. A result positioning Acajutla municipality in position number 58 (in positions of downward indicators), of the 264 municipalities. In comparison the department of Sonsonate has an HDI of 0.731 compared to the national HDI average of 0.708.

Other important socio-economic indicators of the Municipality are shown in Table 5.78.

Table 5.78 – Socio-Economic Indicators of the Municipality of Acajutla

Socio-Economic Indicators	Total	Urban	Rural	Male	Female
Number of people	52,359	25,237	27,122	25,561	26,798
Number of households	12,473	6,486	5,987	8,608	3,865
Average schooling (in years)	4.6	5.4	3.9	4.9	4.4
Adult literacy rate (older than 15 years)	77.9	84.2	71.6	82.1	74.1
Gross enrolment ratio preschool (ODM)	37.1	39.4	35.2	35.4	39.1
Gross enrolment ratio elementary (ODM)	87.0	91.7	83.0	88.1	85.7
Gross enrolment ratio middleschool (ODM)	26.1	36.3	17.9	26.3	25.8
Percentage of people receiving Remittances	8.3	10.7	6.0	6.6	9.0
Percentage of households with housing deficits	41.9	27.0	58.0	na	na
Percentage of households with access to Water (indoors)	51.7	73.6	28.0	na	Na
Percentage of households with access to Lighting	82.6	90.3	74.4	na	Na
Percentage of households with access to Garbage collection services	28.7	49.1	6.6	na	Na
Percentage of households with Sewerage sanitation	44.9	68.8	19.1	na	Na
Percentage of households with Internet service	0.8	1.4	0.2	na	Na
Percentage of households with Phone service	24.0	36.2	10.7	na	Na

Source: USAID/SACDEL 2012.

5.4.2.3.7 Trade and tourism

The trade in the area is varied and is basically located around the central market of the city providing various supplies for the local population, without any type of specialty. As well, informal commerce is dispersed in the surrounding area of the market and at the bus terminal, as well as along the main streets and avenues.

Also of note near the City of Acajutla, is coastal tourism development that consists of tourist resorts along the coast of the municipalities of: Salinitas, Las Veraneras and others, as well as the Hotel Decameron that has large inflow of internal and external tourism.

The tourist trade is located close to the beaches within the cCty. There are places with accommodation and food services. Some do not meet hygiene and sanitation standards. Nevertheless, it is also a developing area of quality restaurants and hotels and is an attraction for visitors.

Within the city and on the outskirts of the City there is a great variety of shops, bars, restaurants and pharmacies. See photo 5.55.

Photo 5.55 – Restaurant and Feeding in Acajutla

Source: www.verfotosde.org/el-salvador/imagenes-de-Acajutla

Other occasional tourist attractions are boats that occasionally arrive at the Port and are temporarily stationed for recreational or educational purposes.

5.4.2.3.8 Recreational Activities

Currently in the lands proposed for the construction staging area, park called Malecón Acaxual has been built. The park owned by CEPA was built in 2015, with the aim of offering a recreation site to its

employees and the population of Acajutla. Entrance to the park is controlled and there is an admission costs of one dollar per person and plus additional parking charges. Currently, park user volumes are low due to the entrance costs and access to the park passes through areas of the City with security problems.

5.4.3 Social Infrastructure

5.4.3.1 Access Routes

The city of Acajutla is united by the carretera delLitoral, CA-2, with the municipalities of Sonsonate, Jujutla and Guaymango. Cantons and hamlets are linked by roads to the municipal head. A branch of FENADESAL crosses the municipality. See Figure 5.50.

The Transportation, Storage and Communications services are an important for generating employment and income in the area.. This happens because the municipality is located in the most important and modern port of the country. The City of Acajutla is connected by the coast road with the municipalities of Sonsonate, Jujutla and Guaymango. Cantons and hamlets are linked by roads to the municipal head.

The Monograph on Human Development and the Millennium Development Goals (MDGs) for the Municipality of Acajutla (2006) indicate that the territory seems to be fairly articulated "outwardly" with the system of land transportation of passengers and goods by road, mainly through two roads: the Acajutla-Sonsonate-San Salvador highway and the CA-2 highway, or Litoral, which connects the western and eastern ends of the country, and ends at the borders of La Hachadura, Guatemala ; And El Amatillo, with Honduras.[13]

Acajutla possesses a privileged and strategic geographical position that strengthens it for the economic, social and industrial development. It has a port infrastructure very important for the country and the Central American region. The Port generates a series of activities that allow the implantation of the industrial zone. In addition, it is located on the shore of the Pacific Ocean, with great the natural area beaches, that could facilitate the development of a tourist circuit with other municipalities in the region. [14]
When considering the articulation within the Municipality, that is, the stretch of the network of streets and roads built to interconnect districts and hamlet; the panorama described above changes since most of the roads are in poor condition or are Inaccessible.[15]

[13] Monograph on Human Development and the Millennium Development Goals ". Municipality of Acajutla, department of Sonsonate. Page 42
[14] FISDL and PATDEL. "Participatory Strategic Plan Acajutla 2007-2011". July 2007. Page 20
[15] Monograph on Human Development and the Millennium Development Goals ". Municipality of Acajutla, department of Sonsonate. Page 42

The topography of the area influences the road system, adding as well, that most of the streets do not have any type of treatment, which causes severe damage during rainy season. However, it should be noted that the Municipality makes investments in the maintenance of the road network.[17] Within the urban area there is a very important road problem since a lot of the streets do not have any kind of surface treatment, most of them corresponding to new lotifications that have arisen in the last years, another part of the streets of the city have different types of coating treatments: cobblestone, asphalt, cement or pavement.

In the vicinity of the study area, the following transportation routes have been identified: (See Figure 5.51) See photo 5.46 to 5.50.

Table 5.79 – Streets Near the Project

Street	Description
Boulevard 25 de Febrero (obelisk)	2 circles of 7 meters wide, asphalt pavement and serves as access to the city center, current status 80%
Calle Acaxual	With varies from 7 mts to 10 mts and leads to the commercial area, type asphalt pavement, currently in poor condition
Boulever Coronel Oscar Osorio	Double circulation of 7 mts wide each, connects the container area with the city
Carretera hacia Acajutla (conexión entre Sonsonate y el Puerto)	With of 16 mts and is the most important route in the Project, it is in good condition.
Calle 24 de Octubre Poniente y Oriente	Double circulation of 7 meters wide, connects the road to the main entrance of the port

Source: Field Visits of the Consulting Team

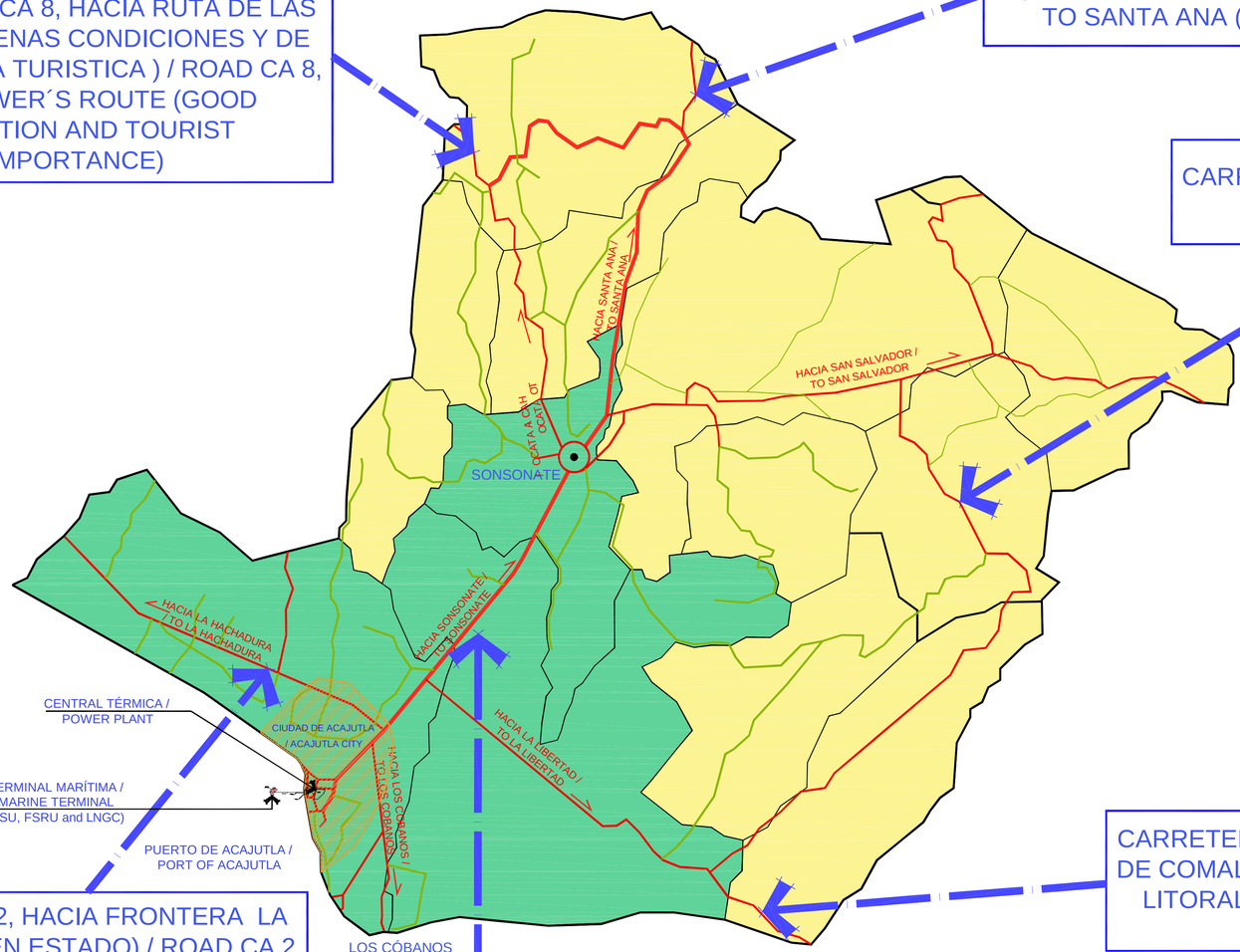
The Calle 24 de Octubre Poniente, is currently closed. The closure was done by CEPA to prevent informal housing encroachment. A few years ago an informal housing eviction was carried out in this area. As there is no current use for this route, it is closed.

[17] Íbidem. Page 21

CARRETERA CA 8, HACIA RUTA DE LAS FLORES (BUENAS CONDICIONES Y DE IMPORTANCIA TURISTICA) / ROAD CA 8, TO FLOWER´S ROUTE (GOOD CONDITION AND TOURIST IMPORTANCE)

CARRETERA CA 12, HACIA SANTA ANA (BUENAS CONDICIONES) / ROAD CA 12, TO SANTA ANA (GOOD CONDITION)

CARRETERA CA 8, (EXCELENTES CONDICIONES) / ROAD CA 8 (EXCELLENT CONDITION)



OCÉANO PACÍFICO / PACIFIC OCEAN

CARRETERA CA 2, HACIA FRONTERA LA HACHADURA (BUEN ESTADO) / ROAD CA 2, TO LA HACHADURA BORDER (GOOD CONDITION)

CARRETERA LITORAL CA 2,HACIA AEROPUERTO DE COMALAPA (EXCELENTES CONDICIONES) / LITORAL ROAD CA 2, TO COMALAPA AIRPORT (EXCELLENT CONDITION)

OCÉANO PACÍFICO / PACIFIC OCEAN

CARRETERA CA 12, HACIA CIUDAD DE SONSONATE Y CONEXIÓN A SAN SALVADOR (EXCELENTES CONDICIONES) / ROAD CA 12, TO SONSONATE CITY , AND CONECTION WITH S.S, (EXCELLENT CONDITIONS) /

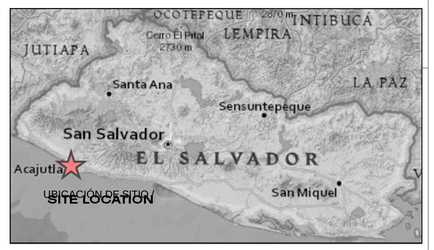
Energía del Pacífico

ENERGÍA DEL PACÍFICO
LNG TO POWER PROJECT

CONECTIVIDAD VIAL DEL MUNICIPIO DE ACAJUTLA EN LA REGIÓN / ROAD CONECTIVITY OF ACAJUTLA MUNICIPALITY IN THE AREA

FIGURA 5.50 / FIGURE 5.50

- CARRETERAS PAVIMENTADAS / PAVED ROADS
- CALLES DE TIERRA / DIRT ROADS
- LIMITE DEPARTAMENTAL / DEPARTAMENTAL LIMIT
- MUNICIPIOS / MUNICIPALITIES
- MICROREGIÓN / MICRO REGION
- SITIO DEL PROYECTO / PROJECT SITE
- CIUDAD DE ACAJUTLA / ACAJUTLA CITY



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VICEMINISTERIO DE VIVIENDA Y DESARROLLO URBANO

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MAPA REVISADO POR / MAP CHECKED BY: LF
PROYECCIÓN DE MAPA / MAP PROJECTION :
UTM ZONA 16 WGS84 / UTM ZONE 16 WGS84

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C:/CAP 5,ECO,DIBUJO 1, EL SALVADOR/ ECO INGENIEROS
C:/CAP 5,ECO,DRAWING 1, EL SALVADOR/ ECO INGENIEROS

PROYECTO / PROJECT: 14-9114
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ACCESO POR BOULEVARD CORONEL OSCAR OSORIO / ACCESS BY BOULEVARD CORONEL OSCAR OSORIO

REDONDEL DE CEPA / CEPA ROUNDABOUT

OBELISCO, ENTRADA A LA CIUDAD DE ACAJUTLA / OBELISK, ACAJUTLA CITY ENTRANCE

ACCESO POR LA CALLE 24 DE OCTUBRE / ACCESS BY OCTOBER 24 TH STREET

CALLE ACAXUAL

TERMINAL DE BUSES / BUS TERMINAL

MUNICIPIO DE ACAJUTLA / MUNICIPALITY OF ACANJUTLA

CALLE ACAXUAL

BOULEVAR 25 DE FEBRERO

CARRETERA A SONSONATE CA 12S / SONSONATE HIGHWAY CA 12S

BOULEVARD CORONEL OSCAR OSORIO

LOTE BALDÍO / VACANT LOT

CEMENTERIO MUNICIPAL / MUNICIPAL CEMENTERY

CALLE 24 DE OCTUBRE PONIENTE A APERTURAR

CALLE 24 DE OCTUBRE ORIENTE

PARQUEO DE FURGONES / TRUCK PAR LOT

SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN SITE

TUBERÍA / PIPELINE

Temporary construction trestle option "B"

Temporary construction trestle option "A"

CENERGICA (TERMINAL DE COMBUSTIBLE / FUEL TERMINAL)

SERVYGRAM (PRODUCTOS AGRICOLAS / AGRICULTURAL PRODUCTS)

CENTRAL TÉRMICA / POWER PLANT

DUKE ENERGY (CENTRAL TERMICA / THERMAL CENTRAL)

CEPA

AVENIDA LAS CARABELAS

LUBRICANTES TEXACO (TERMINAL DE COMBUSTIBLE / FUEL TERMINAL)

PUMA ENERGY (TERMINAL DE COMBUSTIBLE / FUEL TERMINAL)

BODEGAS / WAREHOUSE

FERTICA (PRODUCTOS AGRICOLAS / AGRICULTURAL PRODUCTS)

PUERTO DE ACAJUTLA / ACAJUTLA PORT

UNIFERSA QUÍMICOS INDUSTRIALES / INDUSTRIAL CHEMICALS

ALCASA ALMACENAMIENTO DE GRANOS / GRAIN STORAGE

ALMACENAMIENTO DE GRANOS / GRAIN STORAGE

OCÉANO PACÍFICO / PACIFIC OCEAN

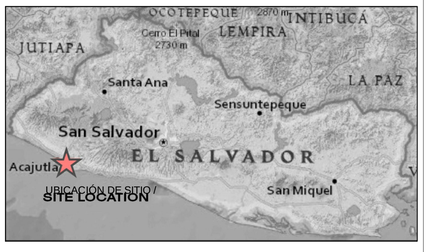
Energía del Pacífico

ENERGÍA DEL PACÍFICO
LNG TO POWER PROJECT

CALLES Y AVENIDAS MÁS PRÓXIMAS AL PROYECTO / ROADS IN THE PROJECT AREA

FIGURA 5.51 / FIGURE 5.51

	CIRCULACIÓN MAYOR / HIGHER CIRCULATION
	CIRCULACIÓN MENOR / SMALLER CIRCULATION
	ACCESO A CALLES / STREETS ACCESS
	CIRCULACIÓN MAYOR DOBLE SENTIDO, TRÁFICO PESADO / HIGHER CIRCULATION TWO WAY, HEAVY TRAFFIC
	CIRCULACIÓN MENOR, DOBLE SENTIDO, TRÁFICO PESADO / SMALLER CIRCULATION TWO WAY, HEAVY TRAFFIC
	CIRCULACIÓN MENOR, DOBLE SENTIDO, TRÁFICO LIVIANO / MINOR CIRCULATION, TWO WAY, LIGHT TRAFFIC
	CIRCULACIÓN MAYOR, UN SOLO SENTIDO, TRÁFICO PESADO / HIGHER CIRCULATION, ONE WAY, HEAVY TRAFFIC
	TERMINAL DE BUSES , RUTA 252 y RUTA 56 / BUS STATION, ROUTE 252 AND ROUTE 56
	CENTRAL TÉRMICA / POWER PLANT
	SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN SITE
	TERRENO PROPIEDAD DE CEPA / CEPA PROPERTY



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PROYECCIÓN DE MAPA / MAP PROJECTION :
UTM ZONA 16 WGS84 / UTM ZONE 16 WGS84

ARCHIVO / FILE
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C:/CAP 5,ECO,DRAWING 1, EL SALVADOR/ ECO INGENIEROS

PROYECTO / PROJECT: 14-9114
ESTADO / STATUS : FINAL / FINAL
FECHA / DATE: 09/18/2014

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Photo 5.56 – Highway to Acajutla

Source: Consulting Team

Photo 5.57 – Highway to Acajutla

Source: Consulting Team

Photo 5.58 – Acajutla Access

Source: Consulting Team

Photo 5.59 – Calle Acaxual

Source: Cnsulting Team

Photo 5.60 – Circle of intersection with Boulevard Coronel Oscar Osorio

Source: Consulting TEam

Some main bus routes provide urban transport. The most important of which are Route 52, which runs from the city center to Barrio La Playa, charging $ 0.25. This route has a number of 10 units or buses.

The transport between Sonsonate and Acajutla is carried out route N ° 252, charging $ 0.60. This route has a number of 15 units or buses. See photo 5.61.

Photo 5.61 – Route Type Unit 252

Source: Consulting Team

There is no regulation in the transport of cargo and light vehicles within the municipality. A count of light and load vehicles was performed. The one day count results are presented in Table 5.80, June 2014.

Table 5.80 – Count of Light Vehicles and Cargo

	Car and Freight Counting 8:00AM – 9:30AM				Car and Freight Counting 10:30AM – 12:00PM		
	Location Point	Type	Quantity		Location Point	Type	Quantity
ENTRY	Obelisco	Carga	35	ENTRY	Obelisco	Carga	20
		Carros	70			Carros	66
	Duke Energy	Carga	90		Duke Energy	Carga	77
		Carros	37			Carros	25
	Zona Puerto	Carga	56		Zona Puerto	Carga	100
		Carros	21			Carros	31
DEPARTURES	Obelisco	Carga	10	DEPARTURES	Obelisco	Carga	13
		Carros	75			Carros	58
	Duke Energy	Carga	51		Duke Energy	Carga	68
		Carros	41			Carros	34
	Zona Puerto	Carga	91		Zona Puerto	Carga	100
		Carros	33			Carros	38

Source: Field Visits Eco Engineers

5.4.3.1.1 Statistics on traffic accidents

There are no specific accident statistics for the Project site and for the streets that access this area. As there is a moderate flow of cargo and transit vehicles to the Port of Acajutla, the roads, therefore, have sufficient capacity for the increase of traffic that the Project can generate.

At the national level, there are available statistics on traffic accidents, including the Department of Sonsonate. More precisely, the municipality of Acajutla, within the framework of the project "Fostering coexistence and citizen security in Sonsonate", the National Road Safety Committee (CONASEVI) deepened awareness of road accidents in the municipality. With the technical support of the General Directorate of Traffic (DGT) of the Vice-Ministry of Transport, the accidents recorded by the Sonsonate PNC were mapped, facilitating the identification of critical accident points in the zone.

Accidents and victims. According to data from the PNC, in 2008 there were 321 traffic accidents in the Municipality of Sonsonate, with 146 victims. December, January and March were the months with the highest number of accidents, which suggest that there is an increase in accidents in the festive periods.

Mortality. 10% of the total deaths from traffic accidents in the country (1,204) occurred in the department of Sonsonate. In the Municipality, the rate was 44.7 deaths per one hundred thousand inhabitants (32 people), almost double the national rate (25 per one hundred thousand inhabitants).

Traffic realted deaths mainly affects men, specifically adults (87%). Minors (13%) and people over 60 are other vulnerable age groups.

Injuries. In the department of Sonsonate, 6% of the total number of people injured in the country's traffic accidents occurred. In the Municipality, there were 114 injured, of which three quarters were adult men. The 18-24 age group was particularly vulnerable.

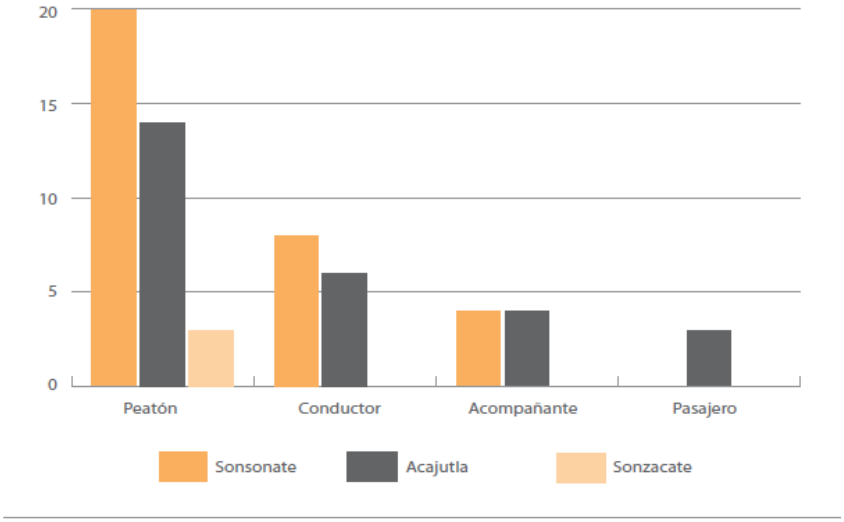
Vehicles. For about half of the accidents (43%) that occurred in Sonsonate, Sonzacate and Acajutla, the type of vehicle involved was not determined. One of the reasons could be the fact that many drivers flee the scene of the accident. Of the vehicles identified, the highest percentage corresponds to private vehicles (26%), followed by a high number of buses (11%). This last finding is particularly worrying considering that at the national level collective transport vehicles represent only 3% of the vehicle fleet.

User type most affected. When analyzing the deaths by accidents and classifying them by type of user of the route, the trend is similar to that observed at the national level**.** Pedestrians were the most affected by accidents (58%), followed by vehicle drivers (24%).

Causes of accidents. Driver distraction, disrespect to the priority signal, and lane invasion were the responsible causes for 59% of all the accidents registered in the Municipality of Sonsonate. Only 4% of accidents were attributed to pedestrian recklessness.[18] See Figure 5.52.

[18] Safe Cities Data, the experience of Sonsonate, United Nations Development Program, 2010

Figure 5.52 – Distribution of Deaths in Traffic Accidents by Type of User



Source: Departmental Delegation of the PCN in Sonsonate, 2008

5.4.3.1.2 Road Safety Plan

Due to the number of traffic accidents, a Road Safety Plan was developed with the participation of the following institutions: City Hall, PNC Transit Department, IML, Departmental Education Department of MINED and the Vice Ministry of Transportation. The objective of this plan is to reduce accidents through prevention strategies and dissemination of traffic regulations, with an emphasis on Flavián Mucci avenue of Sonsonate.

A youth network for road safety education and accident prevention was created for the most vulnerable population, 170 school guides were trained in 10 centers, institutes and schools.

Most of the measures The Monograph on Human Development and the Millennium Development Goals (MDGs) for the Municipality of Acajutla (2006) indicate that the territory seems to be fairly articulated "outwardly"have been taken at the head of the department, the City of Sonsonate. This has included anti-doping controls through toxicology tests in the areas of greatest risk as well as training of emergency personnel in hospitals and the improvement of road signals in the municipalities of Sonsonate, Acajutla and Sonzacate. More road education training is planned at all levels and more controls are proposed, especially on the Highway 12 road to Acajutla due to high traffic speeds and c its used for cargo transport with high weight and therefore high inertia.

5.4.3.2 Infrastructure for Public Health

The Acajutla health facility includes the Acajutla Community Health Family Unit, a Lions Club clinic, three laboratories, four pharmacies and an ISSS clinic. The sanitary conditions of Acajutla show a similar

profile to the rest of the department, in which poverty affects as the main problem that causes and originates the diseases; problem that is accentuated in rural areas

As in the other municipalities of Sonsonate, the demographic and social conditions of Acajutla affect the epidemiological profile. It is characterized by a high incidence of acute respiratory infections (ARI), gastrointestinal and parasitic diseases and, in general, Nutritional deficiencies diseases that are related to deficiencies in the provision of basic services (safe water, solid waste, excreta and wastewater, etc.). In recent years diseases have included the HIV / AIDS pandemic, influenza, rotavirus, dengue and others. According to data provided by the Ministry of Public Health and Social Welfare (MSPAS), incidence rates of classic dengue fever and hemorrhagic dengue fever in Acajutla are slightly higher than those reported in most other municipalities in Sonsonate, and higher than the average rates reported for the whole country.

Similarly, Acajutla had a higher malaria incidence rate than several other municipalities in the Department, but lower than the national average.

In the area of preventive health, one of the problems that most affect the health situation of the population is child malnutrition.

Detailed information on the health aspects is found in Appendix 5AA - Health.

5.4.3.3 Infrastructure for Drinking Water, Sewage and Garbage Collection

For the year 2007, at the municipal level, only 51.7% of the households had access to the water service in the house; this correlates to 73.6% for the urban area and 28% for the rural area. Acajutla has a relatively low coverage of drinking water, especially for rural dwellers.

With regard to basic sanitation,. only 44.9% of households have access to sewerage sanitation; 68.8% of households in the urban area have this service and only 19.1% in rural areas have this service.

The proportion of households that have access to garbage collection services is 28.7%; In other words,, more than 70% of households do not have access to this service. There are 2 public garbage dumps within the municipality that services a total of 5,432 houses (4,548 houses in an urban area and 884 houses in a rural area). Other garbage disposal systems available for 122 urban households and 2,992 rural households for a total of 3,104 households.

The following data are available for the potable water service in households by pipeline or public service, in Table 5.81.

Table 5.81 – Sources of Drinking Water Supply

Municipality	Total	Pipeline Inside Housing	Pipeline outside but within the property	Neighbor's pipeline	Public Pile or Jet
Santo Domingo de Guzmán	1,563	529	1,034	16	16
Sonsonate	17,762	11,151	932	139	399
Acajutla	12,473	5,759	694	181	325
Nahuilingo	2,498	2,864	5,621	867	224
San Antonio del Monte	6,458	4,122	1,323	210	77
TOTAL	**40,754**	**24,425**	**9,604**	**1,413**	**1,041**

Source: Census 2007

There are also 4,571 homes that have access to water service from other sources, such as artesian wells.

Acajutla has 46.17% of dwellings with access to plumbing inside the house, which is below the average for the area. and 5.5% of households with water pipes inside the property, also below the average of the zone. Finally, the average of neighboring water supply pipes is 1.45%. The data on access to health services of different types for the specified totals of households are given below in Table 5.82.

Table 5.82 – Access to Health Services

Municipality	Total	Toilets Connected to Sewer	Toilet Connected to Septic Tank	Latrine	composting latrines	Not available
Santo Domingo de Guzmán	1,563	78	109	1,073	61	242
Sonsonate	17,762	8,646	2,234	3,075	2,372	1,435
Acajutla	12,473	2,872	2,733	4,139	1,461	1,268
San Antonio del Monte	6,458	2,761	1,276	2,148	162	111
Nahuilingo	2,498	1,004	583	433	313	165
TOTAL	**38,256**	**15,361**	**6,935**	**10,868**	**4,369**	**3,221**
%		**38**	**16**	**40**	**1**	**4**

Source: Census 2007

The land where the Project is located does not have piped water service. The industries in the area have their own well for water supply, including the Port.

5.4.3.4 Infrastructure for Energy

In the Municipality of Acajutla, the CLESA Company provides electricity service, with a coverage of 90% urban electrification and 65% rural electrification. There is street lighting in the rural area. In addition, there is a company generating electricity from diesel, but not for the consumption by the municipality. The number of households with access to electricity in the neighbouriong municipalities is presented in Table 5.83.

Table 5.83 – Table of Municipalities and Access to Electricity

Municipality	Number of Homes			Electricity		
	Total	Urban	Rural	Total	Urban	Rural
Santo Domingo de Guzmán	1,563	529	1,034	1,191	510	681
Sonsonate	17,762	12,663	5,099	15,081	11,973	3,108
Acajutla	12,473	6,486	5,987	10,308	5,854	4,454
Nahuilingo	2,498	4,963	1,495	5,417	4,572	845
San Antonio del Monte	6,458	1,815	683	2,015	1,658	357
TOTAL	**40,754**	**26,456**	**14,298**	**34,012**	**24,567**	**9,445**
%				**83**	**93**	**66**

Source: Census 2007

The percentage of electricity coverage in Acajutla urban area is 90.26%, only 3 points below the average of the nearby municipalities, compared to the Rural area has a 74.39%. With respect to the Rural area, it has a 74.39%, which exceeds in more than 8 percentage points the average of the area.

As for electric lighting, 82.6% of all households have or have access to this service.

5.4.4 Cultural, Archaeological, Ceremonial and Historical Resources

5.4.4.1 Cultural Resources

Acajutla, is a municipality rich in legends and beautiful beaches. Every year attracts many tourists, who like to visit especially the port of Acajutla, which is considered the bridge with the rest of the world.

Acajutla dresses up, celebrating its patron saint's feasts in honor of the Holy Trinity, from 6 to 15 June. Local authorities organize a craft fair as well, as well as an artistic presentation, per day, at the premises of the House of Culture. It is also celebrated the coronation of the queen of the patron saint festivities.

June 15 is the day of the Holy Trinity. That day a mass is celebrated, then at 6:00 p.m., the main streets of the city are crossed with the image of the Holy Trinity. At 9:00 p.m., gunpowder is burned from the Botanical Park.

5.4.4.2 Archaeological, Paleontological and Cultural Resources

In the Project area there are no archaeological or paleontological sites identified. With regard to cultural heritage, the Ministry of Culture (SECULTURA) has identified eight buildings or sets of facilities that form the cultural heritage of Acajutla. Among these is the complex of port facilities. It includes the ruined structure of the first building-fortress and the facilities and warehouses of the old port. As part of this inventory are the port police building, built in the second quarter of the last century to house the port

guard and the wineries of the railway station, popularly known as "Bodega San Rafael", built in the first Years of the last century. It has been out of use for several years. Included are five other private homes of great architectural beauty, whose construction dates back to some years after 1955 and are supposed to be inhabited by their current owners.

Figure 5.53 shows the most relevant cultural resources near the Project site.

Energía del Pacífico

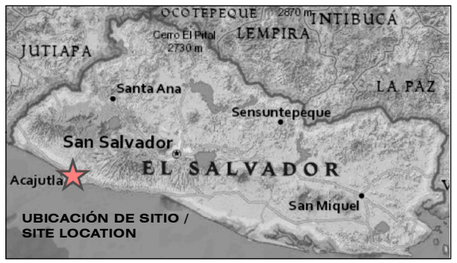
ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

SITIOS PATRIMONIO ARQUEOLÓGICO Y CULTURAL / ARCHAEOLOGICAL AND CULTURAL SITES

FIGURA 5.53 / FIGURE 5.53

- SITIOS PATRIMONIO ARQUEOLÓGICO Y CULTURAL / ARCHAEOLOGICAL AND CULTURAL HERITAGE SITES
- SITIO DEL PROYECTO / PROJECT SITE
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA



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FUENTE / REFERENCE
VISIÓN DEL MUNDO 2 IMÁGENES DE ALTA RESOLUCIÓN / WORLDVIEW 2 HIGH RESOLUTION IMAGERY (2014-02-12)

MAPA CREADO POR / MAP CREATED BY: PFM
MAPA REVISADO POR / MAP CHECKED BY: MW
PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONE 16 WGS84

ARCHIVO / FILE:
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PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL / FINAL
FECHA / DATE: 12/7/2016

DILLON CONSULTING

ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

PAGE FOR PRINTING

Table 5.84 Shows the inventory of properties with cultural value of the municipality of Acajutla.

Table 5.84 – Inventory of Properties with Cultural Value

Name	Description of Property	Category	Construction date	Construction system
Complex of port facilities	Administrative buildings, warehousing, transportation, loading and unloading and housing. In addition, structures in the ruins of the first facilities of the port. Streets and paths with asphalt pavements. Perimeter gardens, guest houses and protection areas bordering the beach.	Historic centre	1959 -1969	Concrete block, concrete structure l and steel
Police Port	Building with neocolonial stylistic tendency. It includes architectural details and ornaments. It is distributed on two levels of floor and has terrace or roof on the west facade. Ceiling distributed in multiple waters.	Relevant monument	1930 -1955	Clay Brick and Concrete Frames.
Isolated Property	Building with neocolonial stylistic tendency. It has decorative details. Distributed on two levels of floor with terrace in south and east facade. Roof distributed in multiple waters, supported by wooden armor with mud cover.	Relevant monument	After 1955	Clay Brick and Concrete Frames
Isolated Property	Building with an architectural tendency of the modern period, with an emphasis on the international style. Predominance of the horizontal and vertical straight line. Volumetric distribution in two levels of floor.	Relevant monument	After 1955	Clay Brick and Concrete Frames
Isolated Property	Modern trend building with emphasis on current international stylist. Predominance of vertical and horizontal straight line; Details and sober textures.	Relevant monument	After 1955	Clay Brick and Concrete Frames
Isolated Property	Building with trend of modernist movement with rationalist emphasis. It has straight lines, wide spans, wide facade framed by a slender porch that supports the roof and deck.	Relevant monument	Después de 1955	Ladrillo de barro y marcos de concreto

Table 5.84 – Inventory of Properties with Cultural Value				
Name	**Description of Property**	**Category**	**Construction date**	**Construction system**
Isolated Property	Ecliptic building with stylistic details of modernist and neocolonial influence. Framed by a series of semicircular arcades. Distributed on two levels of floor.	Relevant monument	Después de 1955	Clay Brick and Concrete Frames
Warehouses of the railway station	Building built as a winery to the railroad station of Acajutla. It is built of uncoated clay brick. The architectural plan describes a semicircle, with doors on the south and north facades. The vaults are escarsanos arcs and carpentry in its doors. The cover is made of foil.	Relevant monument	1900 -1930	Clay brick masonry

Source: Own elaboration 2014.

None of these structures will be affected by the construction of the Project.

As part of the monitoring for the conservation of cultural sites and due to the closeness of the Old Port located at the CEPA facilities, a request for inspection and resolution was made by SECULTURA, which expresses its non-objection to the construction of the Draft. See Appendix 5AB.

5.4.4.3 Monuments

5.4.4.3.1 Monument to the locomotive "La Burrita"

In 1882 the railroad came to Acajutla and El Salvador.

In the 1950s, the locomotive was a machine that operated by steam (water and firewood), lit with firewood, with about 50 slits that were cut to the size of the oven. It transported coffee from the San Roque and San Rafael warehouses. The locomotive (called “burrito”) pulled the cartloads of coffee, El Salvador's main export product, for many years, each cart carrying 100 sacks of coffee and pulling 5 carts.

Because of the amount of cargo it pulled, it was called "La Burrita", this locomotive was manufactured in 1808.

A monument was recently built, where it rests to be displayed to all who enter our city. La Burrita, is part of the port’s heritage, marks the era of the development of rail transport of El Salvador and symbol of the industrial development of the Port of Acajutla.

5.4.4.3.2 El Obelisco Monument

El obelisco, is a monument that is at the entrance of Acajutla, just in front of the road that leads to Sonsonate. Built in 1968 to name city to the port of Acajutla. See photo 5.62.

Photo 5.62 – El Obelisco

Source: www.panoramio.com

5.4.4.4 Ceremonial and Historical Aspects

5.4.4.4.1 Ceremonial Aspects

Although the main thread of the history and culture of Acajutla is determined, mainly by its role as port, there is in its collection a rich vein of religious and cultural traditions.

Apparently, most of its inhabitants profess the Catholic religion. This implies the uses and customs of a calendar of several festivities. The Holy Week is celebrated with events close to the Catholic liturgy, without popular exhibitions. Later, every May 3 there are family celebrations dedicated to the Day of the Cross. In some houses, a small altar with a cross, decorated with scraps of paper, flowers and fruit, is often improvised in the courtyard. From the night before, friends and children come to worship the cross and share the fruit.

A religious landmark of prime importance are the patron saint feasts of May 23, consecrated to the Holy Trinity. Supposedly on that date, Don Pedro de Alvarado ordered a mass in his honor when the ships built for his planned expedition to the Maluku Islands were completed. These celebrations are organized by a committee composed of local authorities, companies from the industrial area and notable people of

the community. Some years ago a variety of popular contests were set up. The "tunco encebado" consisted of the persecution of pigs greased with fat to make difficult their capture; The "palo encebado" consisted of climbing a vertically placed round log, about five rods high, also greased, in order to reach the money or the prize placed at the top. In addition, gala dances were performed with disguises and street dances with masked people, called "los viejos", who danced in the streets of the town with marimba music.

Nowadays, among the most outstanding events of the general program of the festivities are the "alboradas". With band music and gunpowder burning; The so-called "desfile del correo", which announces the beginning of the festivities and enlivens characters with snitches, band music and gunpowder burning. The carriage ride of the queen of the festivities and the crowning ball of the same; The installation of a fair of mechanical rides or "ruedas" recreational. The parades of floats with the queens of barrios and colonies; The popular dances. These are typical activities of the patron celebrations held in the majority of municipalities of the country.

The feast of October 24th is dedicated to St. Raphael the Archangel, patron of the fishermen of Acajutla. According to tradition, he is the protector of the guild by having miraculously restored his sight to a blind man, with a remedy extracted from a fish. The most traditional act of this day is a nocturnal procession of boats in the sea, carrying the image of the saint in one of them, adorned with flowers and spotlights of colors. The celebration culminates with a mass and burning of gunpowder. This seeks to obtain the blessing of the waters from which they draw sustenance and protection from the dangers. During the day a regatta and a children's party are organized for the children of the fishermen.

5.4.4.4.2 Historical data

The present city - port of Acajutla had its origin in indigenous settlements, Yaquis or pipiles, with marine vocation, located in the right margin of the Centzunat or Rio Grande de Sonsonate. The name of this pre-Columbian population appears written in different ways in the colonial documents of the sixteenth century, sometimes as Acaxutla, now as Caxocal. But undoubtedly the correct form of his writing is Acayutla, since this toponímico comes from the words "acat" - cane, carrizo, vara, bushes, bush, ayut "- tortuga" and "tla", locative suffix. At the time, its etymology is "place of turtles and woods."

Acajutla was "discovered" by Don Pedro de Alvarado in the year 1524, commander of the Spanish expeditionary body arrived in Central American lands. Its settlers were the first natives to resist the invasion. Even oral traditions mention precisely his boss, Prince Atonal or "sun of water," to be who in battle struck with an arrow to Pedro de Alvarado, leaving him disabled for the rest of his life. From 1540 to 1558, Acajutla was the seat of the mayor of the region. Afterwards, the authorities moved to the Villa de la Santísima Trinidad, now the city of Sonsonate 50. The port established in Acajutla served as a vital piece in the foreign trade system of the vast Spanish empire. In the old marine Tables he was referred to

under the name of San Luis de Acajutla. Together with Realejo, they were the only two ports to be used by the Crown to link trade routes in the Pacific Ocean. During the colonial period, cocoa, balsam, species and fruits were exported from it to New Spain -Mexico- and Peru.
On December 10, 1831, Acajutla was declared a Port of the Central American Republic, with its consequent population, productive and infrastructural growth and development. In 1835 that title was conferred to the Port of La Libertad. In 1852 the Salvadoran government decided to build a new wooden pier, and the construction of customs and warehouses. In 1869 the services of construction of an iron pier were contracted, having come to work in 1871. This event was accompanied by the creation of a municipality in the Port of Acajutla. It was thus as in the administration of the Licentiate Francisco Dueñas and by legislative decree of 19 of January of 1871. Erected in town the village of the Port of Acajutla, and was given by Cauta to the borders of the Hacienda Tonalá, covering the haciendas of El Sunza, El Coyol, Hacienda Nueva, El Zope and Los Cobanos sites. He was awarded the title of city on February 17, 1967.

Acajutla, which was already Municipality, lost this distinction in 1560, regaining it again in 1853, being abolished a year later because of a lack of neighbors, with skills to hold the office of the municipality.

During that time in Acajutla there were no temples, much less resident priests.

Having the few inhabitants of that time, to travel to Sonsonate for their Cults, Baptisms and Marriages, or having to wait for some other mission that by order of the Bishop will be inaugurated, consisting in the visit of Priests who came Preaching the Repentance, the Conversion and the Arrangement of Families that lived just like that, without the blessing of the Sacrament of Marriage.

The first Catholic Temples that were built in Acajutla, and its surroundings were the church of El Barrio, El Campamento dedicated to San Francisco de Asis (today called "San Juan Maria Vianney"), the church of Metalio and also a Oratorio Built in the lands Of the Cementera (called "Maria Estrella de Mar"). Today this temple that was well adorned, serves as a cellar in the grounds of CEPA.

5.4.4.4.3 Places of cultural interest

According to the House of Culture of the municipality of Acajutla, there is no site of great cultural interest within the municipality, but there are certain cultural groups that are located outside the municipality, who have some type of cultural identification in the area, Such as cultural activities and ceremonial traditions, which are held in places of interest within the municipality, among these places:

- **El Mirador del Parque de Acajutla**: It is a place identified for the development of different cultural activities developed by some indigenous communities in the area, including celebrations such as "Dia de la Cruz", "Día de La Resistencia indígena" and " Día de La

Hispanidad". This park is important because it has historically been recognized as a Ceremonial Center for being considered the highest point of the city of Acajutla, and for its disagreement with the prevailing topography of the city that is relatively flat.

- **Los Cerritos**: It is believed that there are mounds or archaeological vestiges
- **Areas near the rivers**: Mainly in the vicinity of the communities Atarraya, La Coquera, Barrio La Playa, and near San Pedro de Belén in the canton Suncita, where some vestiges have been found, consisting of pieces carved in stone.

None of these are expected to be affected by the Project.

5.4.5 Land Use

5.4.5.1 Potential Land Use

Acajutla presents very particular and special characteristics that differentiate it from the rest of the municipalities of the Region. It is a port city, which emerged in the decade of the 1950's, with zoning of different land uses, a network of large boulevards, which did not reach the desired success. Its port-industrial potential has not been tapped as expected and its potential as the capital of the West Coast has not been fulfilled.

According to the "Territorial Development Plan", prepared by the MOP / FISDL, in 2008,[19] Acajutla presents different characteristics to the other cities in the Region and presents great potential for port, industrial and tourist development, the management proposal is based on four fundamental criteria:

- The first is the use of its industrial potential to provide complementary activities to the Port; as well as logistical activities related to transportation.
- The second is the use of tourism potential for the existence of the coastal area which is of great value
- The third is the reclassification and consolidation of the large estates to develop housing projects with housing built with all services, equipment and good connectivity.
- The fourth is to take advantage of its city-port characteristics for the provision of specialized equipment related to marine activity.

Within the city, there is a need for urban renewal of old spaces and to improve the conditions or relocation of some housing communities.

[19] TERRITORIAL DEVELOPMENT PLAN FOR THE REGION OF SONSONATE, MUNICIPAL ANNEX 5
Synthesis of the Territorial Development Plan for the Municipality of Acajutla. Fifth Report: Final Report, May 2008 prepared by STUDIES, PROJECTS AND PLANNING S.A. (EPYPSA), for FISDL / MOP

Figure 5.54 presents the current and projected use plan of the partial plans of the Territorial Planning Plan. This plan is currently being used to grant place qualification permits.

The meaning of the nomenclature on the map is detailed:

5.4.5.1.1 Consolidated Urban TErritory

The consolidated urban land in Acajutla is easily identifiable due to the compact development of the oldest sector. It is made up of about 676.37 ha and is delimited from the edge of the Sensunapán River in a southerly direction to the industries of the Port of Acajutla.

5.4.5.1.2 Non- Consolidated Urban Territory

The non-consolidated urban land is considered to be the closest settlements to the city, on the other side of the River Sensunapán. The unconstrained urban land consists of 556.80 ha of which 536.02 ha correspond to the large El Milagro, San Pedro El Cañal, north of the city and across the Sensunapán river; The La Atalaya, next to CA-12 and CA-2, and Las Brisas, between CA-2 and the street that leads to El Coyol.

Currently Acajutla is the municipality that has experienced the most growth in the Region. The size of its growth is defined especially by the existence of two large lotifications that make up a single body, El Milagro and San Pedro El Cañal. They have developed in an area with great potential for intensive use and are very disintegrated from the current city. You enter these two estates by the Litoral road, very close to the Kilo 5, together make up the most extensive lotifications in the country.

5.4.5.1.3 The rural Territory

It includes intensive, extensive and forested soils, covering all irrigable plains and susceptible to irrigation. This soil is classified into three sub-categories: Soils for intensive agriculture: with sugar cane crops, basic grains, vegetables and livestock. It is very abundant in the Region. Soils for extensive agriculture: these are associations of classes IV, V, VI and VI with limitations of depth, drainage, surface stoniness, salinity or unfavorable textures, with slopes of 15.25% and Forest Soils: they are divided into two modalities. The first is the soil with the ability to produce shade coffee, the other mode is ideal for forestry production with economic and protective purposes, since most soils present high limitations for technical agricultural production, due to the high slopes and stoniness.

5.4.5.1.4 Land not liable for development

These are lands restricted from urbanization and defined for the conservation of environmental, cultural and / or high restrictions for habitat use due to susceptibility to natural hazards and / or located in headwaters of watersheds that must be protected against possible negative impacts or reserved for infrastructures of high importance. It is divided into three sub-categories: Natural Protected Areas; Land

Susceptible to Risks, and Soils Identified as a Reserve for the Infrastructure of National or Regional Interest

5.4.5.1.5 Urban soil

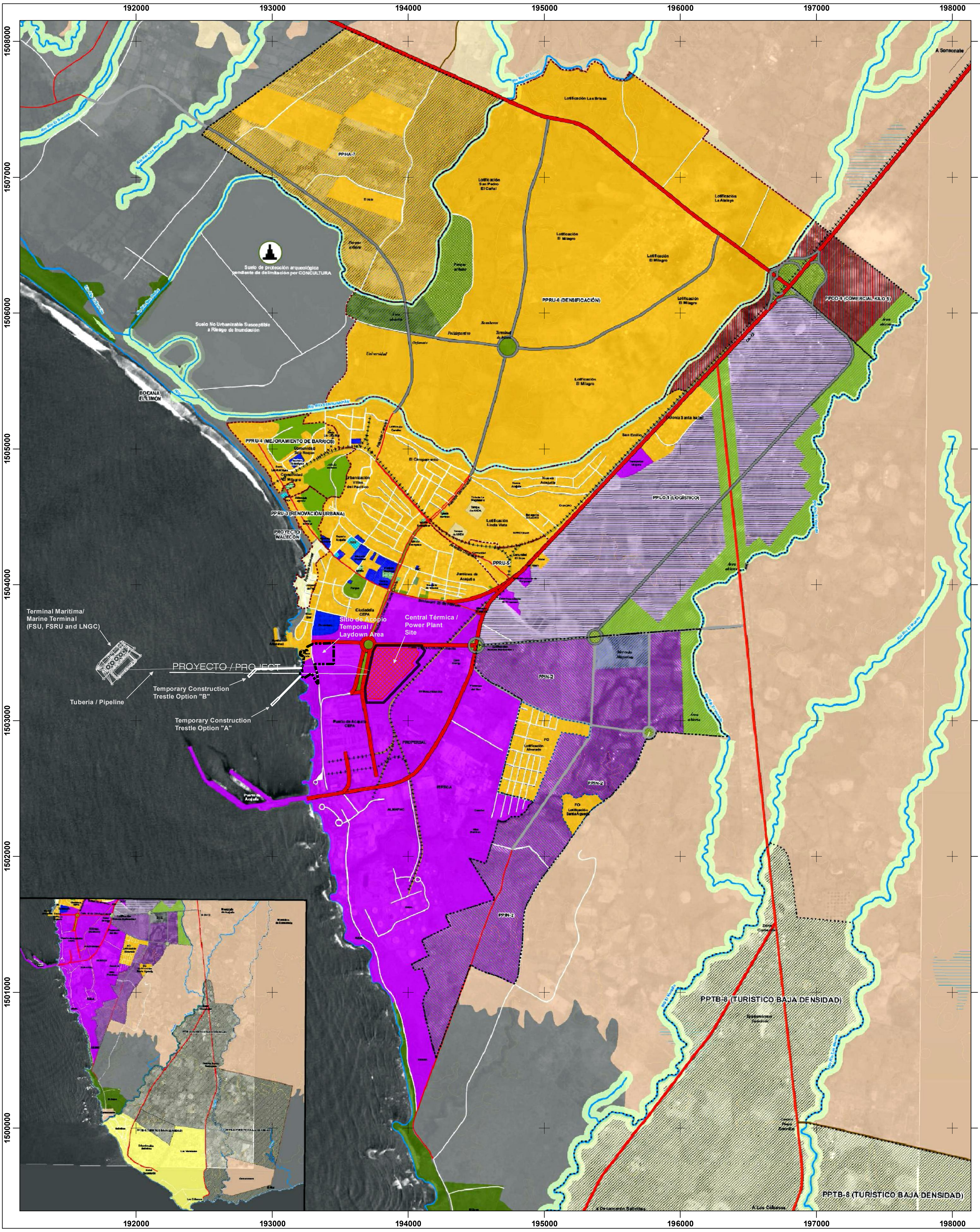
These are lands already affected by buildings and human settlements, including housing uses, services, logistics, industry, commerce and tourism developments. It includes in addition to the buildings, parks and squares destined to the leisure of the inhabitants.

5.4.5.1.6 Soil liable for development

This is land that is pre-destined for urban use within the framework of the Territorial Development Plan. In the same way, urbanizable land includes green zones projected to future for each city. It is subdivided into housing (high, medium or low density), soil for economic activity (industrial, logistic, or trade, services and offices) and tourist land.

Soil of hydric protection: they are soils located in the bank of the rivers and bodies of water not protected like natural spaces. The Forestry Law defines a protection area of 50 m on each side of the channel axis in the rural area and 20 m on each side of the channel axis in urban areas (10 in the case of gullies).

The Project site is located within areas of CEPA with industrial vocation.



Energía del Pacífico

ENERGÍA DEL PACÍFICO
LNG TO POWER PROJECT

PLANO DE USO SUELO / LAND USE PLAN

FIGURA 5.54 / FIGURE 5.54

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LÍDERES EN CONSULTORÍA AMBIENTAL

DENSIDAD ALTA / HIGH DENSITY
DENSIDAD MEDIA / MEDIUM DENSITY
DENSIDAD BAJA / LOW DENSITY
INDUSTRIAL
USO TURISTICO / TOURIST USE
USO FUERA DE ORDENACIÓN / OUTSIDE MANAGEMENT USES
PARQUE URBANO / URBAN PARK
CULTURALES Y RELIGIOSOS / CULTURAL AND RELIGIOUS
EDUCATIVO / EDUCATION
FUNERARIO / MEMORIAL
INSTITUTIONAL / INSTITUTIONAL
SANITARIOS Y ASISTENCIALES / HEALTH AND WELFARE

LIMITE DE RENOVACIÓN URBANA / URBAN GROWTH BOUNDARIES (PPRU-X)
USO HABITACIONAL DENSIDAD ALTA / HIGH DENSITY RESIDENTIAL USE (PPHA-X)
USO INDUSTRIAL / INDUSTRIAL USE (PPIN - X)
USO TURISTICO / TOURIST USE (PPTU-X)
USO LOGISTICO / LOGISTICAL USES (PPLO-X)
USO COMERCIO-SERVICIOS-OFICINAS / COMMERCIAL-SERVICES-OFFICE USE
LIMITE DEL PLAN PARCIAL / PARTIAL PLAN LIMIT
PARQUE URBANO / URBAN PARK
ÁREA ABIERTA / OPEN AREA
TRANSPORT AND SUPPLIES
SUELOS IDENTIFICADOS COMO ÁREA NATURAL PROTEGIDA / PROTECTED NATURAL AREA
SUELOS IDENTIFICADOS COMO SUSCEPTIBLES A RIESGOS / LAND SUSCEPTIBLE TO RISK

SUELOS CON APTITUD PARA LA AGRICULGURA EXTENSIVA / EXTENSIVE AGRICULTURE
SUELOS CON APTITUD FORESTAL / FORESTS
SUELOS CON APTITUD PARA LA AGRICULTURA INTENSIVA / INTENSIVE AGRICULTURE
BY PASS EXISTENTE / EXISTING BY PASS
EJES PRINCIPALS / MAIN HIGHWAY
RESTANTES CARRETERAS CA / OTHER ROADS
EJES ESTRUCTURANTES DE LA CIUDAD (SUELO URBANO) Y RESTANTES CARRETERAS PAVIMENTADAS / URBAN HIGHWAYS AND OTHER PAVED ROADS
CARRETERAS NO PAVIMENTADAS / NON PAVED ROADS
CALLES / STREETS
LINEA FÉRREA / RAILWAY
NUEVAS CARRETERAS PAVIMENTADAS / NEW PAVED ROADS
BY PASS PROPUESTO / PROPOSED BY PASS
VIA DE ACCESO / ACCESS ROAD
VIA COLECTORAS / COLLECTOR ROADS
LIMITE MUNICIPAL / CITY LIMITS

1:27,500

N W E S

0 250 500 1,000 m

FUENTE / REFERENCE
VICEMINISTERIO DE VIVIENDA Y DESARROLLO URBANO / VICE OF HOUSING AND URBAN DEVELOPMENT (VMVDU FOR PNODT)

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PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL / FINAL
FECHA / DATE: 12/7/2016

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5.4.5.2 Use of the land in the Area of Influence of the Project

The Project is located within the lands owned by CEPA where the Port of Acajutla is located, it is surrounded by industrial sites or vacant lands destined for industrial use in the future. The closest houses are located to the north of the Project, in the transition from the industrial zone to the urban residential area of the city.

Figure 5.55 shows the communities closest to the Project's site.

The current use of the land is detailed:

- Power Station Site: barren with shrub and herbaceous vegetation, with scattered trees, as well as rubble and solid waste, mainly organic scattered on the land.
- Pipeline Route: The pipeline will pass through areas that currently include CEPA gardens with fruit trees, mainly coconuts and mangoes. It also passes two CEPA roads and an area that is used for parking of trucks.

5.4.5.3 Use of the Project Land

The land is currently uncultivated, unused and was previously used to deposit material produced by movements of land from other lands within the land of CEPA.

To evaluate the possibility of contamination at the site, a Phase I Site (ESA) was carried out. The Phase I ESA was generally performed in accordance with the scope and limitations of the American Society of Testing and Materials (ASTM) Standard E 1527-13, Standard Practice for Environmental Site Assessments. The executive summary of this document is presented in Appendix AB. According to the evaluation it is concluded:

- No Recognized Environmental Conditions (REC) were found as "the presence or possible presence of hazardous substances or petroleum products in a property under conditions that indicate an existing release, past release or threat release of hazardous substances or products derived from oil in the structures of the property or in the soil, groundwater or surface water of the property".
- No Historic Conditions Recognized, no historical REC identified.
- Other potential environmental issues: The evaluation did not reveal evidence of other potential environmental problems in relation to the property.

The report recommends that a Phase II ESA be completed, which will generate additional information regarding the identification and nature of potential contaminants associated with potential sources of hydrocarbons in the vicinity of the Property.

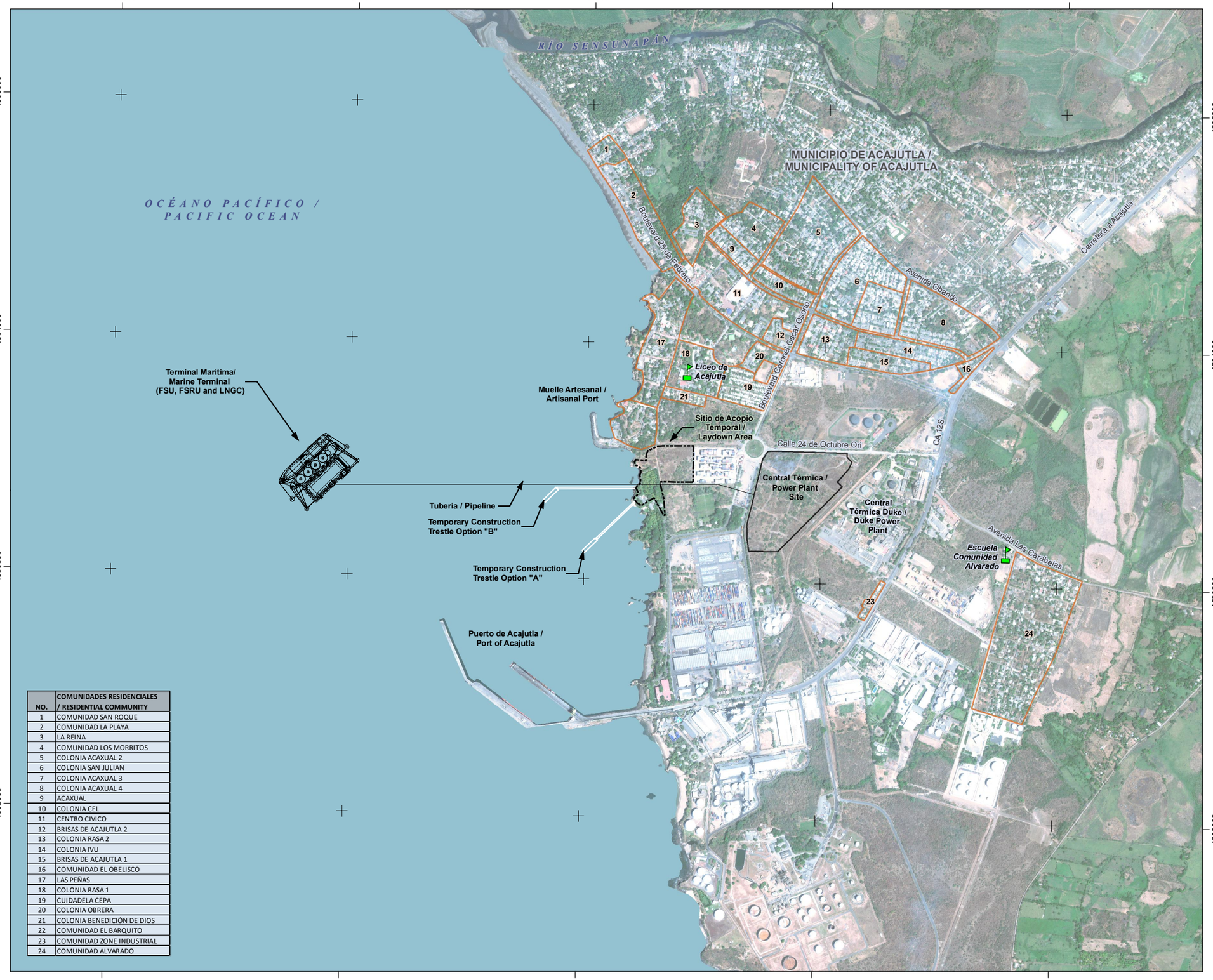
5.4.5.4 Tenure of the Land

Even though it is still difficult to specify changes to the land tenure in Acajutla, for lack of an updated agricultural census, the land ownership situation underwent modifications from the implementation of the agrarian reform of 1980. Large haciendas of the coastal area were converted into cooperatives resulting in a change in the land tenure. At the same time, the implementation of Decree 207 (land direct workers) helped to reduce the problems of access to land in this area. However, it is not possible to affirm the existence of changes in tenure, in such a way that they still persist in the study area, existing different forms of tenure which include large individual property, small subsistence production, the reformed sector cooperatives, leasing and the colonato.

The land where the Project will be developed is owned by CEPA, located within the port area.

5.4.6 Population's Opinion

Chapter 8 presents in detail the entire process of consultation carried out previously to the citizens in order to socialize the project and obtain the opinion of the population.



NO.	COMUNIDADES RESIDENCIALES / RESIDENTIAL COMMUNITY
1	COMUNIDAD SAN ROQUE
2	COMUNIDAD LA PLAYA
3	LA REINA
4	COMUNIDAD LOS MORRITOS
5	COLONIA ACAXUAL 2
6	COLONIA SAN JULIAN
7	COLONIA ACAXUAL 3
8	COLONIA ACAXUAL 4
9	ACAXUAL
10	COLONIA CEL
11	CENTRO CIVICO
12	BRISAS DE ACAJUTLA 2
13	COLONIA RASA 2
14	COLONIA IVU
15	BRISAS DE ACAJUTLA 1
16	COMUNIDAD EL OBELISCO
17	LAS PEÑAS
18	COLONIA RASA 1
19	CUIDADELA CEPA
20	COLONIA OBRERA
21	COLONIA BENEDICIÓN DE DIOS
22	COMUNIDAD EL BARQUITO
23	COMUNIDAD ZONE INDUSTRIAL
24	COMUNIDAD ALVARADO

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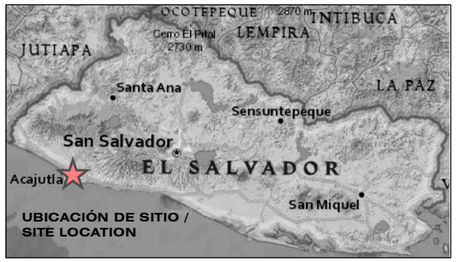
ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

COMUNIDADES QUE RODEAN EL PROYECTO / RESIDENTIAL COMMUNITIES SURROUNDING THE PROJECT

FIGURA 5.55 / FIGURE 5.55

- ESCUELAS / SCHOOLS
- COMUNIDADES / RESIDENTIAL COMMUNITIES
- SITIO DEL PROYECTO / PROJECT SITE
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA



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VISIÓN DEL MUNDO 2 IMÁGENES DE ALTA RESOLUCIÓN / WORLDVIEW 2 HIGH RESOLUTION IMAGERY (2014-02-12)

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Energía del Pacífico

Environmental Impact Study
Project: LNG to Power
TOME II

December 2016 16-3489

ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

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Glossary

Acronym	Description
AAC	Civil Aviation Authority
ADESCO	Association of Community Development
AIP	Project Influence Area
AMP	Port Maritime Authority
ANDA	National Association of Aqueducts and Sewers- ANDA
AP	Project Area
BM	World Bank
CAMARASAL	Chamber of Commerce and Industry of El Salvador
CAS	Chemical Specialty Service
CCNIS	National Coordinating Council Salvadoran Indigenous
CEL	Hydroelectric Commission for the Lempa River
CEM	Electro Magnetic Fields
CENDEPESCA	Directorate General for Fisheries and Aquaculture Development
CENTA	National Center of Agricultural and Forestry Technology
CEPA	Autonomous Port Executive Commission
CN	National Censuses
CNE	National Energy Council
CNR	National Center of Records
CNSP	National Council of Public Security
COMURES	Corporation of Municipalities of the Republic of El Salvador
CONACYT	National Commission on Science and Technology
CONAMYPE	National Commission of the Micro and Small Business
CONCULTURA	National Council for Culture and Art
CORSATUR	Salvadoran Tourism Corporation
COV	Volatile Organic Compounds
CRETIB	Corrosive, Reactive, Explosive, Toxic, Flammable, Bioinfectious
CSSP	Higher Council of Public Health.

Acronym	Description
CSV	Chamber Valuators of El Salvador
dB(A)	Sound pressure levels measured in decibels on the scale A
DBO	Biochemical Oxygen Demand
DGDR	Directorate-General for Rural Development
DGFCR	General Direction of Forest Management Basins and Irrigations
DGOA	Direction of the Environmental Observatory
DGPC	Directorate-General for Civil Protection, Disaster Prevention and Mitigation
DIGESTYC	General Directorate of Statistics and Censuses
DQO	Chemical Oxygen Demand
DRHM	Regulatory Direction of Hydrocarbons and Mines
US-EPA	Environmental Protection Agency
EDP	Energy of the Pacific
EPP	Personal Protective Equipment
EsIA	Environmental Impact Study
FISDL	Social Investment Fund for Local Development
FOEX	Export Promotion Fund
FONAES	Environmental Fund of El Salvador
FONAVIPO	National Fund for Popular Housing
FSU	Floating Storage Unit
FSRU	Floating Storage and Regasification Unit
FSV	Social Fund for Housing
GEI	Greenhouse Gas
GNL	Liquefied natural gas
IDH	Human Development Index
IFC	International Finance Corporation
ISDEM	alvadoran Institute of Municipal Development
ISS	Salvadoran Institute of Social Security
ISTA	Salvadoran Institute for Agricultural Transformation
ISTU	Salvadoran Institute of Tourism
Kg	Kilograms
LDE	Electrical Distribution Line
LFI	Lower Flammable Limit
LMA	Maximum Limit Acceptable
LMP	Maximum Allowable Limit
LMT	Medium Voltage Line
LNGC	Liquefied Natural Gas Freighter
MAG	Ministry of Agriculture and Livestock

Acronym	Description
MARN	Ministry of Environment and Natural Resources
MIDE	Ministry of Defense
MIGOB	Ministry of Government
MINEC	Ministry of Economy
MINED	Ministry of Education
MINSAL	inistry of Public Health and Social Assistance
MOP	Ministry of Public Works
MTPS	Ministry of Labor and Social Welfare
MW	Mega Watt
MW/h	Mega Watt / hour
NMP	Most Probable Number
NOx	Nitrogen oxides
NO2	Nitrogen dioxide
NSO	Salvadoran Obligatory Standard
OMS	World Health Organization
PA	Acajutla Port
PH	Hydrogen Potential
PMA	Environmental Management Program
PM	Particulate Material
PM10	Articulate material less than 10 microns
PM2.5	Particulate material less than 2.5 microns
PNC	National Civil Police
PNUD	United Nations Development Program
PS	Performance Standard
PTS	Suspended Total Particles
RNPN	National Registry of Natural Persons
SC	Superintendence of Competition
SECULTURA	Secretary of Culture
SIGET	General Superintendence of Electricity and Communications
SNET	National Service of Territorial Studies
TDR	Terms of Reference
TDS	Total Solids
UFC	Colony Forming Unit
UTM	Universal Transverse Mercator

Energía del Pacífico

Project: LNG to Power

Chapter 6: Legal Considerations and Environmental Regulations

December 2016 – 16-3489

ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

DILLON CONSULTING

6.0 Legal Considerations and Environmental Regulations

6.1 Introduction

This environmental evaluation has been carried out considering all the environmental, health, and safety conditions for the Project. The applicable framework refers to the legislative full range and the Salvadoran government regulatory requirements, as well as to multilateral environmental agreements from the financing institutions involved in the project. The following subsections describe each of these three categories set forth in this document, which describe the steps taken to address each requirement. The first section describes the legal and regulatory framework governing the environment and development activities in El Salvador. The following section is related to the environmental, health and safety requirements of the international financial institutions associated with the project, specifically the International Finance Corporation's performance standards and the EHS and industry guidelines of the World Bank Group. Finally, the implications of ratified multilateral environmental agreements related to the project are also discussed.

6.2 Legal Considerations and Environmental Regulations Applicable to the Project

The Salvadoran legal references enabling framework, related to the environmental impact assessment of an activity, work or project in general can be found in the Republic Constitution of the Republic, Constitutional Jurisprudence, Laws, Bylaws, Legislative Decrees and Executive Orders, Technical Standards, Ministerial Agreements, Plans, Ordinances Programs, Municipal Regulations and even guides issued by the competent authorities.

Hierarchically, the project constitutional legal basis, is the 1983 Constitution, specifically the following articles:

Art. 84.- The territory of the Republic over which El Salvador exercises jurisdiction and sovereignty is irreducible and, in addition to the continental part, includes: The insular territory consisting of the islands, islets and cays enumerated in the Justice Central American judgment Court pronounced on March 9th 1917, and that also corresponds, according to other International Law sources. Also other islands, islets and keys that also correspond to it, according to the international law. The territorial and community waters of the Fonseca's Gulf , which is a historical bay with closed sea characters, whose regime is determined by international law and by the judgement mentioned in the previous paragraph. The airspace, the subsoil and the corresponding continental and island shelf. In addition, El Salvador

exercises sovereignty and jurisdiction over the sea, subsoil and seabed up to a distance of 200 nautical miles from the lowest tide line, all in accordance with the International law regulations

Art. 117.- It is the State's duty to protect natural resources, as well as the diversity and integrity of the environment, to ensure sustainable development. The protection, conservation, rational use, restoration or natural resources substitution are declared of social interest in the terms established by the Law. The introduction of nuclear waste and toxic wastes[1] into the national territory is prohibited.

Art. 120.- In any concession granted by the state for the ports exploitation, railways, canals or other public works, the mentioned concession terms and conditions must be stipulated, taking into account the facility nature and the investment required. Those concessions must be submitted to the Legislative Assembly for approval. (5)

Consequently, since the Republic Constitution does not impose any kind of prohibition on projects such as the one being evaluated, for the electric energy generation from natural resources, a comprehensive legal analysis of the applicable legal framework has been developed. All in accordance with guidelines Issued by the El Salvador Environmental Ministry, the environmental aspects / impacts study identified in the technical EIA's document, as well as in the discussions and scenarios presented with the rest of the multidisciplinary team participating in the study.

The analysis is presented by the mandatory compliance legislation and regulations which are directly environmental or sectoral impact, which have been considered binding, not only because they reduce the legal risk of facing legal consequences for their omission, but because they exist institutionally Legal requirements that determine the environmental viability of the project. In Appendix 6A, an "Integral Legal Analysis Matrix" is presented, in which a lawyer from the Republic verified the compliance with the Project with respect to the applicable legal framework.

6.3 Definition of the concept "Environmental Legislation"

The criterion used for the legal systematization of this work is detailed below:

A. The environmental legislation began after 1994, with the chapter on Environmental Impact Assessments, contained in the OPAMSS[1] Law and with greater emphasis in 1998, when the Environmental Law was born. Having this last one as governing body the MINISTRY OF ENVIRONMENT AND NATURAL RESOURCES (MARN). This legislation is characterized by

[1] OPAMSS, Ofice for land planification for the metropolitan area of San Salvador (Oficina de Planificación para el Área Metropolitana de San Salvador).

addressing the environmental impact by the anthropogenic effects, with a holistic vision and systematic soil resource, integrator and holder of any other form of "environment"[2]

B. The legislation considered as sectorial of casual environmental relevance, which are the set of laws by which the State protects the protection of the environment components and which are consequently linked to public health, energy, transport, territorial planning, health, safety in work centers, socio-economic and cultural activities, among others. Those regulations first arise in the case of El Salvador, parallel to or subsequent to the creation of the ministerial entities, which become their governing bodies, generally as a way of applying and enforcing institutional competencies emanating directly from the constitution or its own organic law or creation.

The previous differentiation and systematization is in agreement with the one established the Free Trade Agreement between Dominican Republic, Central America and the United States of America (CAFTA DR). Being a Law of the Republic (see Article 144 of the Constitution), since this article makes no distinction between what is a Trade Treaty and the Legal Treaty, in the strict sense of an Agreement. Chapter 17 of this treaty is the one that makes a clear definition in its Article 17.13, of what should be considered ENVIRONMENTAL LEGISLATION, literally expresses:

> ***"Environmental law*** *means* ***any law or regulation*** *of a party or provisions of the same, whose main purpose is the* ***protection of the environment*** *or the prevention of any danger against the life or human, animal or plant health, through:*
>
> ***(a)*** *prevention, reduction or leakage control, discharge or environmental pollutants emissions;*
>
> ***(b)*** *environmentally hazardous control or toxic chemicals, substances, materials and wastes, and the dissemination related to these; or*
>
> ***(c)*** *the wild flora and fauna protection or conservation , including endangered species, their habitat and natural areas under special protection, in areas in respect of the Parties exercise sovereignty, sovereign rights, or jurisdiction, but does not include any law or regulation, or any provision therein, directly related to the safety or health of workers …*
>
> ***…***
>
> *For the "environmental laws" effect definition , the main purpose of a law or regulation particular provision should be determined by its primary purpose reference instead of the law or regulation primary purpose."*

Note that 17.13 does not allude to the exclusive legislation of the environmental authority, it says "any law or regulation". This definition restructures any concept, even institutional-ministerial, that has previously had on environmental legislation, which is binding in the present case to the development of the Project, particularly which is complemented by Article 17.2 (a) of the same treaty, which says:

[2] Cañas, Carlos Gonzalo, (2006), "Legal aspects of the environmental management and land development in El Salvador (Aspectos Legales de la Gestión Ambiental y Territorial en El Salvador)". Universidad Centroamericana José Simeón Cañas de El Salvador.

"A Party shall not fail to effectively enforce its environmental legislation, through a course of action or sustained or recurrent inaction, in a manner affecting trade between the Parties, after the date of entry into force of this Agreement…"

Consequently, an integrated legal analysis, particularly of an EIA, cannot be addressed only formally, atomistically and sectoral, as it faces the possibility of transgressing fundamental rights protected by the Constitution. This point is expanded and illustrated in the matrix in Appendix 6A of this chapter. It also develops the jurisprudential part applicable directly or by incidence to the Environmental Impact Studies.
Also, regarding the laws and bylaws, in this specific case, the legislation of the energy sector has been related that establishes compliance aspects and that refers to environmental aspects and the socio-cultural standard that mediates with environmental categories, particularly in what concerns the Environmental Impact Assessment.

The environmental jurisprudence addressed in this EIA is the one that has emanated from the Justice Supreme Court's Constitutional Chamber. This clarification is made because in a broad sense and in the environmental issue, jurisprudence can be understood as those legal decisions of any instance of the judicial body, an interpretation that will not be addressed in this space, as it is not the legal integral analysis objective.

Likewise, the principles of citizen participation (Principle 10) and precautionary principle (Principle 15), both from the Rio Declaration, are referred to as more relevant doctrinal elements of environmental legislation, recognized in international normative bodies ratified by El Salvador. Like, the Convention on Biological Diversity, Stockholm COPS, Montreal Protocol and Kyoto, as well as principles of environmental policy, according to the Environmental Law.

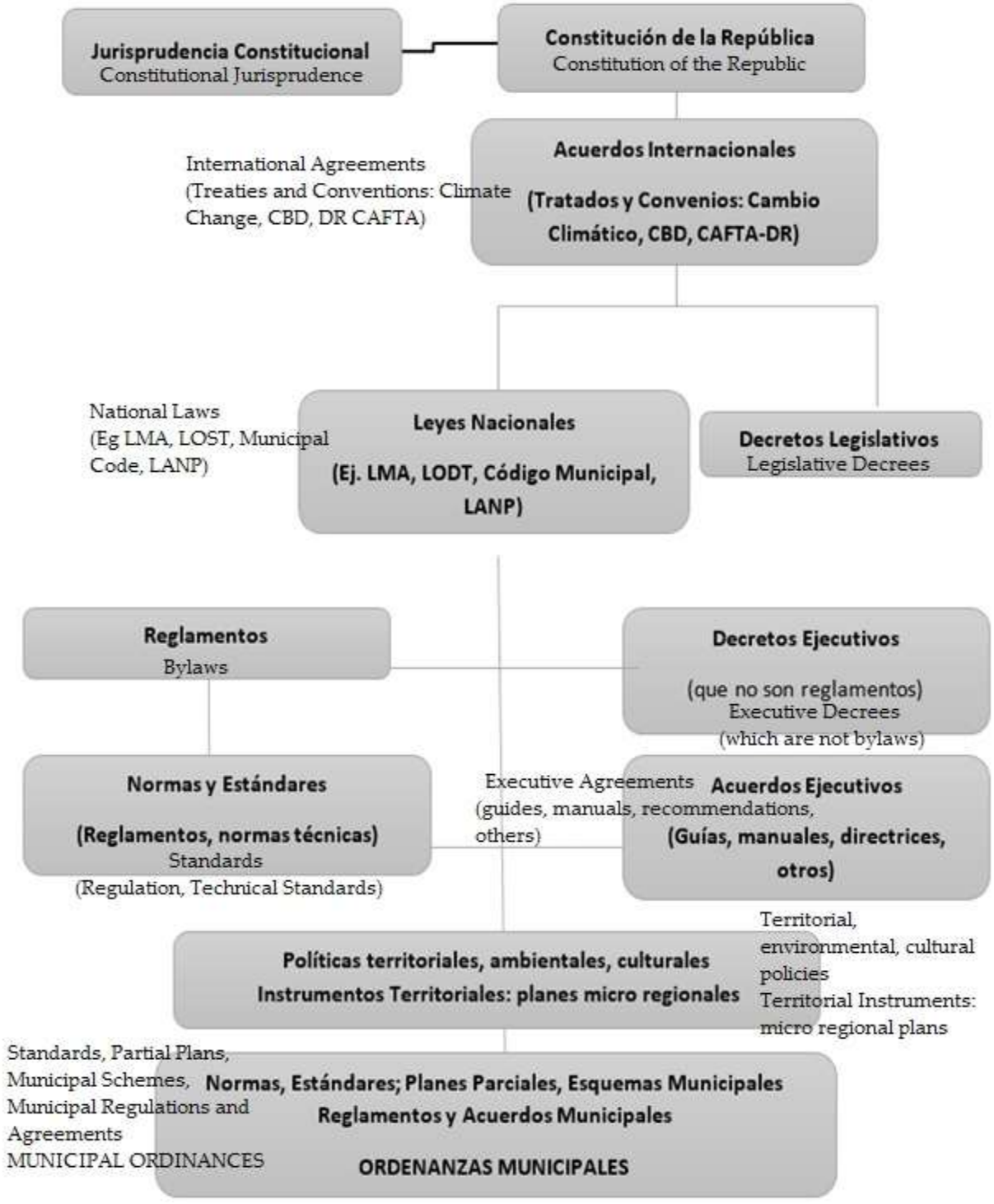
In the same way, the direct environmental regulations have been integrated to the present Integral Legal Analysis, or by incidence of Acajutla municipality in the Sonsonate Department. The last one, include the municipal taxes ordinances that can condition the infrastructure to be developed.

It should be noted that the legal matrix presented in Appendix 6A does not include the IFC standards that are safeguards of sensitive aspects and that the project financier has considered it necessary to ensure the environmental and financial viability of the project. Those regulations are not obligatory in the territory of the Salvadoran Republic, nevertheless the IFC compliance has been requested by the owner, that they be observed as of obligatory fulfillment. Appendix 6A includes the afore mentioned standards, which, after being studied, are considered not to transgress the national legal system.

Finally, it is necessary to recall that due to the new legislation of the National System of Quality, the technical standards can be under the name of NSO (Obligatory Salvadoran standard) or NSR (El Salvadoran Recommended Standard), according to the legislation existing before the Creation Law of the Salvadoran System for Quality, Decree 790, Official Gazette of August 26, 2011. However, it can also be found with the names: NTS (Salvadoran Sanitary Technical Standard); NTV (Voluntary Technical Standard); NTO (Mandatory Technical Standard). It should not be forgotten that some technical standards also come under the name of the Central American Technical Standard (RTCA), as they are applicable to all the Central American territory and that in the legal field some technical regulations issued directly by ministries have been known as NTM Ministerial techniques.

Next, a scheme (Figure 6.1) containing the hierarchy of the Salvadoran regulation is presented and systematized in Appendix 6A.

Figure 6.1 – Hierarchy of the Salvadoran Environmental Regulations



Source: Márquez D y Sánchez A (2014)

6.4 Land Tenure Regulations Related to the Project

The land needed for the project is entirely in the facilities of the Acajutla Port that are owned by CEPA. The project will not have to acquire any other land. EDP has a lease agreement with CEPA for the land use necessary for the LNG Thermal Power Plant and Marine Terminal. The land portion of the jetty and the liquefied natural gas pipeline easement will also enter into a lease agreement between EDP and CEPA, as well as the lease of the temporary laydown area to be used during the construction period. CEPA has provided an initial agreement for the land that will be required for collection and piping.

CEPA was created in 1952, inaugurating pier A in 1961. From that date on was expanding its facilities and acquiring land around the site of the port itself.

6.5 Requirements of International Financial Institutions

The project is expected to include funding from several International Financial Institutions (IFIs). While specific IFIs were not confirmed at the time of drafting this document, it was expected that IFIs that might be involved could include IFC[5], other multilateral or bilateral IFIs, and commercial banks. It can also be anticipated that one or more of these IFIs will be the Ecuador Principles Financial Institution (IFPE).

IFC and IFPE have committed to evaluate the projects under consideration for their financing using the IFC Performance Standards for Environmental and Social Sustainability (Performance Standards) and the World Bank Group's Environmental Health and Safety Guidelines. The Performance Standards provide project sponsors with guidance on how to identify environmental and social risks and impacts and are designed to help avoid, mitigate and manage risks and impacts as a way of doing business in a sustainable manner.

The Guidelines on Environment, Health and Safety are technical reference documents containing general and specific examples of Good International Practice for Industry (GIIP)[6]. When one or more members of the World Bank Group participate in a project, those Environmental, Health and Safety Guidelines are implemented in accordance with the requirements of their respective policies and standards.

[5] International Finance Corporation

[6] Defined as the exercise of professional aptitude, diligence, prudence and foresight that could reasonably be expected from suitable and experienced professionals who perform the same type of activities in the same or similar circumstances at the world level.

The industry-specific guidelines applicable to the project are:

- General Environment, Health and Safety (IFC) Guidelines, 30 April 2007 - addresses general environmental, health and safety issues related to all project components;
- Environment, health and safety guidelines for thermal power plants (IFC: 19 December 2008); - addresses general environmental, health and safety issues related to the Central Thermal Power Plant;
- Environmental, health and safety guidelines for Liquefied Natural Gas (LNG) facilities (IFC dial: April 30, 2007). - addresses general environmental, health and safety issues related to the Maritime Terminal; and
- General guides on environment, health and safety for ports, port areas and terminals (IFC, April 30 2007) addresses general themes of the environment, health and safety related to the LNG cargo ships (LNGC) activities "In the Terminal".

Table 6.1 provides a listing of the Performance Standards, together with an explanation of how the Project intends to meet each of them.

Table 6.1 – IFC Standards of Performance and Compliance Control

Performance Standard	Application and How It Is Approached by the Project
Performance Standards 1: Environmental Assessment and Management, Social Risk and Impacts	**Compliance** The EIS was completed by EDP and is presented in this document. A thorough environmental analysis, social, and economic impacts was carried out. Included within the ESIA in the Community Participation Plan, and through the Environmental and Social Management Program**.** The Transmission Line Project is considered for the purposes of the IFC review process as an "associated project". The Transmission Line is the subject of a EsIA request and process, for which a separate EsIA report has been prepared. EDP is in the process of establishing an Environmental and Social Management System. The system will build on Invenergy's experience with energy projects in the United States and in other places. EDP will require each of its contractors, including the power plant and the LNG Maritime Terminal, as well as contractors of "Engineering, Procurement, Construction Management (EPC)", to the "Operation and Maintenance (O & M) contractors", and its main subcontractors, to have environmental and social management systems, plans and procedures to address the scope of their supplies and activities. Those systems will be based on the principles of continuous improvement and "*plan, do, verify, act*" principles.

Table 6.1 – IFC Standards of Performance and Compliance Control	
Performance Standard	**Application and How It Is Approached by the Project**
Performance Standards 2: employment and working conditions	**Compliance** EDP is developing human resources policies, plans and procedures that address the following, and require the same from EPC & O & M Contractors**:** • Compliance with Salvadoran labor laws and regulations, including procedures to ensure that the project and the supply chain do not employ child or forced labor; • Non-discrimination and equal opportunities; • Respect for collective bargaining and the formation of workers' organizations; • A complaints mechanism for workers that it is timely and transparent and provides feedback without remuneration EDP require EPC and O & M contractors to establish comprehensive health and safety plans and procedures that include: • Identification of potential hazards; • Provision of preventive and protective measures; • Training of workers; • Documentation and notification of occupational accidents and incidents; and • Emergency prevention, preparedness and response measures
Performance Standards 3: Pollution Prevention and Resource Efficiency	**Compliance** The project will have the most efficient thermal power plant in El Salvador. The plant uses a closed-loop refrigeration system to minimize the use of water and associated wastewater discharges. The use of natural gas fuel will result in a lower emission of air pollutants than other fossil fuels, including lower emissions of greenhouse gases. The Project has been designed to be constructed and operated in accordance with El Salvador regulations and WBG-EHS guidelines and will not result in any significant deterioration of the environmental quality.
Performance Standards 4: Community Health and Safety	**Compliance** The power plant will be the most efficient thermal power plant in El Salvador. The plant uses a closed-loop refrigeration system to minimize the use of water and associated wastewater discharges. The use of natural gas fuel will result in a lower emission of air pollutants than other fossil fuels, including lower emissions of greenhouse gases.

Table 6.1 – IFC Standards of Performance and Compliance Control	
Performance Standard	**Application and How It Is Approached by the Project**
	The Project has been designed to be constructed and operated in accordance with El Salvador regulations and WBG-EHS guidelines and will not result in any significant deterioration of the environmental quality.
Performance Standards 5: Resettlements. Acquisition of land and involuntary resettlement	**Non- applicable** All land required for the project is owned by CEPA. The property was acquired by CEPA prior to 1961. There are no known pending claims or complaints from former owners, rights over the original acquisition and current use of the land required for the Project.
Performance Standards 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	**Compliance** The EsIA includes an assessment of the biological characteristics in the Project's area influence, as well as an Ecosystem Services Assessment. There is no significant biodiversity or protected area characteristics that are affected by the project. The land portion of the Project is in previously disturbed areas within the CEPA Port Area boundary. Portions on land will have short-term disturbances during the construction phase, but in the long term the presence of physical facilities is expected to generate habitat for desired marine species. EDP is committed to continuous monitoring and mitigation of the impacts identified for local biodiversity and natural systems.
Performance Standards 7: Indigenous Peoples	**Non- applicable** Recognized indigenous communities and their resources will not be affected by the project, as defined in IFC standards, PS7.
Performance Standards 8: Cultural Heritage	**Compliance** There are no known cultural heritage sites that are going to be impacted by the project. EDP will comply with local and tenant requirements in the management of any unexpected archaeological findings found during the construction of the project

Source: Consulting Team

6.6 International Treaties and Conventions

El Salvador is a signatory State of international environmental treaties, trade agreements with environmental articles, and multilateral environmental agreements (MEAs). A project status with relevant agreements is provided in Table 6.2. In some cases, the requirements of those agreements have been institutionalized through local guidelines and laws on environmental protection and due diligence, as discussed earlier in Section 6.1.

Table 6.2 – General Description of the Multilateral Environmental Agreements and Related Standards for the Context of El Salvador

Law or Bylaws	Project Status: Fundamentals
1971 Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar)	**Non- applicable:** The project will not affect any significant wetlands area or other wetland habitat areas .
1975 Convention on International Trade for Wild Fauna and Flora (CITES) Endangered Species	**Non- applicable:** There will be no import, export, re-export or species introduction to El Salvador as the project result or associated activities.
1982 United Nations Convention on the Law of the Sea (LOS)	**Compliance:** The attached documented EIA has identified impacts of marine habitats and has designed mitigation plans to reduce and control such impacts. EDP will ensure that all storage standards and shipping materials, including LNG delivery are met.
1989 Basel Convention on the Transboundary Movements Control of Hazardous Wastes and their Disposal	**Non- applicable:** The project will not participate in the hazardous waste materials import or export .
1989 Montreal Protocol on Substances that Deplete the Ozone Layer	**Compliance**: According to the Montreal Protocol, the use of any substance that depletes the ozone layer will be monitored and controlled in compliance with El Salvador regulations, and the potential release will be eliminated
1992 Convention on Biological Diversity	**Compliance:** All potential impacts to local biodiversity have been evaluated and documented in this report, and measures to mitigate, those impacts are detailed in Section 7 of this document
1992 Rio Declaration and Agenda 21	**Compliance:** The project will comply with all the principles of the Rio Declaration, particularly in relation to the principle of public participation and the precautionary principle as explained in Section 6.1 of this document
1997 Kyoto Protocol to the United Nations Framework Convention on Climate Change	**Compliance:** The project will have the most efficient thermal power plant in El Salvador. The rapid response time and operational flexibility of the power plant will facilitate the incorporation of other renewable energies such as wind and solar energy into the national grid.
1992 Regional Agreement on the Hazardous Wastes Control Transboundary Movements Control	**Non- applicable:** The project will not participate in the hazardous waste materials import or export
1996 United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (UNCCD)	**Non- applicable:** Activities associated with the project do not include components related to agriculture and will not significantly affect the physical, chemical, biological or the soil economic properties.
2000 Cartagena Protocol on Biosafety to the Convention on Biological Diversity.	**Non- applicable:** The project does not involve any activity related to living modified organisms.

Table 6.2 – General Description of the Multilateral Environmental Agreements and Related Standards for the Context of El Salvador

Law or Bylaws	Project Status: Fundamentals
2000 Cartagena Protocol about the biotechnical security of the biological diversity convention.	**Non- applicable:** The project will not include activities in relation with living modified organisms.
2004 Rotterdam Convention on the Prior Informed Consent Procedure for Certain Chemicals and Pesticides in International Trade	**Non- applicable:** There will be no restricted hazardous chemicals or pesticides used for the project or its associated facilities
2004 Stockholm Convention on Persistent Organic Pollutants	**Non- applicable:** There will be no persistent organic pollutants imported, exported or used by the project or its associated facilities.
2005 Dominican Republic-Central America- United States Free Trade Agreement (CAFTA-DR), Chapter 17 - Environment Cooperation Agreement (ECA)	**Compliance:** The project will comply with all local regulations and environmental laws of El Salvador developed as part of the implementation of CAFTA requirements as well as all relevant articles of the ECA related environmental protection and public consultation.

Source: Consulting Team

6.7 Concordance Analysis of the Environment Permanent Requirements

The project is being designed to meet Salvadoran standards and the GBM-EHS guidelines. A listing of the applicable concordance analysis of the Salvadoran standards and GBM-EHS guidelines set out in Appendix 6B is provided. The two stricter are taken into account to be applied to the project's Environmental Performance Standards. The environmental parameters that are included in the concordance analysis are:

- Environment air quality, emissions and air quality monitoring;
- Sewage, environmental water quality, potable water, water conservation;
- Hazardous Handling materials and waste;
- Waste management;
- Contaminated Soils;
- Occupational health safety planning and workplace safety, including physical hazards, bio hazards, hazardous chemicals, confined space work and isolation;
- Community health and safety, including disease prevention, water, transportation and facility design; and,
- Emergency preparedness and response.

6.8 Legal Documents

The land that has to be used for the Project development is the Comisión Ejecutiva Portuaria Autónoma's property (Autonomous Port Executive Commission), CEPA, named " Acajutla Port ", of the Acajutla municipality, Sonsonate Department (see Appendix 6C). Consequently, CEPA realized a lease agreement with Energía del Pacífico to use part of the land from its property for the LNG Power Plant and the gas supply pipeline development of the (see Appendix 6C and 6D).

During the construction phase, is required 1 land, within the port area, located to the property west side, which will be leased by CEPA to Energía del Pacífico during the construction phase (Appendix 6E).

The housing Vice Ministry and Urban Development issued the site qualification (Land development permit) and the construction line in September 2016, which is in Appendix 4A.

It is necessary to emphasize that Acajutla, municipality where the project will be developed, does not have any environmental ordinance that prohibits or conditions the development of this project.

Energía del Pacífico

Project: LNG to Power
Chapter 7: Identification, Prioritization, Prediction and Quantification of Potential Environmental Impacts, Including Potential Risk Situations

December 2016 – 16-3489

ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

DILLON CONSULTING

7.0 Identification, Prioritization, Prediction and Quantification of Potential Environmental Impacts, Including Potential Risk Situations

7.1 Impact Assessment Approach

This EIA has applied a project life cycle approach to the evaluation and management of potential impacts. This approach take into consideration the El Salvador EIA legislative requirements (including the requirements outlined in the MARN approved to the project Reference Terms), and IFC's Environmental Performance Standards and the World Bank Group Environmental Health and Safety Guidelines, which are used by Equator Principles Financial Institutions. It focuses on the development of impact management measures for all the project phases (construction, operations and decommissioning), in such a way that :

i) The project benefits flow to project affected people and communities, and
ii) The potential adverse environmental, social and health & safety impacts are managed to acceptable levels.

This section provides details on the methodology that was used.

The methodology provides a consistent overall assessment approach across the range of environmental and social features and conditions assessed. At the same time, flexibility has provided to allow the assessment application tools that are specific to a particular feature or conditions. In all cases, the assessment has used quantitative and benchmarks measures.

This assessment has been completed using information from diverse sources, including:

- Existing information and data;
- The information received from stakeholders through the Consultation Plan; and
- New Project-specific information collected as part of the assessment process, such as field studies of terrestrial and marine biological conditions.

To address uncertainty associated with the potential project effects assessment for important infrastructure projects, the environmental and social action for the Project includes commitments for monitoring and further data collection. Those actions will allow EDP to identify, respond, and manage uncertainty and unanticipated project effects.

The assesment of potential environmental, social, health and safety effects generally considered the following:

Project Features and Activities – further the report Chapter 4 , the project has been defined at a detail level , enough for the purposes of the impact assessment analysis. This includes a description of the proposed locations and designs of the various project components, the proposed inputs and outputs, and the anticipated construction and operations activities. The Project will be further detailed in subsequent design phases of the project. The social and environmental action plans have a change management process to deal with and incorporate project design changes that may occur post EIA and over the Project lifetime.

Study Areas/Areas of Influence – The assessment was completed considering the influence area of the various Project facilities and activities. Section 5.1: Project Area (Areas of Influence) provides a details description of the Project influence areas.

Baseline Conditions Description – Existing information and new data collection was completed within the project influence areas to describe baseline conditions. Chapter 5 provides a description of baseline conditions by environmental and social component including the methodologies employed to collect new information and the sources material for existing information.

Legal and Regulatory – Legal and regulatory requirements were reviewed to meet El Salvador and international (World Bank Group) standards for the EIA. Chapter 6 provides the Legal and Regulatory Framework used in the effects assessment and mitigation preparation and monitoring plans.

Identification of impacts and Assessment – A list of potential project issues (potential effects) were generated considering:

- The environmental and social setting for the project;
- Stakeholder comments and input;
- The TOR for the EIA issued by MARN;
- Posible impacts forseen in the IFC Performance Standards and WBG EHS Guidelines; and
- Professional experience of the EIA project team with the similar nature projects

The potential project issues were reviewed and the project activity-effect identification matrix was developed. Section 7.2 provides the screening matrix of potential effects.

Potentially Significant Effects Assessment – The Chapter 7 balance provides an assessment of the potentially significant impacts derived from a previous review. The methods used to identify and assess potential project effects varied depending on the specific issues and included predictive modeling, quantitative counts and measures, and qualitative descriptions. The methodology used to identify project effects is described by each environmental and social component in this EIA Report. In conducting the effects assessment, the following was considered:

i) Direct project activities and facilities on the proponent property or properties managed by the proponent through contractors;
ii) Unplanned impacts but foreseeable events caused by the project, which may occur later or elsewhere; or
iii) The project Indirect impacts on biodiversity or ecosystem services provided to communities that rely on them for subsistence means.

Potential cumulative impacts on areas or resources employed or directly affected by the project were also assessed. See Section 7.9.

A potential effects description has been completed, organized by environmental component (see Sections 7.4-7.6).

Impact Management and Mitigation Measures – To address the potential negative impacts, many management measures are "built-into" the design and standard operating procedures for the project. Including,

- Equipment selection, and facility design and layout;
- Construction process, and activities schedule;
- Source and use of raw materials and inputs;
- Operations processes and practices; and
- Communications and Management procedures and protocols.

Such built-in design measures include treatment systems for wastewater, noise reduction silencers on engine exhausts, secure storage and secondary containment for hazardous material.

The Project has been designed to avoid or control negative effects (e.g., nuisance noise), optimize positive effects (e.g., job creation) and to allow the project to be constructed and operate in compliance with applicable regulatory limits and standards. To manage uncertainty, measures that are effective and

have been proven to be both reasonable and practical have been selected or favored over measures that are experimental or unproven.

Combined with the effects assessment descriptions as noted previously, Sections 7.4 to 7.9 provide a description of the measures that will be adopted to manage the Project's environmental and social effects. Those measures are not included as part of the normal project, carried forward to chapter 10, where there are summarized and costing, timing and responsibilities are identified. Chapter 10 provides a brief description of the residual (or net) effects that are predicted following the application of the mitigation measures. Analysis of residual effects has been included and is consistent with IFC's Performance Standards. A statement on the residual effect for each potential impact following mitigation application is provided in the chapter 10 mitigation measures tables. The residual effects statement was determined giving consideration to the following assessment criteria:

- **Magnitude of the Residual Effect** – Compliance with regulatory limits, guidelines, and thresholds. To what extent would the functionality of the environmental system or population be affected?
- **Geographic Extent of the Residual Effect** –project site, nearby communities, municipality, district, country
- **Duration of the Residual Effect** – short term, long term, permanent, irreversible
- **Frequency of the Residual Effect** – continuous, frequent, sporadic

Monitoring Action Plan – Monitoring will be carried out to provide verification that the Project performs as designed, to confirm that mitigation measures are performing as predicted, and to identify unanticipated effects. Corrective action plans will be developed to address situations where the project in not in compliance with required performance specification, or situations where proposed mitigation is not preforming as predicted. The project monitoring actions during construction and operations are provided in Chapter 10.

7.2 Impacts Identification and Assesment

The potential project issues (potential effects) have been identified using a modified Leopold matrix approach. The approach consists of a matrix with columns representing the various project activities, and the rows representing the various environmental factors to be considered (see Table 7.2).

The Project activities, and the environmental factors to be considered, were identified considering:

- The detailed description of the project presented in Chapter 4 of this EIA report, including built consideration in mitigation and management measures (e.g., treatment system to treat wastewater before discharge);
- The environmental and social setting for the Project;
- Stakeholder comments and input;
- The TOR for the EIA issued by MARN;
- Potential issues provided in IFC Performance Standards and WBG EHS Guidelines; and
- Professional experience of the EIA project team with projects of a similar nature.

The Project activities to be used in the screening matrix, covering both the construction phase and operations phase, are listed and described in Table 7.1. The environmental factors to be considered are listed in the completed screening matrix table, Table 7.2.

The completed evaluation matrix offers the potentially significant interactions identified by the EsIA Team. Each cell in the matrix indicates a potential interaction between a specific project activity and a specific environmental factor. The cells where the interaction was considered could lead to a potentially significant effect (positive or negative) marked according to detail:

- ⊕ Potentially positive effect resulting from normal construction or operation activities;
- ⊗ Potentially negative effect resulting from normal construction or operations; and
- ∅ Potentially negative effect, which would only occur if standard mitigation and management measures failed (e.g. inadvertent release of hazardous material).

The potential issues identified in the evaluation matrix, and the justification of each, are presented in Table 7.3. The detailed assessment of each impact, forms the balance of chapter 7.0 of this report EsIA, organized by the headings of the environmental impacts. In addition, three sub-sections are provided to address impacts associated with associated facilities, ecosystem services, and cumulative impacts. The assessment of ecosystem services is provided in Section 7.8.

In accordance with the format and content specified in the terms of reference provided by the MARN for the EsIA, an analysis of the major hazards is included in a separate chapter of this report (Chapter 9).

Table 7.1 – Project Activities Used in the Impact Assessment Matrix	
Phase Activity/ Characteristic	**Description**
CONSTRUCTION PHASE	
Cleaning and Site Preparation	Vegetation extraction and removal Installation of safety fences
Earthwork	Stripping/removal of topsoil Cut and fill activities, including leveling of the top layer Drilling and excavation.
Driving piles (on land and sea)	Mechanical driving of piles to provide support for the construction of a temporary trestle and possibly for the Maritime Terminal (off-shore), as well as the foundations of the central thermal power plant (pending results of the Geotechnical study)
General ground construction activities	<u>Construction on land will include:</u> • Masonry and concrete Works • Woodwork • Electrical work, • Blacksmith's, metal carpentry, and metal structures • Manufacturing and assembly • Plumbing, installation of chimneys and pipes • General works • Welders and related machine operators • Operation of heavy equipment
General offshore construction activities	<u>Construction at sea will include:</u> • Marine Removal sediment and provision for the seabed preparation, for the Maritime Terminal, and pipeline trenching • Seabed Preparation. • Concrete formwork. • Caissons Installation or protection cell structure (cofferdam or breakwater). • Electric works; • Blacksmithing, metalworking, and metal structures; • Manufacturing and assembly; • Plumbing, piping installation; • General works; • Welders and related machine operators; and • Vessels Operation.

Table 7.1 – Project Activities Used in the Impact Assessment Matrix	
Phase Activity/ Characteristic	**Description**
Traffic related to construction	Traffic related to the construction stage including the movements of: • Buses and vehicles to transport workers to and from the site; • Small vehicles such as pick-ups; • Heavy vehicles (for example, tippers, trucks transporting materials); and • Abnormal and large loads (e.g. special conveyors, multi-wheel for moving heavy equipment such as engines)
Storage, handling, use and disposal of raw materials, waste and hazardous waste	Hazardous supplies or raw materials, necessary for construction including fuels, lubricants, solvents, acids and bases, and other chemicals and compound products. Hazardous waste incluide empty containers, used lubricating oils, solvents and other reagents, batteries and other hazardous consumer products, and other human biological waste.
Cleaning and pressure testing of tanks and pipelines	Hydrostatic pressure tests for the valves pressure valves and piping will be made. Upon test completion, the water will be sampled / analyzed prior to discharge. Contaminant-free water will be discharged into the existing drainage channel. The contaminants water free will be discharged into the existing drainage channel. If a contamination is detected, the water will be sent to a treatment plant prior to discharge. The test shall be completed in accordance with EN 14620-5 (1 test, 24 hours duration).
Disassembling of the temporary trestle used for construction, and access road.	Once all construction at sea (off-shore) is completed, the temporary trestle will be removed and disassembled. This would involve removing the deck from the platform. The supporting piles would be removed (if technically possible) or cut at or just below the level. With respect to the access road through the cliff, small terraced works would be done to minimize erosion, and re-vegetation where reasonable/feasible.
Labor Force Management During Construction	Workforce management during construction, including hiring, workers training and management. The workers in general, will be Salvadoran citizens. If required, foreigners will be hired for some specialized positions. No provision will be provided for workers' housing - Some buses will be used to transport workers from Sonsonate and San Salvador to the work site.
Purchasing and Supply Chain	Goods and purchase services necessary for the Project, including: Food, terracing, concrete supply, laboratory services of quality control, transport, equipment rent , among others. Materials for construction include: cement, sand, gravel, steel, wood, bricks, doors, windows, insulation material, pipes (plastic and metal), electrical equipment and equipment, among others.
Security	Establishment of in-situ security personnel and security equipment, including fences, patrols and checkpoints and access control.

Table 7.1 – Project Activities Used in the Impact Assessment Matrix	
Phase Activity/ Characteristic	**Description**
OPERATION PHASE	
LNG Delivery	A maximum of 32 LNG deliveries will be made on tankers over the course of a year, including inbound and tankers outbound shipping and mooring, and LNG transfer from vessel / to the FSU LNG Storage Tank. Note that the maximum deliveries number for the Power Plant operation are 8 vessels per year. To reach the 32 deliveries, there would need to be demand for natural gas from other users, as such this is a longer term projection. .
Facilities physical presence	The facilities physical footprint and presence , including temporary trestle, FSRU marine enclosure, LNG pipelines, thermal power station, engine room, substation, and other structures and supporting infrastructure, including internal roads and parking areas.
General operating activities	General operating activities include: • Route maintenance and cleaning activities (e.g. maintenance of property, periodic painting, cleaning of drainage channels, etc.); and, • Major maintenance related to scheduled outages, as well as unscheduled outages (e.g. engine maintenance).
LNG storage, management, and regasification	The LNG will be stored in the FSU that will be docked next to the installation of the Maritime Terminal that will contain the FSRU. The LNG will be transferred from the FSU to the FSRU for re-gasification and will then be transported to the thermal plant through a pipeline.
Regasification Sea Water Draw & Discharge	Sea water is required to warm the LNG to convert it to NG (vaporization). This water will be drawn from inside the cofferdam/enclosure and then discharged at a rate and volume of 10,000 m3/hr at two locations outside of the cofferdam. This water will be discharged at a cooler temperature than ambient but will not exceed a delta of 5C degrees.
Boiler Cooling Water Sea Water Draw & Discharge	Water will also be drawn to cool the FSU and FSRU engines/boiler. 10,000 m3/hr will be drawn/discharged for the FSU and 700m3/hr will be drawn/discharged for the FSRU. The FSU water will be drawn and discharged from outside the cofferdam/enclosure. This water will be discharged at a warmer temperature than ambient but will not exceed a delta of 5C degrees.

Table 7.1 – Project Activities Used in the Impact Assessment Matrix	
Phase Activity/ Characteristic	**Description**
Energy Generation	Natural gas combustion in reciprocating engines-generator sets to generate electricity. Steam generated from the waste heat in the exhaust gases will be used to power a steam turbine-generator set. Plant cooling will be provided by roof-mounted, air-cooled, fin-fan radiators. Low-voltage electricity from the generators will be directed to transformers located in the on-site switchyard, which will step-up the voltage to the 230 kV needed for the transmission line. There will also be transformers that step voltage down to 115 kV for an additional interconnection.
Supply and Water Treatment of the Central Thermal Power Plant	Abstraction of 30 m^3 / h of water, through a well of underground water in the site. Raw water will be treated prior to use in the boiler, as well as other process that water needs, and potable water.
Storage, handling, use and disposal of hazardous materials and waste	Hazardous raw materials required for operation (other than LNG and natural gas) include: engine lubricating oil, solvents, acids and bases, and other chemicals and compounds. Hazardous waste includes empty containers, used lubricating oils, solvents and other reagents, used filters, batteries and other hazardous consumer items, and other human biological wastes.
Wastewater discharge	The liquid waste includes discharge, water from the boiler, washing water and drains. The Waste water discharge includes water from the water treatment system, boiler purge, washing water, and waste water.
Stormwater Management	A stormwater management system at the site will collect and direct rainfall that falls on the plant site, and will discharge it into the existing channel on the property west side of the Thermal Power Plant. The pipeline corridor will be graded to maintain existing surface water drainage patters.
Labor Force Management during the operations phase	Workforce management during the operation stage, including hiring, training, and personnel management. For operations the majority of workers will be nationals, and displace to the power plant on a daily basis. There are no provisions for the workers housing.
Purchasing and Supply Chain	The goods and services Purchase necessary for operations, including food, chemicals, transportation services, waste management services, and other consumables.
Facility safety	On-site security personnel establishment, and security equipment, including fences, patrols, etc. For the Marine Terminal there will be a 300m exclusion zone, applicable to all ships, and there will be a minimum exclusion zone of 500m radius, applicable to non-CEPA vessels. Those restrictions zones will be confirmed with the Acajutla Port Authority during the design detail.

Table 7.2 – Impacts Identification Matrix :⊗ Potential negative interaction resulting from normal activities, ⊕ Potential positive interaction resulting from normal activities, ∅ Potential interaction as a result of an accident or abnormal conditions

Environmental factors		The Project Elements and activities																											
		Construction phase													Operations phase														
		Logging and choping off	Earthwork	Driving piles (on land and sea)	Trenching and Installation of Natural Gas Piping	Marine Sediment mannagement Removal and Preparation of the Marine	General construction activities on land	General construction activities at sea	Traffic related to construction	Storage, handling, use and disposal of materials, waste and hazardous waste	Cleaning and pressure testing of tanks and pipelines	Workforce management during construction	Purchasing and supply chain	Facility safety	LNG delivery	The facilities physical presence	General operating activities	LNG storage, management and regasification	Transfer of NG Vía Pipeline	Water discharge from the Regasification process	Energy generation	Water supply	Storage, handling, use and disposal of materials, and hazardous waste	Wastewater discharge	Rainwater management	Labor Force Management during the operations stage	Purchasing and Supply Chain	Facility safety
Air quality	Environment air quality	⊗	⊗		⊗		⊗	⊗	⊗												⊗							
	Disturbing dust	⊗	⊗		⊗		⊗	⊗	⊗																			
Greenhouse emissions and climate change							⊗	⊗	⊗									⊗			⊗							
Noise	Disturbing noise	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗												⊗							
	Low Frequency Noise																				⊗							
Soil	Quality of soil (contamination)									∅													∅					
	Soil quality (physical)		⊗				⊗																					
Superficial water	Quality		⊗	⊗	⊗	⊗				∅	⊗												∅	⊗	⊗			
	Quantity		⊗				⊗									⊗							∅	⊗	⊗			
Underground water	Quality			⊗	⊗					∅	⊗						⊗					⊗	∅	⊗				
	Quantity			⊗												⊗						⊗	∅					
Seawater	Quality			⊗	⊗	⊗		⊗		∅					⊗			⊗		⊗			∅					
Coastal dynamics	Marine currents and sediment transport					⊗										⊗												
Protected natural areas	Terrestrial																											
	Marine																											
Terrestrial Biota	Flora	⊗			⊗					∅													∅					
	Fauna	⊗		⊗			⊗		⊗	∅						⊗	⊗						∅					
Marine Biota	Flora			⊗	⊗	⊗	⊗	⊗		∅					⊗	⊕				⊗			∅	⊗				

Table 7.2 – Impacts Identification Matrix :⊗ Potential negative interaction resulting from normal activities, ⊕ Potential positive interaction resulting from normal activities, ∅ Potential interaction as a result of an accident or abnormal conditions

Environmental factors		The Project Elements and activities																										
		Construction phase													Operations phase													
		Logging and choping off	Earthwork	Driving piles (on land and sea)	Trenching and Installation of Natural Gas Piping	Marine Sediment mannagement Removal and Preparation of the Marine	General construction activities on land	General construction activities at sea	Traffic related to construction	Storage, handling, use and disposal of materials, waste and hazardous waste	Cleaning and pressure testing of tanks and pipelines	Workforce management during construction	Purchasing and supply chain	Facility safety	LNG delivery	The facilities physical presence	General operating activities	LNG storage, management and regasification	Transfer of NG Vía Pipeline	Water discharge from the Regasification process	Energy generation	Water supply	Storage, handling, use and disposal of materials, and hazardous waste	Wastewater discharge	Rainwater management	Labor Force Management during the operations stage	Purchasing and Supply Chain	Facility safety
	Fauna			⊗	⊗	⊗		⊗		∅					⊗	⊕				⊗			∅	⊗				
Disease vectors		⊗	⊗				⊗									⊗	⊗								⊗			
Security and protection of the community		∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅		∅	∅		∅	∅	∅				∅			∅		∅
Demography	Population											⊗														⊕		
	Cultural characteristics																											
Views and landscape																∅												
Community Health	Human health	⊗	⊗	⊗		⊗	∅	∅	∅	∅		⊗					∅	∅			⊗		∅	⊗		⊗		
	Health infrastructure											⊗														⊗		
Recreation		⊗			⊗		⊗	⊗	⊗							∅			∅									
Relocation or eviction	Relocation or eviction of residences or businesses / way of life																											
Land use	Current land use				⊗														∅									
	Projected land use				⊗														∅									
Streets, traffic and public services	Streets and traffic								⊗			⊗					⊗											
	Public services (water / wastewater, energy)		⊗		⊗		⊗	⊗									⊗											
Artisanal dock and commercial fishing				⊗		⊗		⊗							⊗	⊗	⊗	⊗										
Puerto de Acajutla	Security and operations			⊗		⊗		⊗	⊗						⊗	⊗		⊗										

Table 7.2 – Impacts Identification Matrix :⊗ Potential negative interaction resulting from normal activities, ⊕ Potential positive interaction resulting from normal activities, ∅ Potential interaction as a result of an accident or abnormal conditions

Environmental factors		The Project Elements and activities																										
		Construction phase													Operations phase													
		Logging and choping off	Earthwork	Driving piles (on land and sea)	Trenching and Installation of Natural Gas Piping	Marine Sediment mannagement Removal and Preparation of the Marine	General construction activities on land	General construction activities at sea	Traffic related to construction	Storage, handling, use and disposal of materials, waste and hazardous waste	Cleaning and pressure testing of tanks and pipelines	Workforce management during construction	Purchasing and supply chain	Facility safety	LNG delivery	The facilities physical presence	General operating activities	LNG storage, management and regasification	Transfer of NG Via Pipeline	Water discharge from the Regasification process	Energy generation	Water supply	Storage, handling, use and disposal of materials, and hazardous waste	Wastewater discharge	Rainwater management	Labor Force Management during the operations stage	Purchasing and Supply Chain	Facility safety
	in Puerto de Acajutla and dock																											
Economy	Employment											⊕														⊕		
	Economic activity												⊕														⊕	
Archaeological, cultural, ceremonial and historical resources		⊗	⊗	⊗			⊗																					
Workers Health and safety		∅	∅	∅		∅	∅	∅	∅	∅	∅				∅		∅	∅					∅					

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Table 7.3 – Justification for Identifying Potential Interactions / Significant Issues			
Environmental factors		**Basics for the problems identification/significant interactions**	
		Construction phase	**Operations phase**
Air Quality	Ambient air quality	Earthworks, General Construction activities on shore and offshore, and construction related traffic all involve operation of equipment with internal combustion engines that generate air emissions.	Natural gas fuel use will result in NO emission $_x$, and small to SO_2 negligible amounts and particulate matter (TSP, PM_{10} & $PM_{2.5}$). Other sources were considered to be negligible.
	Nuisance dust	Activities with potential for raising dust include earthworks, general on-shore construction activities involving excavation and soil handling and dusty material, and construction related traffic. Dust from other activities was considered to be in-significant.	Operation phase activities are not considered to have potential for raising significant dust levels
Greenhouse gas emissions and climate change		Heavy machinery, worker transportation, and other activities using internal combustion engines will generate greenhouse gases emissions .	The power plant operation , and fugitive natural gas will result in greenhouse gases emission.
Noise	Nuisance noise	Machinery Operation and portable power driven equipment, pile driving, and other general construction related activities will generate noise.	Power plant Operation will generate significan noise level .
	Low Frequency Noise	not applicable	Reciprocating engine power plants can generate significant low frequency noise, and noise induced vibration effects .

Table 7.3 – Justification for Identifying Potential Interactions / Significant Issues			
Environmental factors		**Basics for the problems identification/significant interactions**	
		Construction phase	**Operations phase**
Soil	Soil quality (contamination)	Soil contamination could result from a unintentional release of a hazardous raw material or hazardous waste.	Soil contamination could result from a unintentional release of a hazardous raw material or hazardous waste.
	Soil quantity (physical)	Excavation, handling, stockpiling and movement of soils during earthworks and movement of heavy machinery can result in mixing of topsoil and subsoil, erosion, and compaction.	Not applicable
Surface water	Quality	Surface water contamination could result from a unintentional release of a hazardous material used or produced on site.	Surface water contamination could result from a unintentional release of a hazardous material used or produced on site.
	Quantity	Changes to the site as a clearing and earthworks result will affect the drainage characteristics of the site and may increase peak storm water flows .	The facilities physical presence including building and impervious surfaces and the storm-water management system design will affect the drainage characteristics of the site and may increase peak storm water flows.
Groundwater	Quality	Ground water contamination could result from a unintentional release of a hazardous raw material or hazardous waste.	Ground water contamination could result from a unintentional release of a hazardous raw material or hazardous waste.
	Quantity	During construction water use will be low compared to the operation period.	The power plant Operation will require approximately 4.5 liters of water per second

Table 7.3 – Justification for Identifying Potential Interactions / Significant Issues			
Environmental factors		**Basics for the problems identification/significant interactions**	
		Construction phase	**Operations phase**
Seawater	Quality	Marine water contamination could result from a unintentional release of a hazardous material used or produced on site or sediment dispersion in preparing the seabed for marine terminal enclosure construction.	Marine water contamination could result from an unintentional release of a hazardous material used or produced on site. LNG Release to NG warming water and water used for FSU/FSRU engine cooling could result in change in water temperature in vicinity of the facility. On-board wastewater treatment plant discharge could also impact marine water.
Coastal dynamics	Marine currents and sediment transport	Sediments Dredging to prepare seabed for marine terminal and pipeline installation will result in increased turbidity and sediment deposition in the surrounding area.	The marine physical presence marine terminal enclosure could affect currents and the sediment transport patterns.
Protected natural areas	Terrestrial	Not applicable - no protected areas in the influence area.	Not applicable - no protected areas in the influence area.
	Marine	Not applicable - no protected areas in the influence area.	Not applicable - no protected areas in the influence area.
Terrestrial Biota	Flora	The main effects to flora will occur during the site clearing. Flora might also be affected by a unintentional release of a hazardous raw material or hazardous waste.	Flora might be affected by a unintentional release of a hazardous raw material or hazardous waste.
Terrestrial Biota	Fauna	The main effects to flora will occur during the site clearing. Fauna might also be affected by a unintentional release of a hazardous raw material or hazardous waste, on-site traffic and disturbance from general activities.	Fauna might be affected by a unintentional release of a hazardous raw material or hazardous waste.

Table 7.3 – Justification for Identifying Potential Interactions / Significant Issues			
Environmental factors		**Basics for the problems identification/significant interactions**	
		Construction phase	**Operations phase**
Marine Biota	Flora/Fauna	Offshore pile driving, marine sediment removal and disposal, and marine terminal enclosure construction will generate noise and require lighting that can have lethal and sub-lethal effects on marine mammals and other marine fauna. The at-sea disposal of the dredged sediment could also impact marine biota. Fauna might also be affected by a unintentional release of a hazardous raw material or hazardous waste, on-site boat traffic and disturbance from general activities	Marine physical presence terminal enclosure creates cover and structures that might improve habitat for certain flora and fauna. Marine biota could be affected by: warm release /cold water, wastewater release from the on-board treatment facility, unintentional release of a hazardous raw material or hazardous waste, boat traffic to access the facility, and disturbance from general activities. Further, facility lighting can affect behaviour of marine life, particularly turtles.
Disease vectors		Clearing and earthworks can change drainage patterns and create breeding habitat for disease vector, specifically mosquitoes	The physical presence of the facility, storm-water management and general activities can create breeding habitat for disease vector, specifically mosquitoes
Community safety and security		While secure construction sites are generally not considered to pose a risk to community safety and security, most activities are a risk to anyone who enters the site without authorization. There are also risks to shipping and boaters from off-shore activities.	There is a risk to shipping and boaters from offshore activities related to LNG delivery and other activities. Operation activities are a safety risk to anyone who enters the site without authorization.
Demography	Population	workers influx and job seekers may affect cause a temporary increase in the population of the host community	Workforce needed for operation may cause a small but permanent increase in host community population .
	Cultural Characteristics	the Project Construction is not expected to affect cultural practices of the host community norms	The project Operation is not expected to affect cultural practices of the host community norms.

Table 7.3 – Justification for Identifying Potential Interactions / Significant Issues			
Environmental factors		**Basics for the problems identification/significant interactions**	
		Construction phase	**Operations phase**
Landscape and Views		Not applicable	The physical presence of the facilities has potential to affect the landscape and vistas
Community Health	Human health	Normal construction activities have potential to affect community health (e.g., noise and dust emissions). There is also potential that accidental events could affect health (e.g., accidental release of hazardous material)e.g.e.g.	Normal construction activities have potential to affect community health (e.g., emissions to air). There is also potential that accidental events could affect health (e.g., accidental release of hazardous material)e.g.e.g.
	Health infrastructure	The construction phase workers and job seekers possible influx could place stress on the existing health infrastructure	Workers possible influx could place stress on the existing health infrastructure
Recreation		Pile diving and general offshore construction activities may affect tourism and recreational activities related to boating, the CEPA shoreline park use, and Acajutla Beach use. Onshore construction (pipeline installation) may affect the CEPA sports complex use.	There is negligible potential to affect recreation activities or facilities once the project is operational.
Relocation or eviction	Relocation or eviction of residences or businesses / lifestyle	All land used for construction will be obtained from CEPA – no physical resettlement of residences or business will be required	All land used by the facility for operations will be obtained from CEPA – no physical resettlement of residences or business will be required
Land use	Existing / planned land use	The land to be used for the project is located within an industrial area, and is zoned for industrial uses. The project activities are consistent with the existing and planned land use	The land to be used for the project is located within an industrial area, and is zoned for industrial uses. The project activities are consistent with the existing and planned land use

Table 7.3 – Justification for Identifying Potential Interactions / Significant Issues			
Environmental factors		**Basics for the problems identification/significant interactions**	
		Construction phase	**Operations phase**
Roads, traffic	Traffic and roads	Project related traffic, including heavy goods loads needed during earthworks and delivery of equipment, supplies and machinery, and traffic for personnel may affect road conditions and congestion	The low level of traffic generated during operations is not expected to have a significant effect on road conditions, capacity, or congestion
Public Services	Public services (energy, water and wastewater)	The project will use onsite well for water and be self-sufficient for power and wastewater. The project will require disposal of waste material at the local, municipal land fill	The project will not require connections with any public utilities. The project will generate modest amounts of waste suitable for disposal at the local, municipal land fill
Fishing and artisanal pier		The temporary trestle Construction, starting with pile driving, will displace oyster and tuberos fishers from accessing fishing grounds along the shoreline. During construction of the marine terminal enclosure, an exclusion area may impact fishing and travel to fish areas. Sediment dispersion from dredging could temporally impact fish activity in the port area.	The physical presence of the marine terminal enclosure and associated restriction area may impact local fishing grounds and travel to off-shore fishing grounds.
Acajutla Port	CEPA pier and port operations and safety	Construction activities, including trestle pile driving and construction of the mariner terminal enclosure, will introduce additional ship/boat traffic in the port area and introduce new navigation hazards	The physical presence of the marine terminal enclosure, and the need for restricted zones around the facility including the LNG Tankers when at the terminal create new navigation hazards for ship traffic in and out of the Port
Economy	Employment	Construction will require a peak labour force of 1200 workers	Operations will require a labour force of about 60 workers
	Economic Activity	Procurement of goods and services will boost the local economy	Procurement of goods and services will boost the local economy

Table 7.3 – Justification for Identifying Potential Interactions / Significant Issues		
Environmental factors	**Basics for the problems identification/significant interactions**	
	Construction phase	**Operations phase**
Cultural, archaeological, ceremonial and historical resources	Construction activities involving excavation, including clearing, earthworks, piling, foundations Have potential to affect unidentified archaeological resources	Not applicable
Occupational health and safety	All construction activities pose a risk to worker health and safety	All operations activities pose a risk to worker health and safety

The remaining sections of this chapter discuss the interactions identified in the environmental factor matrix.

7.3 Project's Benefits

The Project will convey benefits at the national, regional and local levels of the community. A description of key benefits is provided in the following sections:

- Economic contribution to the social development of the Acajutla municipality (through the Social Investment Fund for Local Development (FISDL) and the municipal hall;
- Employment;
- Foreign direct investment;
- The natural gas introduction to El Salvador; and
- Improved reliability in the country's energy supply.

7.3.1 Fund for Local Development Works

Energía del Pacífico, Ltda de C.V. (EDP) is committed to economic and social development in the Acajutla Municipality , allocating an annual amount of over USD $ 500,000, which represents an important investment for the area.

In the second quarter of the year 2015, after approval by the Acajutla city Municipal Hall the first projects list to be implemented by EDP during the period June 2015-May 2016, included the following works:

- Electrification in Caserío La Planta;
- Improvement of Calle Benigno Cabrera, located in CEPA Citadel;

- Calle RASA Improvement, located in CEPA Citadel;
- Enlargement of Plazuela de la Resistencia Indígena and Calle Huiscoyolar; y
- Counterpart for the project "Introduction of sewage system in Lotificación Port".

So after several meetings with representatives of the Municipal Hall and FISDL, on April 28 a Technical Cooperation Agreement between EDP and those entities was signed. It establishes the framework from which to propose, select, prioritize and approve works of social and economic development in the Acajutla Municipality . According to the Supply Contracts clause 5.6 provisions that EDP has signed with the distributors, as well as in number xvii of Annex 3, regarding the TECHNICAL, LEGAL, FINANCIAL AND COMMERCIAL REQUIREMENTS of the Free Bidding Bases No. DELSUR-CLP-001-2012.

The said Agreement is intended to serve as a basis for the joint and reciprocal actions execution for the previous works approval of the by the Muncipal Council and FISDL, in the time and manner established in the above mentioned provisions, whose execution will be in charge of EDP.

For the projects EDP implementation has selected as "partner executor" the strengthening and social action program (hFORTAS). It belongs to the FUSADES development center, whose work is to implement projects and efforts to promote economic and social development in the country, as is the commitment acquired by EDP through the bidding rules and tender contracts previously related.

After several meetings with the Municipal Council , the FISDL and FORTAS representatives, , being this last one our "partner executor" from such works, we were informed that the previous listing would be modified. This, with the aim of tackling and prioritizing the most urgent needs in the communities of the municipality, being conformed the new listing for the period June 2015-May 2016 for the following projects:

- Improvement of Calle Benigno Carrera, located in CEPA Citadel;
- Improvement of Calle RASA, located in CEPA Citadel; and
- Reconstruction of "Casa Capricho" for Vocational Training Center, as a "USAID violence Prevention strengthening in the Acajutla Municipality , Sonsonate Department .

In the fourth quarter of the year 2015 began the technical preparations to start with the construction works for each projects, which it held several meetings with the municipality representatives, in order to finalize details and obtain the corresponding local permissions.

Projects for improving the Calle Benigno (407 meters in length with a cost of $ 228,702.89) and Calle RASA (205 meters in length with a cost of $ 116,282.76) were started on February 1, 2016. On July 18,

2016, the improvement project of Calle Benigno was completed. Subsequently, on August 23, 2016, the improvement project of Calle RASA was completed.

The work provided to the Acajutla Municipal Hal is recorded in the Delivery Report dated September 2, 2016, thus finalizing the projects contemplated for the period June 2015 - May 2016.

The "Casa Capricho" Reconstruction project for Vocational Training Center was discarded from June 2015-May 2016, with unused funds remaining available for this project in the period June 2016-May 2017. This is due to Legal issues with the land owenership deed where the project would take place. The land is not legally registered in the CNR by the municipality. On this project, only the Technical Dossier has been worked out which includes consultancy on the design and equipment.

According to June 2016-May 2017 periods works, in August of this year, the municipal agreement has been emited in order to ratife and approve the list of the following works:

- Well study of Colonia El Milagro, Municipality of Acajutla;
- Introduction of electrical energy in Caserío El Porvenir, Cantón Metalio, Municipality of Acajutla;
- Introduction of electricity in Caserío Los Abetos, Canton El Suncita, Municipality of Acajutla;
- Introduction of electrical energy in Caserío Miramar, Cantón Metalio, Municipality of Acajutla;
- Installation of decorative lamps and ordering in Boulevard 25 de Febrero up to Capitanía, Boulevard Sensunapan and Barrio La Peñas;
- Roofing of basketball court in COED Metalio, Canton Metalio, Municipality of Acajutla;
- Concrete works in 6 passages Colonia Los Morritos, Municipality of Acajutla;
- Construction of a house for the Tourism Police, Los Cóbanos Village, Punta Remedios, Acajutla Municipality;
- Concrete works Calle Principal de la Colonia Magdalena to CA:12, Municipality of Acajutla;
- Construction of soccer field, parking and main accesses in Colonia Obrera, Municipality of Acajutla;
- Main market construction, Canton Metalio, Municipality of Acajutla;
- Roofing of basketball court and construction of perimeter wall in communal house Colonia IVU, Acajutla Municipality; and
- Construction of vocational training center (Casa Capricho) Barrio Las Peñas, Acajutla Municipality.

At the moment, the mentioned projects profiles above have been elaborated and FUSADES has been requested the requirements for each one and to be able to elaborate the projects Technical Dossier. Finally, for the period from June 2017 to May 2018, EDP has started with the respective process but for now is waiting for the project listings approval by the Acajutla Municipality, in conjunction with the FISDL.

Photo 7.1 – Calles RASA Inauguration and Benigno Carrera

Source: Energía del Pacífico files, 2016

7.3.2 Employment

Most of the workforce that will WORK for the Project will be national, most of them are expected to come from local communities in the Acajutla municipality. The construction phase will provide temporary employment , up to 1,200 people during the peak construction period. A small number of workers are likely to be foreigners, to provide Project management services or to contribute with skills s that cannot be provided by the national workforce. The operating phase will create approximately 60 permanent jobs.

Indirect employment will rise in the area as a result of the demand created by the Project for goods and services, including housing, food and beverage industries. In addition, during the project life, temporary jobs will be created annually as a result of the projects execution financed through the social development fund.

Individuals who are trained or acquire knowledge and experience during the project construction phase will acquire skills that can be used to secure employment in future construction projects or other similar

projects. It is also an added value for the municipality at the community and regional level,since the skilled labor availability is one of the factors that industries use when considering locations and expansion, or creation of new projects.
Section 7.6.10 discusses the economic impacts of the Project in greater detail.

7.3.3 Foreign Direct Investment

The project will require an investment of approximately USD $ 800 million. It is expected that this investment will contribute to economic development in El Salvador, being mainly with foreign investment.

7.3.4 Introduction of Natural Gas to El Salvador

The Project will invest the fixed costs necessary for the establishment of the LNG Terminal. Once the terminal is installed, the excess capacity of the terminal can be used to supply gas to other customers. At the time of drafting this document, no concrete plans have been developed for the additional use of gas. However, based on the current availability of fuels and prices in El Salvador, it appears that there is potential for existing thermal power plants, which use imported liquid fuels, to switch with natural gas. Other energy-intensive industries that depend on imported liquid fuels, such as cement production, may also consider switching with natural gas. Those uses will require the development of the necessary infrastructure to transport and measure gas to those large consumers. These potential future developments would be subject to the applicable regulatory permitting and planning processes.
Other gas markets that would require the Government to establish new regulatory regimes include the gas distribution services development for municipalities and gas exports to distant markets including Guatemala. Those projects would be subject to the applicable regulatory authorization and planning processes.

7.3.5 Reliable Power Supply

The Project will be able to provide up to 380 MW of electrical power at its maximum capacity. This represents about a third of the current installed capacity in the country. It is anticipated by not adding additional energy to the national system, El Salvador will experiment energy shortages, due to the anticipated increase for the demand from 2018 (According to data from the National Energy Council CNE).

7.4 Impacts to Physical Conditions and Characteristics

Further the Table 7.2, "Impact Assessment Matrix", The physical environmental factors have been identified and assessed and include:

- Air quality;
- Greenhouse Gas Emissions and Climate Change;
- Noise and Vibrations;
- Soil;
- Surface water;
- Groundwater;
- Sea water and marine sediments; and
- Coastal Dynamics.

7.4.1 Air Quality

7.4.1.1 Methodology

The Impacts Assessment Matrix, Table 7.2, Section 7.2, identified the following significant potential interactions between project activities and air quality characteristics:

- Construction phase
    - Cleaning and Site Preparation;
    - Earthworks;
    - General ground construction activities;
    - General activities construction in the sea; and
    - Traffic related to construction.
- Operation phase
    - Power generation.

To assess the impact of the Project on air quality, a qualitative assessment of activities during the construction phase was completed, and a quantitative assessment of air quality modeling for the operating phase was completed.

The assessment also took into account current baseline air quality conditions. As described in more detail in Section 5.2.2 of this ISA, Project-specific monitoring indicates that concentrations of carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxides (NOx), and particulate matter with aerodynamic diameter less than 2.5 microns ($PM_{2.5}$), are all within the permissible concentrations or limits of El Salvador's air quality standard. Measured concentrations of total suspended particulate matter (PST),

and particulate matter with aerodynamic diameter less than 10 microns (PM_{10}), exceeding the Salvadoran air quality criteria in some cases. This is further elaborated in Section 5.2.2.

For this project, ambient air quality monitoring was carried out for O_3, NO, NO2, NOX, CO and $PM_{2.5}$. $PM_{2.5}$ was monitored in response to concerns that baseline levels were elevated. Because $PM_{2.5}$ levels monitored within the airshed were well below the criteria, and $PM_{2.5}$ emissions from natural gas combustion are expected to be very low, modeling of Emissions $PM_{2.5}$ was not carried out.

7.4.1.2 Construction phase

Project construction could have a short-term impact on air quality conditions in the study area, through the emission of criterion atmospheric pollutants (CAC) and particulate matter (e.g., dust).

The potential sources of CACs during construction would be air emissions from the operation of diesel and gas engine equipped stationary generators, motor vehicles, mobile construction equipment such as trucks, excavators, and graders, and jack-up barges and other vessels needed for construction of the trestle and marine terminal enclosure. Air emissions would also be generated from the temporary concrete batch plant that may be used if concrete cannot be sourced locally and/or the project constructor prefers to produce its own concrete on-site. The concrete batch plant, if required, will be located in the construction lay-down area. CACs associated with fossil-fuel (diesel and gasoline) burning include CO, SO_2, NO_X, particulate matter ($PM_{2.5}$ and PM_{10}), and volatile organic compounds (VOCs). Additionally, land clearing and earth moving could also result in dust impacts. However, the effects on air quality from construction activities would be localized, short-term and transient in nature, and therefore would be anticipated to be insignificant.

In addition to using equipment that complies with El Salvador's emission specifications and standards, the atmospheric emissions from the stationary generators will be managed through:

- Place stationary generators 50 m from the site boundary, to the south; and
- Apply regular equipment maintenance plan (including records and follow-up).

In addition to selecting modern modeling equipment and optimum conditions, emissions to the atmosphere from the operation of mobile sources (buses, trucks and other mobile equipment) will be managed through:

- Frequent engine maintenance (including a registration and tracking system);
- The use of buses for the workers transportation coming from Acajutla to the project site; and
- Anti-idling protocol.

Potential sources of particulate matter emission include soil exposed during land clearing, gravel props, dirt or other dusty materials, and the motor vehicles movement (especially on unpaved or untreated surfaces). Local actors identified this impact by dust generation as one of their main concerns.

A dust management plan will be applied to handle the emissions that could be generated. The Dust Management Plan, which will be prepared prior to the construction activities start, will include:

- A site map showing:
    - property boundary, contours, compass points, existing landforms, prevailing wind directions and adjacent features;
    - all areas and vegetation to be retained or left undisturbed;
    - all areas and vegetation that will be disturbed;
    - location of the proposed development, and facilities;
    - location of physical barriers such as fencing;
    - location of stockpiles and storage areas;
    - traffic routes and stabilized site access/exit points.
- Dust Control Measures (how dust will be managed on-site), including:
    - Construction Site Measures:
        - Fenced or block off areas to be protected
        - Use physical barriers to block wind (fence) and to trap larger particles blown at ground level (straw bales)
        - Site traffic control: post signage, erect fencing and place barriers to direct traffic; designate specific routes for haulage and access; set and enforce a maximum speed limit of 20 km/hr; Provide tire washing station at exit
        - Management earth moving activities: plan earth moving to minimize the amount of time the site is left cut or exposed, schedule works so that they are completed just prior to the time they are needed; and observe weather conditions and do not commence or continue earthmoving works if conditions are unsuitable (dry and windy); pre-water, if possible, the areas earmarked for disturbance and the material that is being moved
        - Use watering sprays during dry and windy conditions and during works that are raising dust
        - Stabilize soils that are likely to be exposed for long periods of time or whenever work is completed in an area with vegetation cover
    - Storage Piles/General Material Storage Measures:
        - Locate piles in sheltered areas
        - Place the pile lengthwise into the wind

        - Minimize the slope of the upwind surface (2:1 slope max)
        - Limit pile sizes
        - Install barriers on three sides (with no less than 50% material porosity)
        - Limit activity to the downwind side of the pile
        - Use the last in – first out management system.
        - Stabilize unused pile materials
    - Hauled Materials Management Measures:
        - Limit load sizes to ensure that material is not above the level of the vehicle sidewalls
        - Use bedliners to minimize seepage and material spillage from bottom-dumping trucks
        - Use material covers, such as tarpaulins, plastic or canvas, to cover the entire load and prevent spillage and windblown dust
        - Ensure driving practices are smooth and slow to reduce material spills
    - **Site Access and Exit Control Measures** (applies when vehicles are exiting the site to minimize the land dragging or other materials, towards the pave road, which increases the dust risk production.)
    - **the accesses and exits covering**, with a gravel cap or another material, on a sufficient length to eliminate the dirt and other materials dragged by the vehicles.
    - **Lavado de todas las ruedas del equipo y vehículos,** utilizando rociadores de agua manuales o automatizados.

    - **Wash all equipment wheels and vehicles,** using manual or automated waters sprayers.
    - **Cleaning or sweeping** of any soil deposits tracked into paved surfaces.
- Site Inspection Provisions
    - Regular inspections will be carried out to confirm compliance with the dust control measures specified in the plan, as well identify any issues where additional actions may be needed.

7.4.1.3 Operations Phase

During the operational phase, NOx and CO would be emitted from the groups of stacks associated with the LNG combustion engines from the Floating Storage and Regasification Unit (FSRU), the Floating Storage Unit (FSU), and the ship Freighter that could be docked and unloading to the FSU. There are also other sources of less significant emissions (e.g. combustion unit) associated with the operations phase.

Project operations may have an impact on air quality resulting from the following sources:

- 19 natural gas engines in the Central Power Plant will be the project emissions main source, and its planned operations (24 hours a day 7 days a week) would define this source as an important emissions source.
- The gas combustion unit of the LNG terminal should only be used for emergency purposes, more specifically to allow the pressure release from the LNG pipes in case of the process alteration. This operation represents a low frequency event associated with a small emissions source and therefore the gas combustion unit has been considered as an insignificant emissions source.
- Operation of FSRU natural gas generators (3 in total) that provide power for the regasification process. Those generators are expected to function regularly and have been included in the model.
- The natural gas boilers Operation of the FSU, while it is moored. Those boilers are expected to run regularly. As an alternative to those boilers, a generator can be used. The generator would function regularly and the "worst case" condition was included in the model.
- The natural gas boilers Operation of the LNG carrier, while it is docked and unloaded to the FSU. It is expected that those boilers will function regularly and have been included in the model.

Therefore, the assessment of the possible impacts on air quality includes the stack emissions from the the Thermal Power Plant operation, as well as the operations of the FSU and the FSRU, in a conservative manner, with the all equipment in continuous operation, as well as the ones that operate occasionally within the model.

The stack emissions dispersion into the atmosphere has been simulated using the AERMOD dispersion model system. It is the preferred regulatory model of the US Environmental Protection Agency (US EPA). For this project, AERMOD was used to predict maximum concentrations at ground level receptors that extend from the Generating Power Plant limit, up to 30 kilometers in all directions. The maximum concentrations predicted by AERMOD were compared to the El Salvador air quality criteria / standards. Table 7.4 presents the modeling results of the AERMOD dispersion.

The model considers the following project design elements to be implemented to manage potential impacts on air quality:

- The use of natural gas as a fuel for power plants, which does not have emissions of SO_2 and NOx and PM emissions compared with heavy fuel oil or coal-fired power plant;
- The use of the combined cycle system to further reduce the emission per MW of energy generated;

- The stacks Height (50 m) adjusted according to the "Good Engineering Practices", to minimize the boom drag effects; and
- Grouping individual chimneys into groups, to improve boom elevation, and reduce concentrations at ground level.

Emission rates and chimney parameters for the modeled emission scenarios are summarized in the Air Dispersion Modeling section of this report (see Appendix 5B). The emission rates of the significant sources were calculated using the following resources:

- Central Thermal power plant - Engine performance specifications, guaranteed by the manufacturer (Wartsila).
- FSRU, FSU, - Emission rates provided by the equipment supplier (Exmar).

In consultation with the Environment and Natural Resources Ministry (MARN), it was determined that the project emissions would be subject to comparison with the emission limits documented in the Draft Standard - Atmospheric Emissions, Fixed Point Sources (NSO 13.11.02: 11). More specifically, emissions associated with the plant would be subject to limits in Table 5 (maximum permissible emissions for the generation of electricity from internal combustion engines) of the Draft Standard. The Table below compares the emissions from power plants with those of the MARN limits.

Table 7.4 – Comparison of Emissions of the Central Thermal Power Plant with the Limits of Table 5 of NSO 13.11.02.11

Compound	Central Thermal Power Station Emission Level (mg/m^3)	Maximum Allowable Limit for New Sources (mg/m^3)
Nitrogen oxides	285	2700

Source: Draft of the Salvadoran Standard NSO 13.11.02.11

As indicated above, since the thermal power station will operate with natural gas, SO_2 and particulate emissions are expected to be insignificant. CO emissions are documented in Table 7.7 and CO_2 emissions are documented in Section 7.4.2. CO and CO_2 do not have maximum permissible limits comparing to Table 5 of NSO 13.11.02.11.

The inputs and assumptions applied to the modeling are :

- To obtain the AERMOD-ready meteorological data files, a 5-years top-of-the-line meteorological data set, generated using a meso-scale meteorological model was introduced to AERMET (Version 15181, US EPA, 2016). In the AERMET model, recommended the surface roughness values, Bowen ratio for average moisture conditions and Albedo (US EPA, November, 2004a) were selected. Based on the land cover within a 3km radius of the Project site, three different

sectors of windward surface characteristics were determined for use in AERMET modeling. Figure 3.1 (from Appendix 5B) illustrates the area within a 3km radius around the Project site. The ground cover compositions and the monthly the surface characteristics average of each sector are presented in Appendix 5B.

- Global elevation data from the Shuttle Radar Topography Mission 3 arc-set (SRTM3) was used for land calculations;
- Buildings and structures were profiled for plume dispersion calculations, with base elevations of all chimneys and building block building that will be 24 m above sea level (the current average elevation marked for constructions Of the Thermal Power Station), excluding the FSRU, FSU, and the LNGC freighter, which have a base elevation of 0m located in the sea;
- Conversion from NO to NO_2 was modeled by AERMOD using the ozone concentration (OLM) method with an annual ozone base concentration of 25 ppb;
- Recipient grids extended up to 30km away from site, removing recipients within property boundaries, as shown in Figure 1.1 of Appendix 5B. The recipient location is 100 m from the residential areas closest to the facility;
- Modeling was completed using AERMOD (Version 15181); and
- The proposed project was evaluated under different operational scenarios. The results showed that the scenario in which it was assumed that all the engines of the plant operated at 100 percent load, 24/7/365 represented the maximum expected impact on air quality.

Tables 7.5 and 7.6 show the parameters used for AERMOD simulations.

Table 7.7 provides the maximum predicted CACs concentrations at the soil level in the defined modeling area. The maximum concentrations foreseen correspond to the total of the existing baseline, plus the expected maximum concentrations provided by AERMOD.

As shown in Table 7.7, the maximum concentrations are below the applicable standards for environment air quality in El Salvador, with two exceptions: the 24 hours TSP concentration and the 24 hours PM_{10} concentration. For those two cases, the existing baseline concentrations already exceed El Salvador's standards. However, because the Power Plant contribution is a small fraction of the guideline limit (about 3% of the TSP standard and 5% of the PM_{10} standard), the Project impact is considered insignificant.

Table 7.5 – Parameters Entered to AERMOD – Central Thermal Power Plant									
# of engines	Group of Chimneys	Chimney Height (m)	Base elevation (m)	Chimney Temperature (K)	Chimney Diameter (m)	Speed (m/s)	Gas Volume Flow (m^3/s)	NO_X Emission Rate (g/s)	CO Emission Rate(g/s)
19	A	50	24	454.15	2.77	18.70	112.90	18.14	18.47
	B	50	24	454.15	3.92	18.70	225.90	36.25	36.97
	C	50	24	454.15	3.92	18.70	225.90	36.25	36.97
	D	50	24	454.15	3.20	18.70	150.60	24.17	24.63

Source: Wärtsilä 2016

Table 7.6 – Parameters entered to AERMOD - LNGC FSRU, FSU, *										
Source	Base elevation (m)	Platform height (m)	Height of Chimneys on deck of ship (m)	Chimney Elevation (m)	Chimney Temperature (K)	Chimney Diameter (m)	Speed (m/s)	Gas Volume Flow (m^3/s)	NO_X Emission Rate (g/s)	CO Emission Rate(g/s)
FSRU	0	17	20	37.00	698.15	0.67	35.00	12.34	1.96	1.39
	0	17	20	37.00	698.15	0.67	35.00	12.34	1.96	1.39
	0	17	20	37.00	698.15	0.67	35.00	12.34	1.96	1.39
FSUBOILE	0	15.5	20.75	36.25	449.15	1.30	3.50	4.65	0.74	0.29
	0	15.5	20.75	36.25	449.15	1.30	3.50	4.65	0.74	0.29
FSUGEN	0	15.5	20.75	36.25	698.15	0.60	35.00	9.90	0.78	1.50
LNGVESS	0	15.5	20.75	36.25	449.15	1.30	3.50	4.65	0.74	0.29
	0	15.5	20.75	36.25	449.15	1.30	3.50	4.65	0.74	0.29

* Additional modeling details are provided in Appendix 5B.

Source: Wärtsilä 2016

Table 7.7 – Predicted Impact on Air Quality						
Compound	**Average Period**	**Baseline Concentrations Air Quality (µg/m³)**	**Project Predicted Maximum Air Quality Concentration (µg/m³)**	**Estimated Cumulative Impact (Baseline + Project) (µg/m³)**	**Air Quality Criteria (µg/m³)**	**7.4.1.3.1.1.1 Project Impacts Assesment**
Nitrogen Dioxide	24- horas	11.0	134.16	145.2	150	The cumulative impact of the Project plus the baseline is below the applicable air quality criterion.
Nitrogen Dioxide	Anual	2.1	25.71	27.8	100	The cumulative impact of the Project plus baseline is below the applicable air quality criterion.
Carbon monoxide	1-hora	540.9	734.51	1275.4	40,000	The cumulative impact of the Project plus baseline is below the applicable air quality criterion.
Carbon monoxide	8-horas	457.7	338.90	796.7	10,000	The cumulative impact of the Project plus the baseline is below the applicable air quality criterion.

*Note: * Annual Concentrations calculated using 24hr at an annual factor of 0.1916*

Source: Emissions Modeling Result, Consulting Team, 2016.

The results show that under the worst operating conditions scenario, using a conservative assessment methodology, the facility is expected to be below the relevant air quality criteria for air quality indicator compounds. In addition, offshore equipment does not make a significant contribution to the overall expected impacts.

Appendix 5B shows the modeling isoplethic graphs results of the central thermal power plant.

Conservatism within previous predictions can be highlighted by the fact that baseline concentrations include the contribution of the existing fuel oil thermal power plant , which is located adjacent to the proposed Thermal Power Plant. Existing fuel oil facilities are expected to have significantly higher NO_2 emissions than the proposed natural gas facilities and therefore have a greater impact on air quality than on proposed operations. Initial air quality levels, including the existing central fuel combustion, are well below the relevant air quality criteria.

In addition, in the future, it is anticipated that the operation of the Project will result a reduction in the operations of other power plants working on fuel oil. Since natural gas is a fuel that produces cleaner emissions than fuel oil, and the Project will be more efficient than existing plants, the total load of pollutants into the atmospheric basin could decrease. Therefore, it is reasonable to expect that air quality in the atmospheric basin can actually improve.

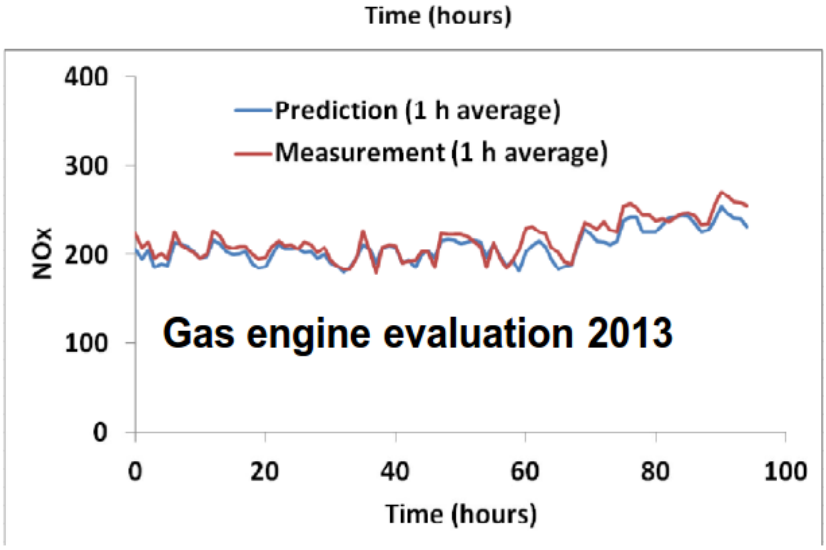
To manage the impacts associated with the Project's emissions, EDP will implement:

1.) Annual stack emission testing for NO_x emissions. If the emission test results are shown to be constant (for 3 consecutive years) and significantly below required levels (e.g. less than 75%), the frequency of an annual sampling may be reduced every two or three years;
2.) Predictive Monitoring System (PEMS) continued emissions of NO_x; and
3.) Establish a permanent off-site air quality monitoring station for continuous monitoring of NO_2 ground level concentrations (The location of this monitoring station is to be determined and must be in a secure location at or beyond the property fence line).

Predictive Emissions Monitoring System (PEMS)

This system calculates the emissions of the process parameters, using a model developed by the engine manufacturer, Wärtsilä. The system uses the existing equipment and its quality can be assured by reference methods. The graph provided in figure 7.1 provides the test results, which shows that the predicted NO_x concentrations are similar to the actual measured NO_x concentrations.

Figure 7.1 – Predicted NO_x Concentrations vrs Measurements



Source: Wärtsilä PEMS Status Presentation, March 2014

In the United States the US-EPA Performance Standard 16 provides requirements for PEMS's – if a proposed PEMS can comply with the Performance Standard 16 requirements then it can replace an analyzer based system. As a result, there are several hundred installations using PEMS for emissions reporting in the United States. PEMS's are also recognized in many European countries, the Philippines, and United Arab Emirates.

Ambient Air Quality Monitoring Station

An ambient air quality monitoring station will be used to monitor:

- Ground level concentrations of NO2
- Meteorological conditions – wind speed, wind direction

Air quality parameters will be monitoring using a continuous air quality monitoring system such as the airpointer® compact air quality monitoring system. [1]

[1] http://recordum.eu/recordum-airpointer/

7.4.2 Greenhouse Effect Gas Emissions and Climate Change Impacts

7.4.2.1 Methodology

The Impact Assessment Matrix, Table 7.2, Section 7.2, identified the following potential significant interactions between project activities and characteristics, with greenhouse effect gas emissions and the climate change effects :

- Construction phase
  - General activities related to construction; and
  - Traffic related to construction
- Operation phase
  - LNG handling and regasification storage; and
  - Power generation.

It is widely believed that climate change or global warming is related to increasing amounts of greenhouse gasses effect in the atmosphere, which traps heat from the sun. Some greenhouse gases effect occur naturally. Additional, contributions are generated by human activities, including the fossil fuels burning that release carbon dioxide (CO_2) into the atmosphere.

The Project will generate greenhouse effect gases (GHG), due to the fossil fuels use in the equipment to be used during the construction and operation phase. Methane fugitive emissions (CH_4) from the LNG / NG management and storage system will also contribute to GHG emissions. U Sulfur Hexafluoride (SF6) gas used in high voltage switches also contributes to GHG emissions.

The greenhouse generation gases during the construction period is short term and insignificant, therefore it has not been quantified in this assessment. This evaluation focuses on the most important greenhouse gases generation from the project operation phase.

For the operating phase, the CO_2 and CH_4 emission factors for the natural gas used by the engines were taken from Section 3.2 EPA AP-42, while the N_2O emission factor was taken from the US EPA's Climate Leaders Greenhouse Gas Inventory Protocol Core Module Guidance – Direct Emissions from Stationary Combustion Sources.

For the floating storage unit, the boiler can operate either with fuel oil or liquefied natural gas. Taking a conservative approach, it was assumed that fuel oil would be used. Greenhouse gas emission factors were taken from Section 1.3 EPA AP-42 (Combustion fuel oil).

CH4 Fugitive emissions from LNG transmission were estimated on the study basis. (Lelieveld, J.; Lechtenböhmer, S. Assonov, S.; Brenninkmeijer, CAM; Dienst, C., Fischedick, M., Hanke, T. Greenhouse effect gases. Low methane leakage from natural gas pipelines 2005, 434, 841-842), which estimates that methane losses from natural gas transport systems in Russia were in the range of 1, 0 to 2.5%. As a conservative approach, 2.5% was assumed to estimate methane loss for this Project.

Fugitive SF6 emissions from circuit breakers were considered 0.5% per year based on a study conducted jointly by the US EPA and an ICF Consultant. The global warming potential (GWP) of 21.310 and 23.900 were respectively used for CH4, N2O and SF6 to convert their respective emissions into CO2 equivalent (CO2e).

7.4.2.2 Construction Phase.

The project construction will have a short-term greenhouse gases emission , and the contribution to climate change should be insignificant. The main greenhouse gasses sources during construction come from construction activities in general and related traffic; including the operation of diesel-working equipment such as trucks, excavators, motor graders, etc. To use the concrete plant operation plant would also generate greenhouse gases (GHG), (and would also be generated if the concrete is obtained locally).

To minimize GHG emissions, the project construction activities will use the industry standard equipment and the activities will conform to industry best practices, such as:

- The equipment proper use (Protocol on idling of engines); and
- Maintenance and vehicles and machinery nspection, inspected for acceptable emission control and fuel efficiency (through a maintenance plan that will include a registry and monitoring system).

7.4.2.3 Operation phase

Project operations may generate GHG emissions, from the following sources:

- Natural Gas Combustion in the Central Thermal Power Plant;
- SF_6 leaks from high voltage switches.
- the FSRU / FSU Unit Operations; and
- LNG / Natural Gas leaks from the maintenance and storage system.

Using the methodology described previously in section 7.4.2.1, total annual GHG emissions are estimated at 1,741.59 $CO2_e$ kt / year, summarized in Table 7.8. The equivalent CO_2 emission per kWh is approximately 1.16lb / kWh, which is similar to the reference value of 1.22 lbs / kWh provided by the United States Energy Information Administration[2].

Table 7.8 – Annual GHG Emissions during Operation

Source	**CO2e(**kt/ year)
Combustion of LNG in the Central Thermal Power Plant	1,385.94
FSU	36.17
FSU	26.89
LNGC Vessel	26.89
Fugitive	265.69
High voltage switches	0.15
Total	1,741.59
CO_2e (lb/kWh)	1.16

Source: Elaboration by Consulting Team

The proposed Thermal Power Plant, in part, will shift existing generators, which use heavy fuel oil in single cycle power plants. This shift will have a benefit in GHG emissions, based on the reduced carbon intensity and increased the efficiency of the proposed facility. This is reflected in the comparative indices GHG intensity of two plants. The proposed Thermal Power Plant has an index of 1.16 CO2e lb / kWh, which is considerably lower than the existing 1.68e CO2e / kWh.

To minimize potential impacts on climate change, natural gas will be used as fuel for the Thermal Power Plant, which will significantly reduce GHG emissions relative to other high-carbon fuels (e.g. fuel oil). In addition, the ability to work in combined cycle mode will improve efficiency and reduce the GHG emissions rate per unit of electricity generated.

[2] La Administración de Información de Energía de Los EE.UU., Análisis y Estadísticas Independientes. Cuánto dióxido de carbon se produce por kilowatt/hor al generar electricidad con combustibles fósiles? Artículo obtenido el 18 de Septiembre, 2014 <http://www.eia.gov/tools/faqs/faq.cfm?id=74&t=11>.

7.4.3 Noise and Vibration

7.4.3.1 Methodology

This section deals with the noise and vibration induced noise outside the boundaries of the property. Noise levels within the property limits are addressed in Section 7.6.12: Health and Safety.

The impact identification matrix provided in Table 7.2, Section 7.2, identified the following potential significant interactions between Project activities and noise vibration induced by recipients located outside the site's boundary:

- The construction phase activities.
    - Logging and chopping off;
    - Earthworks;
    - Pile driving (on land and sea);
    - General construction activities - on land;
    - Construction General activities - at sea; and
    - Construction related to traffic.
- Operation phase.
    - Power generation (for example, the operation of the Thermal Power Plant)).
    - LNG regasification to NG.

The construction phase effects in the noise levels and vibration in the surrounding communities has been assessed qualitatively, with the existing noise consideration and assuming typical construction techniques. Considering the noise effects , a prevention and attenuation approach has been adopted. The objective of this approach is to manage impacts through the implementation of good international industry practices

The operations phase effects on noise levels have been assessed using standard industry numeric modeling tools. The method consist in monitoring the noise levels in residential areas in order to establish the background noise levels and modeling the noise spread of the main noise sources in the place.

The programmed baseline, detailed in Section 5.2.3 was completed through monitoring to measure existing noise levels, including the low-frequency noise, in the influence area of the project. The monitoring program involved two programs:

- Monitoring to establish background 'A' long-term average noise levels; and
- Short-term (or "point") monitoring to establish low-frequency background noise levels.

In summary, the residential recipients closest to the Central Thermal Power Plant are located on the west side of the boulevard Coronel Oscar Osorio, north of Boulevard 25 de Febrero and east of Avenida Las Carabelas (Lotificación Alvarado). The school closest to the site, Liceo de Acajutla, is also located in this residential area. The closest residential recipients of the proposed pier are located to the north, near the artisanal fishing pier.

Table 7.9 provides a results summary for the noise monitoring background noise conditions and includes the applicable criteria applied to the Project based on World Bank's guidelines.

Table 7.9 – Noise Monitoring Summary and Noise Criteria Applicable to the Project

Monitoring Point	Monitoring Dates	Por hora Leq (dBA)					
		Day: 0700 a 2200 CFI Guide[3]: 55 dBA			Night: 2200 a 0700 CFI Guide: 45 dBA		
		Maximum	Minimum	Applicable standard	Maximum	Minimum	Applicable standard
L1: Northwest Residential Zone	April 9 – April 13, 2014	63.8	48.3	55	63.9	50.3	50.3
L2: Northern Residential Zone	April 9 – April 13, 2014	66.1	53.9	55	62.6	53,6	53,6
L3:Southwest Residential Zone	April 9 – 10, April de 2014	67,3	52,8	55	61.7	55.5	55.5
L4: Zone near Artisanal Pier	April 11-April 13, 2014	62.6	46.2	55	58,9	43,9	45

Source: Elaboration by Consulting Team

Additional spot noise measurements were gathered in the vicinity of the existing thermal power plant, as well as the surrounding residential areas to assess levels of existing low-frequency noise. The details are found in Section 5.2.3 of this EsIA report. In summary, the existing noise measurements are indicative of an acoustic environment dominated by low-frequency noise with some tonal characteristics. The appearance of low-frequency noise is more sensitive at night when the background noise due to traffic or general urban buzz is lower and the dominant noise source is the existing Central Thermal Power Plant.

[3] Noise Level Guides from the International Finance Corporation

The modeling was done with the method described in the international standard ISO 9613-2 acoustic - Attenuation of sound during propagation outdoors - part 2: general calculation method. The actual software implementation of the method is CADNA A version 4.4. The additional details are found in Appendix 5C. Appendix 5C also lists the specifications of the noise sources that were modeled (see section: "Equipment specification").

The operation phase effects for low frequency noise and vibration-induced noise was assessed through the analysis of the frequency noise profile for a similar equipment for a Central Thermal Power plant built by the same provider. Additional details can be found in Appendix 5C.

7.4.3.2 Construction Phase

During the construction phase, noise will be generated during cleaning, earthworks, pile driving (on land and sea), general construction activities and traffic related to construction. Those are typical noise sources for the main construction activities result of material handling and machinery use and equipment on the site. A proposed concrete batch plant to be located in the construction laydown area would also generate temporary noise. Those activities occur mainly during the day between 07:00 and 22:00 hours.

Good International Industry Practices (GIIP) will be used to reduce the noise effects of the normal construction phase to insignificant, at short-term levels. These measures include:

- The Equipment Limit use with potential for noise impacts during the day (0700 to 2200hrs);
- Use of barriers and enclosures to block noise;
- Whenever possible, locate noisy equipment (e.g. compressors, stationary generators) away from site boundaries;
- Apply no idling and use the external access routes provided in the Traffic Management Plan; and
- Community Liaison Program to inform communities of the project activities in general, including any activity particularly noisy, as well as seek for feedback.

Additional mitigation is not considered necessary for typical noise sources.

However, further mitigation may be required for pile driving noise (e.g. for the thermal power station and temporary pier construction). The mitigation will take the noise management plan form for pile driving that will consider:

- Type, number and piles location;

- Use low-noise techniques for the driving (for example, vibratory pile, press in drive); and
- Pile driving hours operations.

To make it easier for noise problems to be quickly identified and addressed, the Project grievance mechanism (Appendix 7A) will be monitored for comments and complaints from residents about noise. Those comments types related to noise complaints will be identified for follow-up and immediate action.

7.4.3.3 Operations phase

Noise

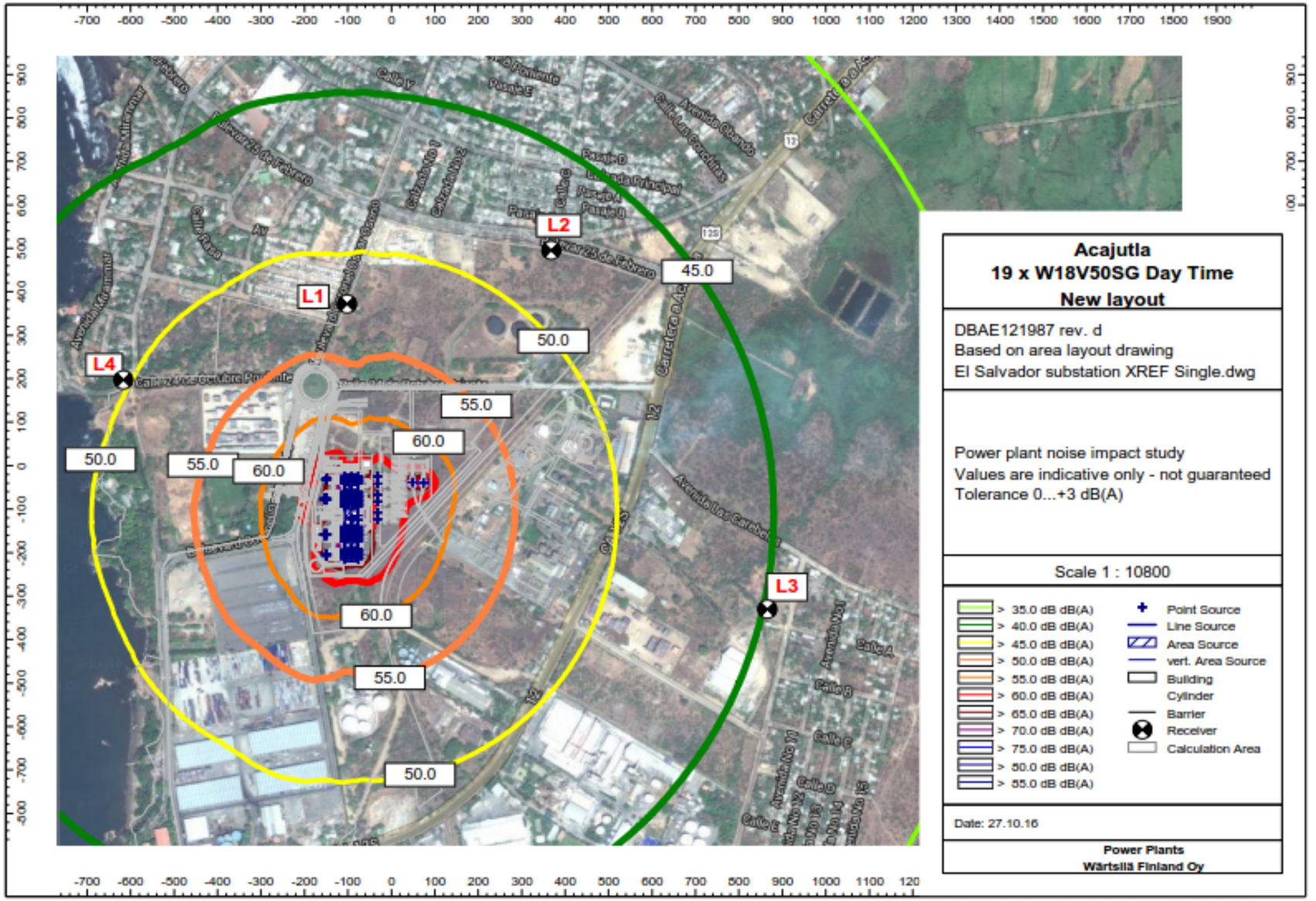
The noise modeling completed for the project indicates that noise levels provided by the project operation in the neighboring industrial areas and residential areas will be at or below applicable exposure limits of the project. As there are no current normative in El Salvador related to noise, the limits of the project have been taken from the IFC-EHS Guidelines.

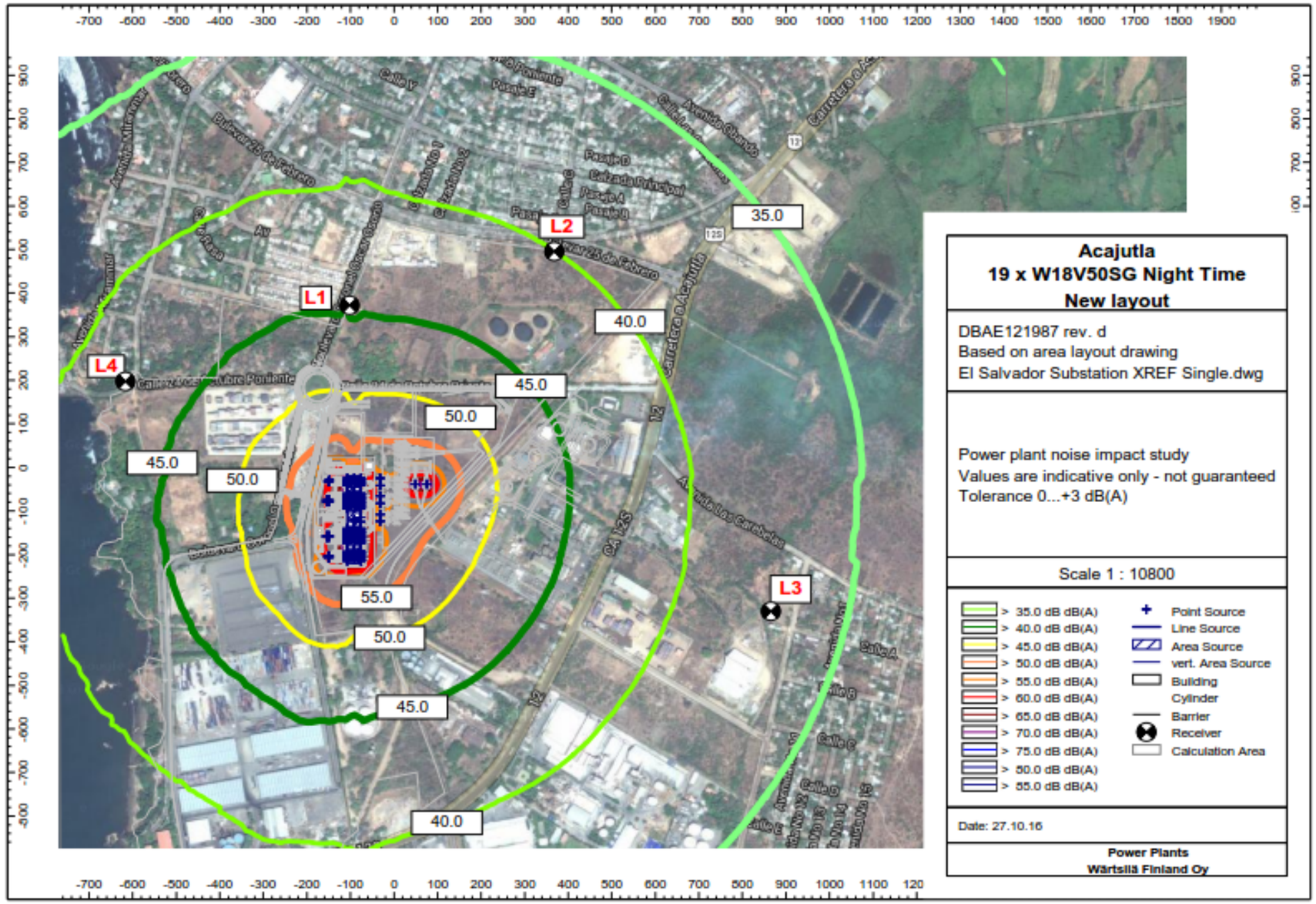
For the industrial and commercial areas around the project the applicable standard 1-hr LAeq limit is 70 dB (a). However, if the measured background noise is greater than 70 dBA, than the WBG-EHS Guidelines indicate that the contribution of noise from the Project should not exceed the existing 1-hr LAeq. As shown in Figure 7.2 and 7.3, the contribution of the project to noise levels in the industrial and commercial areas will be below 70 dBA, so they comply with the limits applicable for the project.

For residential areas around the project the applicable standard 1-hr LAeq limit is 55 dB(A) during the day (07:00 to 22:00 hrs) and 45 dBA during the night (22:00 to 07:00 hrs). However, if the background noise measured is greater than the specified during the day or night, the CFI-EHS guidelines indicate that the noise contribution of the project should not exceed existing levels for 1-hr LAeq.. As presented in detail in Section 5.2.3, the existing night-time noise levels exceed the guideline limits at three of 4 monitoring points that correspond to the nearest residential areas, resulting in the project applicable limits for the 4 receptors listed in in Table 7.10 and 7.11.

As indicated in Table 7.10 and 7.11, the noise Thermal Power plant contribution at the four recipients will be less than the applicable limits (Noise levels include tolerance + 3dB of the standard calculation). Figure 7.2 and 7.3 show the location of the recipients providing contours for both daytime and nighttime noise levels.

Table 7. 10 – Noise limits applicable to the Project and Maximum Projected Noise contributed by the Project in 4 recipients				
Recipient	Limit during the day [dB(A)]	Estimated impact during the day [dB(A)]	Limit during the night [dB(A)]	Estimated impact during the night[dB(A)]
L1	55	55	50 dB	47 dB
L2	55	51	54 dB	43 dB
L3	55	48	56 dB	40 dB
L4	55	53	45 dB	45 dB


L1
L2
L3
L4
45.0
50.0
55.0
60.0
Acajutla
19 x W18V50SG Day Time
New layout
DBAE121987 rev. d
Based on area layout drawing
El Salvador substation XREF Single.dwg
Power plant noise impact study
Values are indicative only - not guaranteed
Tolerance 0...+3 dB(A)
Scale 1 : 10800
> 35.0 dB dB(A)
> 40.0 dB dB(A)
> 45.0 dB dB(A)
> 50.0 dB dB(A)
> 55.0 dB dB(A)
> 60.0 dB dB(A)
> 65.0 dB dB(A)
> 70.0 dB dB(A)
> 75.0 dB dB(A)
> 80.0 dB dB(A)
> 85.0 dB dB(A)
Point Source
Line Source
Area Source
vert. Area Source
Building
Cylinder
Barrier
Receiver
Calculation Area
Date: 27.10.16
Power Plants
Wärtsilä Finland Oy


L1
L2
L3
L4
35.0
40.0
45.0
50.0
55.0
Acajutla
19 x W18V50SG Night Time
New layout
DBAE121987 rev. d
Based on area layout drawing
El Salvador Substation XREF Single.dwg
Power plant noise impact study
Values are indicative only - not guaranteed
Tolerance 0...+3 dB(A)
Scale 1 : 10800
> 35.0 dB dB(A)
> 40.0 dB dB(A)
> 45.0 dB dB(A)
> 50.0 dB dB(A)
> 55.0 dB dB(A)
> 60.0 dB dB(A)
> 65.0 dB dB(A)
> 70.0 dB dB(A)
> 75.0 dB dB(A)
> 50.0 dB dB(A)
> 55.0 dB dB(A)
Point Source
Line Source
Area Source
vert. Area Source
Building
Cylinder
Barrier
Receiver
Calculation Area
Date: 27.10.16
Power Plants
Wärtsilä Finland Oy

To verify compliance with the applicable guideline limits noise levels will be measured at representative locations of nearest residential areas and at power plant property boundary during initial operation phase when plant is operating at full capacity. Thereafter, noise levels will be measured on a yearly basis or more frequently if significant changes are made to power plant equipment and/or operations has the potential to change noise levels.

Vibration Induced by the Low-Frequency Noise and Noise

Low noise frequency and noise-induced vibration were identified as a concern by nearby residents nearby communities. Low-frequency noise, in the frequency range of about 10Hz to 200Hz, has been recognized as a special environmental noise problem, particularly for people in their homes. Conventional nuisance evaluation methods which are typically based on an average equivalent level are insufficient to evaluate low-frequency noise as the average noise level underestimates the effects of low-frequency sounds. In addition, there are no standards or guidelines that apply to the Low-Frequency Noise Project. For those reasons, an independent analysis was completed to assess low background frequency noise levels and to evaluate the project impact on low-frequency noise levels.

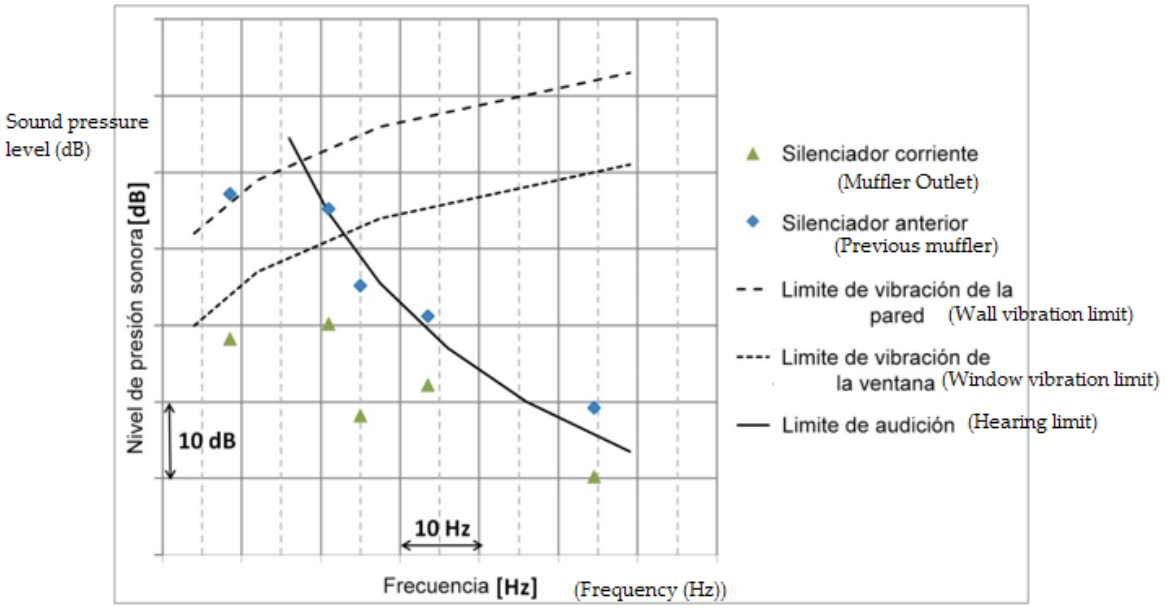
Monitored background noise, as detailed in Section 5.2.3, shows that existing low-frequency noise levels are high. The main source of low-frequency noise appears to be the existing reciprocating engine Power Plant (W18V46) located immediately east of the Project site (currently owned by Duke Energy).

A spectral analysis of the existing Duke W18V46 power plant against the design for the proposed EDP power plant (W18V50SG) was completed by the plant manufacture, Wärtsilä. The spectral analysis indicates that the sources of low frequency noise in a reciprocating engine-based power plant applicable to this Project are the exhaust system, and possibly the engine cylinder combustion. Characteristic to both processes is noise emission at clearly defined engine rotational harmonic frequencies, for which typical frequency range is ~15 Hz to 60 Hz. The proposed EDP power plant (W18V50SG) will have improved noise control measures compared to the noise control technology used for the Duke W18V46 power plant that was built more than 10 years ago.

A spectral comparison between the Duke W18V46 power plant and the proposed EDP W18V50SG plant indicates that the use of current engine exhaust manifold and exhaust silencer technology, and the use of new power house construction methods, together contributes to a reduction of plant low frequency noise at frequencies below 200 Hz by about 10 dB. Figure 7.5 provides a comparison of the current exhaust model performance (as proposed for the W18V50SG plant), the previous exhaust model performance (e.g., as used on the existing W18V46 plant), and hearing and building elements vibration thresholds. As shown, the previous exhaust model generated low frequency noise above the thresholds

for hearing, window vibration, and possibly wall vibration. The current exhaust model performance is below the thresholds at all frequencies.

Figure 7.4 – Noise low frequency emissions from the exhaust system in comparison with the audience and the Vibration thresholds



Source: Wärtsilä 2014

Wärtsilä's analysis concludes that:

- due to advances in exhaust system acoustic design the annoyance-inducing secondary vibration at residences would be reduced significantly compared to the existing W18V46 plant;
- it is expected that, depending on the specific measurement location, the new W18V50SG plant the low-frequency noise will be about 10 dB quieter than the existing situation; and,
- A 10 dB difference is considered to be a significant difference, and can be described as subjectively felt as a noise halving.

To verify that the EDP thermal power plant does not contribute significantly to the low-frequency noise levels in the local communities, monitoring in representative locations during the initial operation phase will be carried out when the Thermal Power plant is operating at full capacity. Subsequently, low-frequency noise levels will be measured on an annual basis.

7.4.4 Soils

7.4.4.1 Methodology

The Impact Screening Matrix on Table 7.2, Section 7.2 identified the following potential significant interactions between the Project's activities and soil characteristics:

- Construction phase
    - Earthworks and activities including excavation and handling have the potential to adversely affect physical properties and soil condition (e.g. compaction and mixing of soil layers such as organic with non-organic).
    - Storage, handling, use and raw materials disposal, waste and hazardous waste - potential for soil contamination result of an accidental event.
- Operations phase:
    - Storage, handling, use and raw disposal disposal, waste and hazardous waste - potential for soil contamination result of an accidental event.

Soil impacts have been assessed based on a qualitative methodology, with consideration given to activities in each project phase cycle and based on understanding the existing soil conditions in the area as described in Section 5.2. 5, 5.2.6 and 5.2.7.

It is possible that excavation and soils relocation at the site is required, due to earthworks. In addition, the trench excavation for NG underground pipeline will alter the soil's horizon profile. The soil surface layer will be preserved and replaced once the duct is in place.

During construction, procedures will be required to control slope erosion and sedimentation, although those processes are not expected to significant as the land is predominantly flat. Local industries near the Project area include food processing, processing of petroleum products, storage, and transportation, fertilizer and chemical manufacturing, all of which have impacted soil conditions over time. A Phase 1 environmental site assessment was completed for the Thermal Power plant site by ERM consultants. The executive copy summary part of the report can be found in Appendix 5AB. As indicated in the report, based on data obtained during the Phase 1 site assessment, including a site survey, interview with persons familiar with the site and its history and review of available documentation, this assessment does not reveal the historical presence or likely presence of hazardous substances or petroleum products on the property in question. However, a Phase II study has been recommended.

During the construction phase, earthworks and general construction activities, including excavation and sorting, will affect the physical soil quality (soil / subsoil mixture, compaction). The soil Contamination is

also possible from accidental hazardous material release. Landscaping will be carried out to reduce the visual and superficial construction impact.

7.4.4.2 Construction Phase

Effects on Physical Characteristics

The main activities impacting the on-site soils are earthworks and the general construction activities that will require:

- Clearing and stripping of all existing vegetation and structures
- Removal of soils unsuitable for supporting the facilities and replacement with suitable, load bearing fill
- Cut and fill activities to achieve the desired grades
- Cut through the bluff to provide access to the construction trestles
- Excavation to allow foundations installation, pipeline or other works that are needed below grade.

For the rocks presence and hard soil (cemented volcanic ash) some blasting is expected during earthworks. The ground blasting may be required for the on-shore pipeline installation and to provide access through the shoreline bluff to access the construction trestle. Blasting would be undertaken by a qualified contractor and would meet local safety requirements and procedures.

Spoil piles generated by site excavation would be stockpiled on site and re-used for various purposes, including providing material for backfill and topsoil cover for areas to be vegetated or landscaped. At writing time , because the detailed earthworks, foundation designs, and site grading plans have not been completed, the specific material volume to be excavated is not known. However, assuming that 1 m material depth will need to be stripped across the entire site, then it can be estimated that about 75,000 m^3 of material will need to be stripped. If 40 % of that material can be reused on site, it leaves 60%, or 45,000 m^3 to be disposed of off-site. At 10 m^3 per truck load, this represents an estimated 4,500 material truckloads to be removed.

To manage the construction activities effects on EDP soils will follow the provisions for soil management provided in Wartsila's – Quality and Installation Instruction, Earthworks, Power Plants (Appendix 7B). Those practices would include the following:

1. A Soil Management Implementation and Sediment and Erosion Control Plan, which would include the following components, as identified as appropriate during the detailed design phase:

a) To prevent mixing of topsoil and subsoil top soils to be stripped prior to subsoil excavation. Topsoil and subsoil to be stored in separate stockpiles
b) Spoil Development piles and pits protection by berms in order to control sediment run-off and prevent erosion from exposed areas during construction.
c) Silt fencing to prevent run-off
d) Possible installation of a temporary or permanent retaining structure to protect the site during earthworks activities, based on the site contractor's assessment at the initiation of the survey and measurement phase.
e) Slope protection with plastic sheeting and continuous grading to reduce run-off from inclined areas of the site
f) Excavation slopes the bottom protection, pits, or cuts with lean-mix concrete
g) Ditch Protection corners and curves with large rocks as 'riprap'.

2. There are not expected to be any significant exposed slopes. However, if final grading plan requires slopes, the following will be considered to protect exposed soils:
   a) Swale Installation at the slope top.
   b) Slope erosion prevention with jute matting or geocells
   c) Slime suitable varieties planting or other plants to control run-off
3. Areas protection receiving high-velocity water on site with the use of:
   a) 'large rocks Riprap' consisting (approx. 100mm in size), based on the site contractor's design calculation of suitable size and rocks gradation.
   b) Separation geotextile and rocks at the pipe discharges and outlets site
4. Regular inspection of all run-off, erosion, and sedimentation control structures to ensure their stability and adequate performance.

Blasting will be performed by a contractor that specializes in blasting. The contractor will obtain all required permits before construction. All explosive materials will be safely stored as per applicable regulations. Advance notification of blasting activity will be made in the local community.

While effects to the soils physical conditions are unavoidable due to the facilities physical presence (e.g., internal roads and parking areas, power house and switchyard), the measures above will minimize topsoil loss, and reduce concerns related to erosion and downstream siltation.

7.4.4.3 Effects on Soil Quality (contamination)

The construction requires the hazardous materials use such as paints, solvents, fuels and other materials and generates hazardous waste such as used lubricants, batteries, used filters, rags and other materials. Types details and hazardous raw materials quantities and hazardous wastes are provided in Section

4.11 of this EsIA and summarized in Tables 4.25 and 4.26. Accidental leakage of such hazardous materials or waste may result in soil contamination.

To minimize the contamination soil risks, as well as surface and groundwater, the provisions for the handling and storage of hazardous wastes and hazardous materials will be applied. Those provisions will be established in the Health, Safety and Environment Plan (EHS Plan), which is implemented in conjunction with the Occupational Health and Safety Plan and Emergency Response and Contingency Plan. The provisions to be included in the EHS Plan will be as follows.

Hazardous Materials Assessment

The risk level will be established through a continuous assessment process based on:

- The hazardous materials types and quantities present in the Project. This information will be recorded with a summary Table with the following information:
    - Hazardous materials name and description (for example, mixture composition) classification (like: code, class or division) of hazardous materials;
    - Internationally accepted, regulator threshold reports or Salvadorean equivalent[4] of hazardous materials;
    - Number of hazardous materials used per month; and
    - Features that make them dangerous (flammability, toxicity, etc.)
- Analysis of potential spill and release scenarios with available industry statistics on spills and accidents where available;
- Analysis of the potential for uncontrolled reactions such as fires and explosions;
- Potential consequences Analysis based on the physical-geographical characteristics of the Project site, including aspects such as its distance from settlements, water resources and other ecologically sensitive areas; and
- Risk assessment should be performed by specialists using internationally accepted methodologies such as Hazardous Operations Analysis (HAZOP), Failure Mode and Effects Analysis (FMEA) and Hazard Identification (HAZID).

Management Actions

- Management actions to be included in a Hazardous Materials Management Plan should be commensurate with the risk level identified in the risk assessment.

[4] Amounts provided by the United States Environmental Protection Agency: protection of the environment (title 40 CFR part 112-68 and 355).

Prevention and Control Launching

The EHS Plan will include the following management actions for the prevention and hazardous materials emissions control of:

- Operator training in spill prevention, including specific exercises for hazardous materials as part of emergency response training;
- Inspection programs implementation to maintain the mechanical integrity and pressure vessels operation, tanks, piping systems, relief and venting valve systems, containment infrastructure , emergency shutdown systems, controls and pumps and process of equipment associated;
- Written standard operating procedures (SOPs) preparation for the storage tanks filling or other containers or equipment as well as for transfer operations by trained personnel in the safe transfer and filling with hazardous materials and in the spills prevention and response;
- SOPs for the secondary handling containment structures, specifically the elimination of any accumulated liquid such as rainfall, to ensure that the system only fails by accident or intentionally;
- The location hazardous materials identification and associated activities in a site map of the emergency plan;
- The personal protective equipment avaibility documentation of spill response equipment sufficient to handle the initial spill phases and a equipment and personal external resources list if necessary, to complement internal resources; and
- Response activities description in case of a spill, release or others including chemical emergencies:
    - Internal and external reporting procedures;
    - Specific responsibilities of individuals or groups;
    - O decision process to assess severity of releases and determine appropriate actions;
    - Rutas de evacuación de la instalación;
    - Post-event activities such as cleaning and disposal, incident investigation, employee return; and
    - Spill response equipment restoration

Occupational Health and Safety

The EHS Plan will address occupational health and safety relevant aspects to the use and hazardous materials management including:

- Safety analysis to identify specific potential hazards for the workers and industrial hygiene studies, as appropriate, to monitor and check the levels of exposure to chemicals and if it applies, to compare with relevant occupational exposure standards;

- Hazard communication and training programs to prepare workers to recognize and respond to chemical hazards in the workplace. The programs will include hazards identification aspects, safe operation and special risks unique to their jobs, safety work practices, basic emergency procedures, and procedures for materials handling;
- The training will incorporate Material Safety Data Sheets (MSDS) information for hazardous materials being handled. The MSDS will be accessible to employees in Spanish and English;
- Definition and implementation of authorized maintenance activities, such as hot work or confined space entries;
- Appropriate Personal Protective Equipment Provision(PPE) (footwear, masks, protective clothing and goggles in appropriate areas), shower and emergency showerheads, ventilation systems and sanitary facilities; and
- Monitoring and recording activities, including auditing procedures designed to verify and record the prevention and control of occupational hazard exposure and accident maintenance and incident investigation reports on file for a period of five years.

Preventive Measures: Transfer of Hazardous Materials

Uncontrolled releases of hazardous materials may result from small cumulative events, or from more significant equipment failure associated with events such as manual or mechanical transfer between storage systems or process equipment.

Practices to avoid hazardous releases process materials include:

- Use of dedicated fittings, pipes, and hoses specific to materials in tanks (e.g., all acids use one type of connection, all caustics use another), and maintaining procedures to prevent addition of hazardous materials to incorrect tanks;
- Transfer equipment use compatible and suitable for the characteristics of the materials transferred and designed to ensure a secure transfer;
- Periodic inspection, maintenance and repair of hoses, pipes and fittings; and
- Provision of secondary containment, trays or other overflow and drip containment measures for containers of hazardous materials in connection points, or other points of possible overflow.

Preventive Measures: Overfill Protection

Ships Overfilling and tanks are among the most common spills causes resulting in soil and water pollution. Preventive measures against overfilling to be implemented include:

- Written procedures for transfer operations will be prepared including a list of measures to be taken during operations, operators will be trained in these procedures;
- Meters installation in the tanks to measure the interior volume;

- Drip use hose connections for vehicle tanks with fixed connections and storage tanks;
- Automatic shut-off valves provision in storage tanks to prevent overfilling;
- Sump pump use around the filling pipe to collect spills;
- Pipe Use connections with automatic transmission with overfilled protection (floating valve);
- Lower volume than available capacity in the tank or pumping vessel by ordering material less than its available capacity; and
- Overfill Provision protection or over-pressure ventilation that allows the controlled release to a capture point.

Preventive Measures: Reaction, Fire and Explosion Prevention

Reactive, flammable and explosive materials will be administered to avoid uncontrolled reactions or conditions that could cause fires or explosions. Prevention practices include:

- Incompatible materials storage (acids, bases, oxidizing agents, flammable products, reactive chemicals) in separate areas and containment facilities by separating the storage material areas;
- Specific storage supply material for extremely hazardous or reactive materials;
- Flame reduction use devices in the flammable storage containers vents ;
- Grounding provision and lightning protection for staff handling flammable materials;
- Construction materials selection compatible with stored products for all storage parts and delivery systems and avoiding the tanks reuse for different products without checking their material compatibility;
- Hazardous materials storage in an facility area separate from the main works. In its proximity is inevitable, physical separation will be provided using structures designed to prevent fires, explosions, spills and other emergency situations from affecting installation operations; and,
- All sources prohibition in areas near flammable storage tanks.

Control Measures: Secondary Containment (Liquids) and Leak Detection

A critical aspect for the liquid hazardous materials accidents control during storage and transfer is the secondary containment provision. It is not necessary for secondary containment methods to satisfy long-term material compatibility as with primary storage and pipelines, but their design and construction must effectively retain spills until they can be detected and recovered safely. Appropriate secondary containment structures consist to retain walls, dikes or walls capable to contain more than 110% of the largest tank or 25% of the combined tank volumes in areas with above-ground deposits with a total storage volume equal to or greater than 1,000 liters and will be made with waterproof

material, resistant to chemicals. The secondary containment design will provide the means to avoid contact between incompatible materials in the case of a release.

Other secondary containment measures to be applied depending on site-specific conditions include:

- The hazardous materials or vehicles transfer will be carried out in areas with sufficiently impervious surfaces to avoid loss to the environment and inclined to a collection or containment structure not connected to the pluvial collection system;
- Hazardous materials generated with a total volume of 1,000 liters or more should be stored in areas with impervious surfaces that are sloped or berms to contain a 25 percent minimum of the total storage volume;
- Secondary containment shall be provided for components (tanks, pipelines) of the hazardous materials storage system, to the possible extent; and
- Periodic (daily or weekly) storage content reconciliation and inspection of visible parts of tanks, drums, pipes and other leakage containers.

Hazardous Materials Treatment and Disposal

Hazardous waste generated during the project activities will be transported by a licensed contractor for transportation to a facility designated for the proper treatment and disposal. There will be no use of project areas to bury hazardous or non-hazardous waste. The use of oil and lubricants will be monitored, with safe containment and disposal measures elimination of waste generated by operating machinery. Sewage and waste material produced during plant operations shall be stored in sealed containers at the facility to prevent spillage, before being transported to a facility with a designated permit for the handling and hazardous wastes disposal.

During construction, portable toilets with built-in holding tanks will be provided to workers. All portable toilets will use chemical odor reduction (deodorant) in the tank. Portable toilets will be inspected daily and regular maintenance will be done to prevent spreading and odor control. Material collected will be collected in trucks for treatment and disposal off-site in an authorized center.

During operations, on-site portable letrines will treat human waste.

The measures described above are considered adequate to minimize the hazardous material soil and water contamination risk. The net effect can be characterized as short-term and largely reversible; with proper care and practices of soil sustainable management applied for the proper contaminated materials disposal may be returned to the site to usable condition.

7.4.4.4 Operations Phase

During the operations phase the main risk to soils is the contamination from accidental hazardous material spillage. Details on the hazardous raw materials and hazardous types wastes are provided in Section 4.11 of this EsIA.

Management measures to be used to manage the Hazardous Material release risk are provided in Section 7.4.4. The measures specified above are considered adequate to minimize the soils and water contamination risk from hazardous material spilled during operations. The net effect can be characterized as short-term and largely reversible; with appropriate care and sustainable soil management practices applied for the proper disposal of contaminated materials, the site may be returned to a usable condition.

7.4.5 Surface Water

7.4.5.1 Methodology

In the impact matrix Table 7.2, Section 7.2, the following significant potential interactions between Project activities and characteristics and surface waters were identified:

- Construction phase:
  - Earthworks including land management;
  - Pile Driving (on land and sea);
  - Ditching and installation of the NG pipeline
  - General construction activities on land;
  - Cleaning and pressure testing of containers and pipes; and,
  - Storage, handling, use and disposal of hazardous raw materials and hazardous wastes (potential interaction only if there is accidental spillage).
- Operations phase:
  - Waste water discharge;
  - Stormwater management; and
  - Storage, handling, use and disposal of hazardous raw materials, wastes and hazardous wastes (potential interaction only if there is accidental spillage).

The effects on surface water resources in the construction and operation of the project have been assessed qualitatively, with consideration of the surface water current status and assuming typical construction techniques. The current status of surface waters in the study area is provided with detail in section 5.2.8.

When considering the effects on surface waters, a prevention and mitigation approach has been adopted. The objective of this approach is to minimize the risk to the environment due to surface waters by applying internationally accepted industry practices and management controls in the construction phase and the project operation. The clear and actionable SSM Plan establishment is a key component of reducing surface water impacts during both stages. The overall objectives of management measures will be to protect the surface water environment in the Project area, develop an approach to demonstrate compliance with regulatory agency requirements (e.g. permits and authorizations) and reduce environmental liabilities associated with the Project.

7.4.5.2 Construction Stage

Quantity of Water - Stormwater Management

The Project construction is expected to have a moderate potential to impact surface waters. This is the modifications result to the project surface area through the leveling and alteration of topography, soil removal and vegetation cover and the replacement of permeable surfaces with impervious surfaces. This is expected to result in higher and more intense peak runoff events that may overwhelm the the existing drainage channel capacity that will receive the surface drainage majoring.

A Construction Phase Stormwater Management Plan will be developed to manage stormwater effects. The plan will be prepared concurrently with development of general construction plan and taking into account requirements for internal roads, temporary and final grading, staging and stockpiling areas, and the final site stormwater management system. The elements to be included in the Construction Phase Stormwater Management Plan include:

- Establishing temporary stormwater management facilities (e.g., ditches, culverts as road crossings, swales and ponds) to manage flows and surges;
- Periodic inspections and monitoring of stormwater management system elements.

Surface Water Quality

The Project construction has the potential to affect surface water quality through:

- Release of stormwater with excess sediment and turbidity; and
- Accidental release or improper disposal of hazardous materials.

Soil erosion leading to high turbidity, suspended solids, and sediment in surface water will be managed through the application of Soil and Sediment Management and Erosion Control Plan described in Section 7.4.4 of this EsIA. Additional measures to control sediment to surface drains include:

- Sediment control measures installation (berm, silt fences, sediment traps and basins, bales of sandbags / straw);

- Construction of the temporary diversion measures (gutters, ditches); and
- Installation of energy dissipation devices at the outlets and discharge locations.

The measures specified in Section 7.4.4 to reduce the accidental realease risk of contaminating material will also be effective to minimize the risk to surface waters. In addition, the surface water characteristics presence (for example, drainage) should be considered in the storage areas siting, refuelling locations and storage equipment.

7.4.5.3 Operations Phase

Water Quantity and Stormwater Management

A hydraulic analysis was completed to determine that the project effect on stormwater generation. (Appendix 5G). The analysis indicates that site changes such as paving, building installation, and other "surface hardening" will increase peak storm flows and will decrease the infiltration rate into the soil. The analysis also indicates that it will be necessary to improve CEPA's drainage channel that receives the pluvial water from the Project to handle the flows peak generated on the Project property without overbalance. During the detailed design, EDP will coordinate with CEPA on the viability to make improvements in the drainage channel.

The on-site stormwater management system will be designed to ensure the site water flows following development are not significantly different that the current situations. This will be accomplished by considering "Low Impact Development" (LID) techniques such as:

- Reduced impervious areas;
- Permeable pavement;
- Gutters and bioretention;
- Vegetation, landscaping; and
- Wetlands.

To further control flows, EDP will install two storm-water management ponds at the southwest corner of the site. The ponds have been sized to accommodate the expected flows for a 100 years return period storm, according to U.S. standards. The ponds will serve to retain and gradually discharge peak flows, and will provide additional benefits in reducing sediments and other possible pollutants in the storm water flow. One pond will be for rainwater excess from the substation and the other for the other areas of the property. The pond will discharge to the CEPA canal/channel that eventually outflows to the sea. The canal receiving the outflow has available capacity to accommodate the anticipated out flow volume. Appendix 5H, provides details on determining the pond size.

In general, there is not expected to be a significant effect on the water amount as a Project result, and no flood or other adverse effects are anticipated.

Water Quality

Wastewater Discharge

All process water effluent (e.g. oily waters) and wastewater effluent will be treated in on-site treatment systems as described in Section 4.16.2, 4.16.3 and 4.16.4. The treated wastewater will be discharged into the surface water drain that carries rainwater off the property owned by CEPA. The drainage flows into the sea near the existing CEPA pier.

Surface water that may contact equipment or be otherwise contaminated with oils will be directed to an oily-water treatment system prior to discharge to the common storm water system.

The wastewater will be treated to meet the project applicable wastewater discharge limits. The surface drain eventually carries the discharge to an existing discharge point in the Pacific Ocean. The volume of water to be discharged is very small compared to the dilution capacity of the Ocean, and it is not expected to result in any significant contamination or impairment of aquatic habitat.

Solid waste residue from the treatment plant and from the oily-water treatment system shall be transported off site for further treatment and or disposal at a licensed facility.

Hazardous Materials Accidental Release

The measures specified in Section 7.4.4 to reduce the contaminating material accidental risk will also be effective in minimizing the risk to surface water during operations. In addition, the surface water features presence (e.g. drainage) should be considered and avoided when siting storage areas, re-fuelling locations and equipment storage.

To verify that wastewater treatment systems are working as designed, and to verify that operations do not result in surface water quality degradation, the discharge channel periodic monitoring will be carried out. The monitoring will be completed at a frequency and with methods to enable compliance confirmation with regulatory norms and limits.

7.4.6 Groundwaters

7.4.6.1 Methodology

The Impact Screening Matrix Table 7.2, Section 7.2 identified the following potential significant interactions between Project activities and characteristics and groundwater:

- Construction phase:
    - Excavation including pipeline trenching (excavation could encounter groundwater)
    - Pile Driving (on-shore) (vibrations may affect water quality and quantity produced from nearby water wells);
    - Cleaning and pressure testing of containers and pipelines (groundwater collection for pressure testing); and
    - Storage, handling, use and disposal of raw materials, wastes and hazardous wastes (potential interaction only if there is accidental spillage).
- Operations phase:
    - Physical presence of the facilities (reduction of permeable surface for the grounwater recharge;
    - Water consumption (4.5 l / sec , water abstraction per groundwater hour); and
    - Storage, handling, use and disposal of raw materials, wastes and hazardous wastes (potential interaction only if there is accidental spillage).

Modeling was completed to assess the groundwater abstraction effects. Potential pollution effects have been assessed qualitatively, with the local groundwater environment consideration and assuming typical construction techniques. The groundwater current status in the study area is detailed in Section 5.2.9.

When considering the effects in groundwater, a prevention and mitigation approach has been adopted. The approach objective is to minimize the risk to groundwater through the best practices implementation in international industry and management controls in the construction and operation phase. The clear and actionable EHS Plan establishment is a key component to reducing impacts to groundwater during construction. The overall objectives of best practices will be to protect groundwater in the Project area, develop an approach to demonstrate compliance with regulatory agency requirements (e.g. permits and authorizations) and reduce the overall environmental liability associated with the Project.

7.4.6.2 Construction phase

Excavation

A certain soil excavation amount will be required for the thermal power plant, and trenching will be required for the underground NG pipeline installation . As the watertable is about 30 m below ground level, groundwater is unlikely to be encountered for the thermal power plant construction or the pipeline installation.

Accidental Release of Hazardous Materials

The measures specified in Section 7.4.4 to reduce the risk contaminating material accidental release risk will also be effective in minimizing the risk to groundwater during construction.
In addition to the protection measures above, the detailed design of the facility and construction will incorporate measures to ensure that sub-surface works do not provide a preferential conduit for movement of contaminants, including materials released at surface, material migrating in groundwater, or sea water across geologic (aquitard) layers. Vertical holes (piles, caissons etc.) will be appropriately sealed to prevent the movement of contaminants and horizontal structures should incorporate design elements (where appropriate) to ensure the unintended materials movement is mitigated (e.g., low permeability trench plugs, etc.).

Finally, groundwater monitoring wells will be set at the property boundary both above and below gradient the groundwater flow direction . Groundwater samples will be analyzed for hydrocarbons and other contaminants on a quarterly basis.

Water consumption

The water amount required during the construction phase will be relatively small compared to the operation. The grounwater amount is not expected to cause interference with existing wells or pose a groundwater intrusion risk. The potential impacts details of groundwater consumption during operations are provided in the following section.

7.4.6.3 Operations phase

The facility operation has the potential to affect groundwater through pollution as a release result or materials discharge (eg, water, fuel, and chemical process residues) into the groundwater system and withdrawal of groundwater for the operation and water process.

Accidental Release of Hazardous Materials

The measures specified in Section 7.4.4 to reduce the contaminating material accidental risk will also be effective in minimizing the risk to groundwater during operations.

Groundwater monitoring wells shall be established at the property boundary both gradient above and below the groundwater flow direction. Groundwater samples will be analyzed for hydrocarbons and other pollutants on a quarterly basis, and more frequently for other pollutants that may indicate marine intrusion.

Water consumption

The average hourly water demand for the Project over a day is 13.5 m3 / h. Under actual conditions the pumps will run 20 hours per day at a rate of 4.5 L / s. Based on the detailed analysis provided in Appendix 5I, the following configuration is capable to provide the necessary water with a low interference risk with existing wells and low seawater intrusion risk:

- Overall Depth: 120 meters.
- Perforation Diameter: 12 inches.
- Coating Diameter: 8 inches
- Static Probable Level: 30 meters.
- The location of the recommended site for drilling the well is shown on Map 8, Appendix 5II

So far, there is no saline intrusion evidence in the Acajutla area, despite the significant use of groundwater from wells in the area. The Project is expected not to cause saline intrusion because the water amount required for the Project is relatively small compared to the flow rate of the aquifer to the ocean.

The well will be equipped with a flow meter to record the amount and groundwater withdrawal. In addition, monitoring wells are proposed for up-gradient and down-gradient to the direction of groundwater flow. Parameters to be monitored include static level, temperature, conductivity, and dissolved solids, as well as contaminants such as fats and oils (to determine hydrocarbons).

7.4.7 Sea Water and Marine Sediments

7.4.7.1 Methodology

In the Impact Screening Matrix Table 7.2, Section 7.2, the following significant potential interactions between Project activities and and seawater were identified:

- Construction phase:
    - Pile driving in the sea;
    - Marine sediment dredging for the seabed and installation preparation of the NG pipeline in the sea.

    - General construction activities at sea - and specifically fresh concrete use; and
    - Storage, handling, use and raw materials disposal, wastes and hazardous wastes (potential interaction only if there is accidental spillage).
- Operations phase:
    - LNG delivery and delivery ;
    - LNG storage, handling and regasification;
    - LNG regasification warming water release
    - Storage, handling, use and raw materials disposal, wastes and hazardous wastes (potential interaction only if there is accidental spillage).

A significant project adverse effect on water quality or marine sediment is defined as an effect that causes the substances deposition or substances in the marine environment. That results in elevated levels of a specific parameter in sea water or marine sediments above the existing background levels and at a potentially harmful level to resident marine flora or fauna.

Seawater and sediment quality have the potential to impact in many ways, including:

- Increased suspended sediments / turbidity;
- Ballast discharge from vessels;
- Bilge water water discharge from vessels;
- Wastewater discharge from vessels;
- Accidental spills of oil, fuel or other hazardous materials; or
- Release of other harmful substances (e.g. concrete).

It is expected that most potential effects on seawater and marine sediments during construction relate to the potential mobilization and sediments re-suspension because of: marine sediment dredging, NG pipeline installation, and the pile placement/installation for the trestle construction. In addition, all in-water marine works has the potential to result in hazardous material spills which could result in localized impacts to the marine environment.

As described in Section 5.3.9, the marine environment in the Marine Terminal vicinity to higher turbidity levels of heavy discharge periods from the area's rivers, including Río Sensunapan, Rio Barranca and El Sunza, particularly during the rainy season. Water samples in the area indicate that sediment levels can be around 180 mg / l to 300 mg / l.

As described in Section 5.3.9, marine sediment samples were collected over a larger area, and chemical concentrations were analyzed. A total of 29 sediment samples were collected and analyzed in 2016.

Based on this analysis, it was determined that the all key sediment paremeters concentrations were much lower than their respective criteria. Those results suggest that no adverse biological effects are expected in the Project area as a metal and metalloid concentrations result in sediments.

7.4.7.2 Construction Phase

An increase in turbidity is expected during marine construction activities. Eggs, sessile creatures (e.g. coral, benthic invertebrates) and juvenile fish may be subject to sediment re-suspension due to their lack of mobility. Filter feeders may be particularly affected due to impaired filtering, leading to reduction in foraging ability and survival. Sediments re-suspension reduces visibility for predators that rely on visual cues for hunting. Corals are particularly sensitive to sedimentation impacts due to the smothering likelihood, burial and shading.

Pile Driving (Offshore) - Suspended Sediments and Water Turbidity

Pile driving will be required for installation of the construction trestle near the shoreline. Given that the substrate type as being predominately sandy, and the minimal disturbance involved in placing the pilings (no dredging or excavation works are needed) increased turbidity is expected to be temporary and localized. Any disturbed suspended sand will quickly fall out of the water column and re-settle. The use of tug boats in shallower areas would prevent sedimentation from the prop wash from larger vessels with larger and more powerful propellers. Biota will quickly recolonize any disturbed areas.

Marine Terminal Seabed Preparation & NG Pipeline Marine Installation – Suspended Sediments and Water Turbidity

The proposed marine terminal is to be located approximately 1.25 km the Acajutla west coast, at a water depth of approximate 15 m below mean low water spring. The subsea pipeline runs from the marine terminal to on-land LNG storage and power plant site. During the marine terminal construction there could be activities that result in the sediments release into the surrounding waters, including:

- Trenching of the subsea pipeline.
- Site preparation for the installation of the cofferdam (dredging), and
- Disposal of dredged material.

Section 4.8 describes how sediment will be removed and the estimated volume to be removed. When sediment is removed there will be somd sediment dispersion amount and increase turbidity in the surrounding environment. To determine the amount and the dispersion extent , a sediment modelling exercise was undertaken..

The DHI MIKE 21 Particle Tracking (PT) model was used to determine the transport of re-suspended materials during dredging. The MIKE21-PT model is forced using the MIKE21 hydrodynamic (HD) model. It simulates the dredging material release by inputting a sediment concentration as particles. The PT module calculates the path of each sediment particle and outputs individual classes instantaneous concentrations. Suspension, settling and transport is interactively simulated for each specified sediment class. As an output, the extent of the suspended material transport and the predicted concentration are simulated.

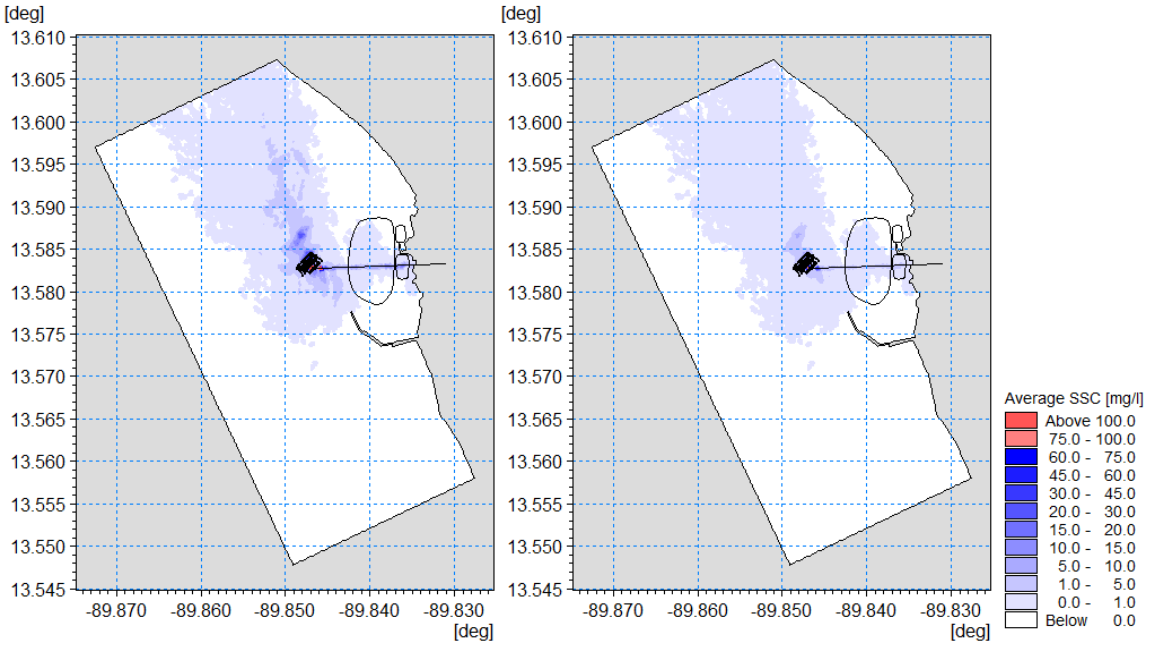
The environmental flow conditions, the dredged materials characteristics, the volumes and the release rates, have been determined through discussions and coordination with the technical and environmental teams and EDP. Model details and recognized assumptions are described in the Sediment Plume Dispersion Analysis Report (Appendix 7C).

Average Concentrations of Suspended Sediments (CSS) and Total Suspended Solids (TSS)
Given the dredging activities nature and the tidal fluctuation influence, average concentrations assist in the representation of the suspended sediment characteristics for this project. In addition, the sediment depth deposited is provided. As the suspended sediment is released from the water column it creates a blanket across the influence area. The deposited sediments depth determines the impact. Figure 7.5 presents CCS over a period of 7 days and 30 days, with a smaller scale presented in Figure7.6. The selection of the periods is discussed below.

From Figure 7.6, it can be seen that the average SSC at the previously identified net, lobster and oyster fishing areas is less than 15 mg/l for the 30-day average, less than 65mg/l for the 7 day average. There are two areas at the marine terminal location and immediately the terminal east location where the averages are above 100 mg/l – these are point source indicators based on the model representation of the trailer suction hopper dredger. The modeled release rate for this dredging operation does not represent the vessel motion (a constantly moving 3-5 knot track). Instead it is shown as a single point source release. However, even with this method of representation, which is significantly more conservative than the actual dredger motion, the 7-day averaged SSC is below 2.5g/l within 250 m of the release location. Figure 7.7 shows the concentration pattern against time for two extraction points, defined as Point X – at the marine terminal and Point Y – at the boundary of the net fishing area. This figure illustrates the the SSC peaks short duration and the very rapid reduction in peak concentration with short distance from the release point.

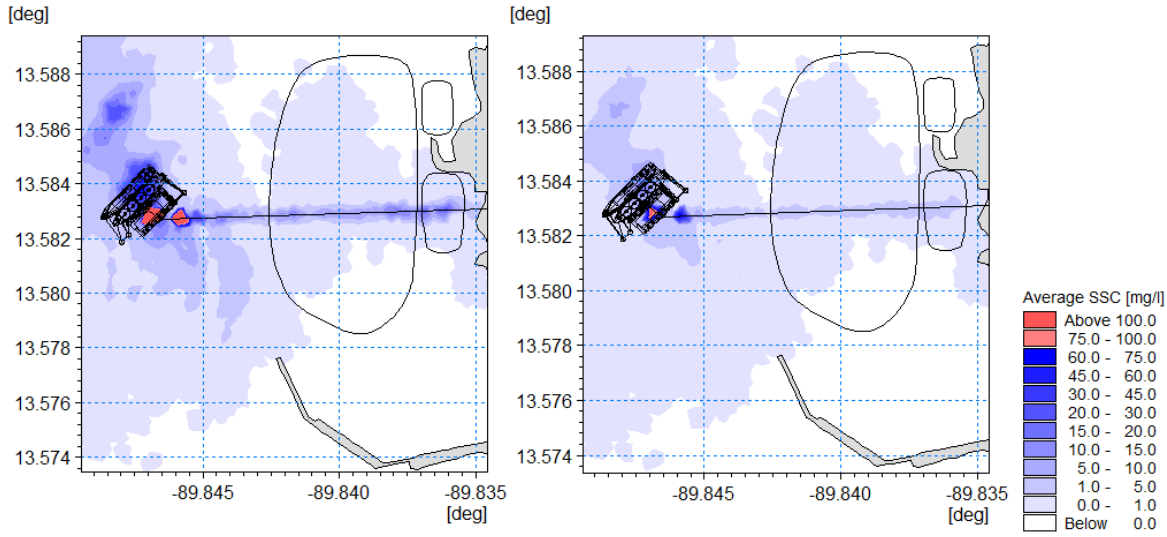
Referring to Figure 7.6, the maximum CSS, along the northern model boundary is 0.6 mg / l for the average of 7 days, 0.2 mg / l for the average of 30 days.

Figure 7.5 – Total concentration of suspended solids averaging 7 days (left) and 30 days (right), in mg / l



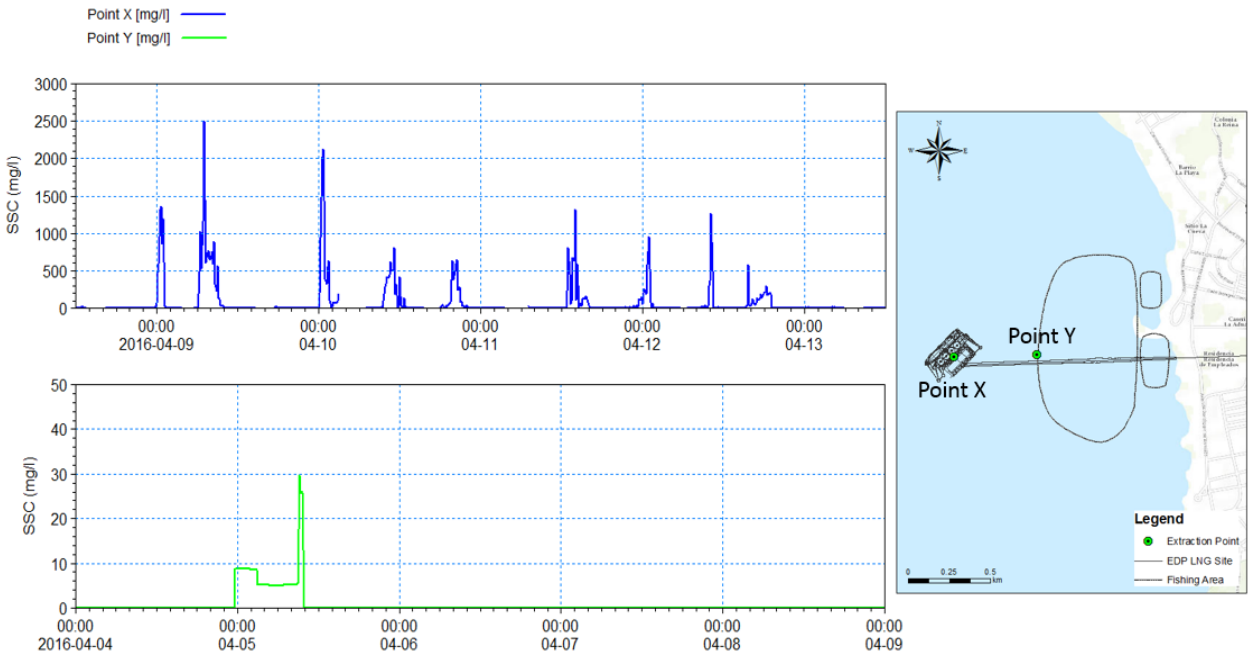
Source: Sediment Dispersion Study

Figure 7.6 – Total concentration of suspended solids of an average of 7 days (left) and 30 days (right) in the fishing zones, in mg/l



Source: Sediment Dispersion Study

Figure 7.7 – Total Concentration of Suspended Solids Instant Time Series at two Extraction Points

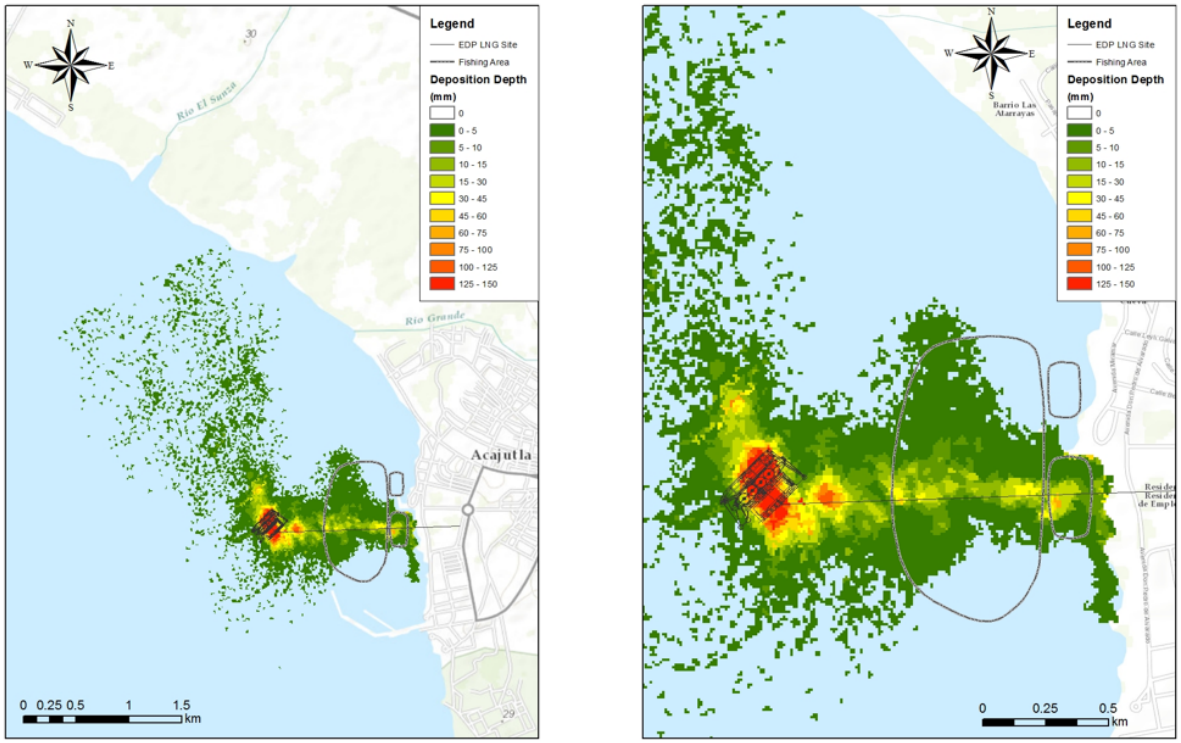


Source: Sediment Dispersion Study

Sediment Depth Deposition

As discussed above, deposition depth is another impact indicator. Based on example projects in southern California and the dredging operations biological effects by Engineers US Army Corp (2005), a 3 to 6 inch maximum depth (equivalent to 75 to 150 mm) deposition for intertidal habits and 4 inch (equivalent to 10cm) for submerged aquatic vegetation are suggested. The Figure 7.8 below shows the deposition map after the dredging. The deposition within the fishing areas is less than 75 mm (3 inch) in depth which is below the suggested threshold tolerance level of 3 to 6 inch. There is no significant deposition along the shoreline within the modeled area. The peak deposition anywhere within the modeled area is about 0.8m which is confined to a small area in direct proximity to the marine terminal.

Figure 7.8 – Depth of Total Deposition on the Zone (Left) and Approach in Fishing Zones (Right)



Source: Sediment Dispersion Study

Concentrations Suspended Along the Northern Boundary

A particular analisys of Figure 7.5 and 7.8 show that the the suspended sediment spatial trajectory will reaches and surpass the numerical model northern boundary . The results however also show that the SSC and the deposition depth are very low, particular in terms of the results extracted in the model.

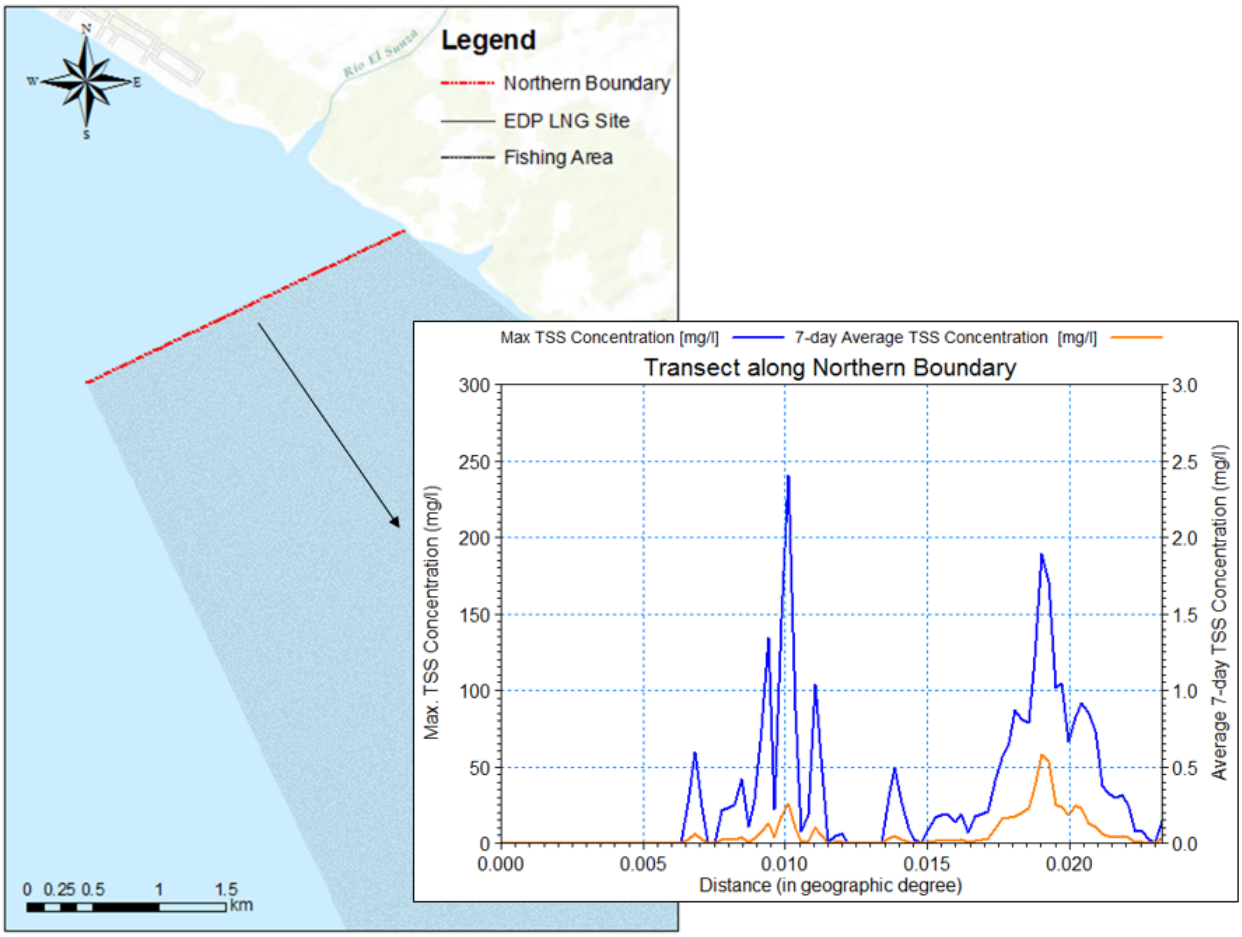
The Figure 7.9 demonstrates the suspended concentration along the northern boundary from deep water to the shoreline. The maximum SSC along the boundary at any time during the entire dredging period does not exceed 250 mg/l (shown as the blue line in Figure 7.9). Even then, the peak concentration is only experienced as an instant concentration lasting a very short period; less than 2 hours. The average SSC (shown as the orange line) significantly drops when averaged over 7 days. The highest average 7-day SSC along the northern boundary line is only approximately 0.6mg/l.

The plume characteristics (shape, trajectory and concentration profile) are established by the time it reaches the northern boundary. With the shoreline orientation (running south-east to north-west) the plume will encounter the shore within 1.5 km from the model boundary. It is not unreasonable to expect the plume to continue its trajectory and continue to disperse in SSC terms. Therefore, although

the model domain does not include the entire plume trajectory for the dredging cases shown,the model extension is not considered necessary to predict the impact, nor to verify the final plume fate.

Similarly, the dispersed sediment deposition pattern , shown in Figure 7.9, indicates that the deposition is less than 5 mm (which is immeasurable) at points along the northern boundary. The deposition measurable frequency decreases very rapidly within 1 km from the terminal.

Figure 7.9 – Maximum Concentration (in Blue Line) and Medium Concentration (in Orange Line) along the North Rim of the Modeled Area



Source: Sediment Dispersion Study

Compliance Standards

Since the USA has Pacific Ocean coastline and has an established environmental compliance system, review of the Environmental Protection Agency (EPA) standards was used as a guideline to environmentally diligent sediment concentration standards. The EPA water quality standards for turbidity in California sets criteria for averaged turbidity based on 7-days and 30-days. For Ocean Waters the limiting concentrations are 75 JTU for the 30-day average, and 100 JTU for 7-day average. Given the short time peak SSC occurrence duration, in combination with tidally driven dispersion, a compliance standard based on averaged turbidity at environmentally sensitive locations appears to be consistent with the California EPA water quality guidelines.

In relation to the modeled results, the SSC was averaged over the modeled period. The 30-day average concentration was calculated assuming the non-dredging period incurs zero increase in turbidity. The 7-day average concentration was computed using moving average method over the modeling period and the highest 7-day average was presented.

California EPA standards refer to JTU (Jackson Turbidity Units), which is an obsolete unit. For the purposes of this study it is assumed that JTU is equal to NTU (Nephelometric Turbidity Unit). The relationship between NTU and suspended sediment concentration is more complex. NTU is an optical measurement; For example, 1 mg / l of sand (> 63 um) will affect the light penetration and therefore will show less turbidity than 1 mg / l of clay (<63 um) due to the larger particles. The specific relationship is particular to the site, based on sediments and conditions. Based on the sediment characteristics used in this study, it is not unreasonable to assume that NTU is approximately equal to CSS.

Based on the cases studied and considering possible environmental compliance standards, such as the standard suggested by the California EPA, the following conclusions are made with respect to sediment conditions and potential impacts resulting from construction and the EDP LNG terminal operation. The conclusions are focused on the identified interest areas.

Fishing Areas

Based on the suggested standards, suspended sediment columns from dredging activities do not have a significant impact on any fishing areas identified in Figure 7.6. The average CSS for 7 days and 30 days is well below the suggested tolerance of 75 mg / l and 100 mg / l, respectively. The deposition depth on the fishing grounds is also within the suggested acceptable range.

Coastal Line and Beaches

The dredging assessment activities indicates that the sediment feather is limited to open waters and does not affect the coastline immediately after release. The impact on recreational beaches from the terminal 4 km north is minimal, and possibly significantly less than the annual suspended sediments impact from river reservoirs following the rainy season. The average CSS over a period of 7 days at the beach does not exceed 10mg / l, below California EPA standards.

Open waters

The sediment plume generated during the dredging works is limited to open water. Concentrations are strongly influenced by high tide and low tide, with a small concentration accumulation near the release points only during the dead tide. Maximum concentrations only occur in very short periods, before returning rapidly to / near base levels.

Dredged Sediment Disposal

The appropriate selection for the material disposal to the proposed marine sediment dredging (hereinafter ODMDS "Ocean Dredged Material Disposal Site") was made taking into account the recommendations made in USACE EM 1110-2-5025 for dredging and management of dredging materials (July 2015).

The following requirements have been established for the selection of an ODMDS. The site must:

- Be located within an economically feasible distance from the dredging point;
- Be established in such a way to minimize potential damage to critical resources, as well as to minimize interference with other beneficial but incompatible uses of the ocean environment;
- Provide the storage capacity required to meet the dredging requirement and to provide this capability while minimizing potential adverse impacts to the aquatic environment and human health; and
- Do not cause, in a short term / construction phase, nor in a long term / permeant phase, a danger for navigation.

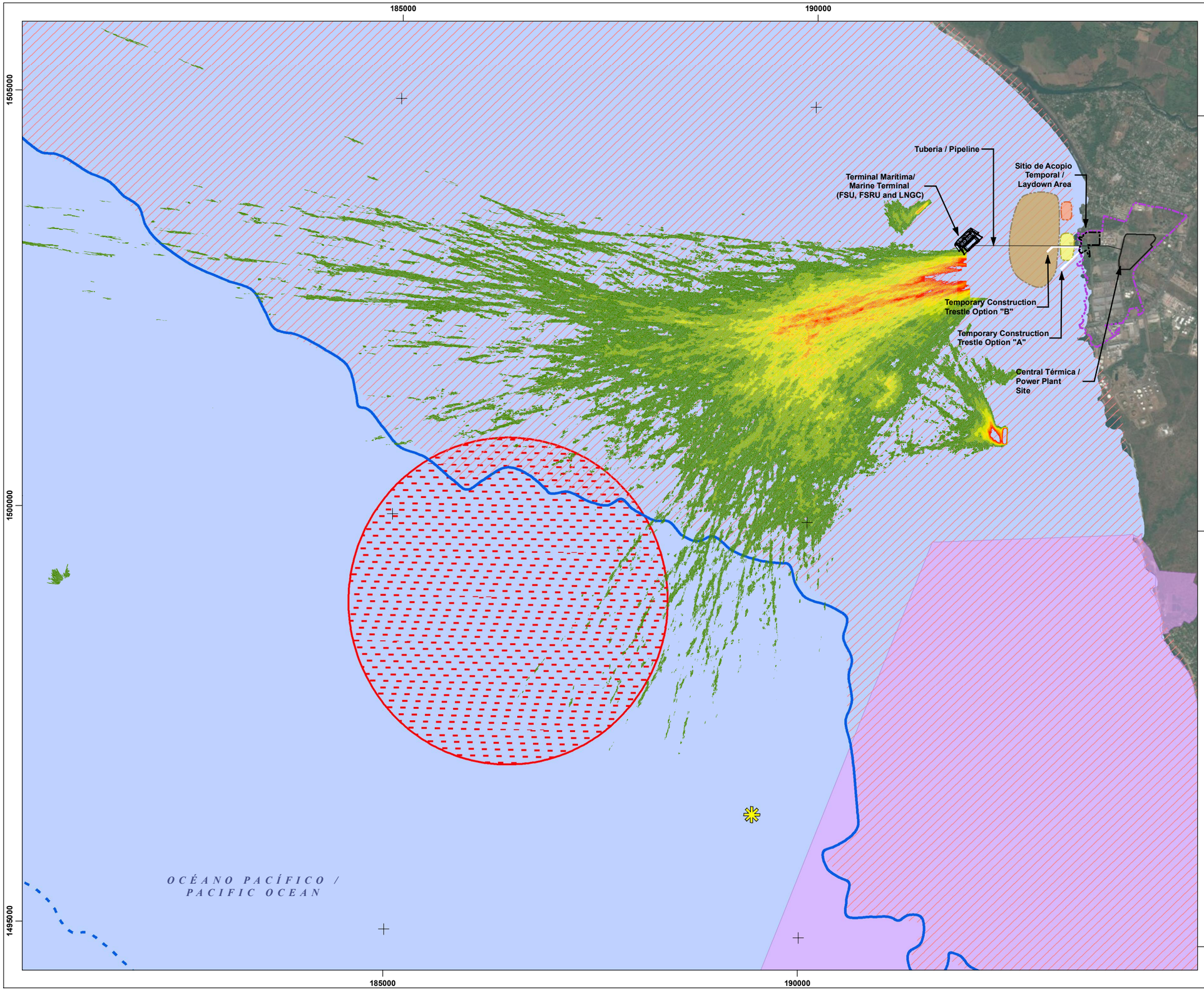
The technical considerations in the selection of ODMDS, considering the objectives mentioned above, include: water depth, physical characteristics of the dredged material, disposal nature operations, and environmental forcing characteristics (waves and currents). These technical factors have been determined during the Front-End Engineering and Design (FEED).

Studies on the dredging fate material in open water have determined that for the dredging type and the intended disposal operation, as well as the dredged material physical characteristics, after being

dumped, will probably crush. Looking somewhat like the disk shape, as it takes a circular, horizontal shape (assuming a flat, unobstructed background) with a small vertical dimension. The deposition shape can be affected by waves and currents. For Acajutla, where the wave influence is only on the surface and the tidal currents decrease with the water depth, this circular form is expected to form or appear as an ellipse oriented with thede ti direction. As the released dredged material thickness , rapidly descends towards the bottom of the laying area forming a low gradient circular or elliptical mound, the vertical extent is affected by the cohesiveness and the material slope stability, as well as the erosive waves and currents characteristics.
Using the dredge plume dispersion analysis result (M & N 2016 ref.), Local bathymetry and marine use, and considering the probable disposal operations, it is proposed that the ODMDS radius be 1.5 nm with a 0.5 nm damping with a center radius of -89.8971, 13.5424 (WGS84) (See Figure 7.10) This allows a buffer zone for the ship / dredge in terms of maneuverability and drift, while ensuring that sediments resuspended within the specified ODMDS's.

The dredger would reduce its velocity when approaching the specified central point, then it would remain firm on the designated area or maintain a slow course within the radius of 1,5 nm. The additional 0.5 nm damping provides a resuspension zone.

The proposed ODMDS Upon acceptance, it is expected that the site and its use will be issued as "Notice to Mariners" and that all vessels associated with dredging operations shall display lights and signaling in accordance with current legislation and authority.



Energía del Pacífico

ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

SITIO PROPUESTO PARA DISPOSICIÓN DE MATERIAL DE DRAGADO / PROPOSED DREDGED MATERIAL DISPOSAL SITE

FIGURA 7.10 / FIGURE 7.10

- BARCO HUNDIDO / SUNKEN SHIP
- NIVEL 30 METROS / 30 M CONTOUR (1987)
- NIVEL 50 METROS / 50 M CONTOUR (1987)
- SITIO DEL PROYECTO / PROJECT SITE
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA
- TERRENO PROPIEDAD DE CEPA / CEPA PROPERTY
- PESQUERIA CON REDES / NET FISHING AREA
- PESQUERIA DE OSTRAS / OYSTER FISHING AREA
- PESQUERIA DE LANGOSTAS / LOBSTER FISHING AREA
- ÁREA NATURAL PROTEGIDA (LOS COBANOS) / NATURAL PROTECTED AREA (LOS COBANOS)
- EVITAR ÁREAS DE MÁS DE 30M DE PROFUNDIDAD / AVOID AREAS SHALLOWER THAN 30 M
- EVITAR ÁREAS DE MÁS DE 30M DE PROFUNDIDAD / AVOID AREAS SHALLOWER THAN 30 M

TRÁFICO DE BARCOS (NÚMERO DE BARCOS) /
VESSEL TRAFFIC (NUMBER OF VESSELS)

10 - 20 | 21 - 30 | 31 - 40 | 41 - 50 | 51 - 60 | 61 - 70 | > 70

0 100 200 400 m

1:45,000

N
W
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S

FUENTE / REFERENCE
VISIÓN DEL MUNDO 2 IMÁGENES DE ALTA RESOLUCIÓN /
WORLDVIEW 2 HIGH RESOLUTION IMAGERY (2014-02-12)

MAPA CREADO POR / MAP CREATED BY: PFM
MAPA REVISADO POR / MAP CHECKED BY: MW
PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONE 16 WGS84

ARCHIVO / FILE:
I:\GIS\163489 Acajutla\GIS\MXDs\Reporting - 2016\4 - X - Dredege Disposal Avoidance Areas.mxd

PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL / FINAL
FECHA / DATE: 12/9/2016

DILLON CONSULTING

ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

Storage, Handling, Use and Disposal of Hazardous Waste

During construction, there is potential for the hazardous materials accidental release, such as fuel, hydraulic fluids, refrigerants, and lubricants, into the sea. Spills can be caused by malfunctioning barges accidents, ships, vessels, as well as collisions. Spill impacts in receiving environments can be physical (like suffocation) and biological (bioaccumulation and toxic effects, for example) in nature. Spills can occur to varying degrees in many different circumstances and can range from minor to severe. All project personnel must comply with all practices related to the proper handling of fuels and lubricants.

A spill prevention and control procedures specific for Marine Construction Activities will build into the Project EHS Plan and incorporate Best International Industry Practice marine construction spill prevision and contingency plans. The procedures shall be based on the procedures defined for the handling and hazardous materials storage on land as set forth in Section 7.4.4 of this EsIA. Additional procedures for maritime activities will include:

- Biodegradable oils and lubricants use and for construction equipment at sea;
- Spill kits will be available for immediate deployment (absorbers, oil booms, skimmers); and
- Workers trained in marine spills, prevention, response, and cleaning, will be present during construction activities.

General Construction Activities - Concrete Use

Some limited amount of concrete poring may occur to cap the cofferdams (if used to create the marine terminal enclosure). The total amount of cast in place concrete to be used offshore is approximately 6,000 m3. Where the concrete is manufactured and brought to the terminal has not been confirmed. Potential options include: 1) the manufacturing of the concrete at a batch-plant located in the construction laydown area and then transported to the off-shore terminal by trucks on barges or 2) a small batch plant would be located on a barge and them operated next to the cofferdam cells. It is important that concrete be produced, transported and poured in a manner that is sensitive to environmental impact. Uncured liquid concrete can be toxic to fish life due to its alkaline nature and therefore it should be prevented from entering the marine environment. This will be achieved by constructing appropriate concrete formwork in a manner that will prevent fresh concrete or cement paste from leaking into the ocean. Chutes or concrete pump delivery lines will have joints and connections sealed and locked and crews will oversee that concrete forms are not overfilled. Equipment and tools will be washed in fresh water (not the sea) that will be disposed in a suitably approved location on land in accordance with the EHS Plan. Those measures are sufficient to avoid cement significant quantities and concrete from entering the marine environment.

7.4.7.3 Operations stage

The operation of the FSU/FSRU and delivery of LNG via tankers have the potential to impact seawater and sediment quality.

Potential impacts to seawater and marine sediments during site operations are expected to be minimal, mainly limited to potential spills (fuels, etc.) and waste water potential discharge, ballast water, and wastewater from The FSU and the visiting tankers.

Turbidity

Propeller wash from ships in shallow water with soft bottoms can result in sediment re-suspension and increase water turbidity. The expected approach and initial maneuvering areas to be used by tankers will be the same as for other ships visiting the port area. The tanker numbers is expected to be a maximum of 32 per year although in the foreseeable future for the power plant operation there will be approximately 8 ship deliveries per year. Thus, any additive effect in those areas will be minor.

Spills

During operation there is a fuel spills risk from routine operations - especially with respect to refuelling activities, and from major events such as a ship collision or grounding.

The fuel spill risk during routine operations is small. Visiting tankers will not be refuelled at the site. The FSU will require fuelling approximately up to 32 times per year. While remote, there is also spills risk during the LNG transfer from the visiting tanker shops to the FSRU. In the leak event, the amount of LNG spilled from the pipeline or equipment will rapidly vaporize due to the large change in temperature (from –163°C to 27°C). When there is a significant LNG released amount, a LNG portion located inside the volume released will stay liquid. This situation creates a potential for a pool. The scenarios for which a pool fire is possible have been determined to be unlikely to occur and are further detailed in Chapter 9 which examines potential project risks. The engines required to power the FSRU will require fueling. Tenders fueling and other smaller vessels that will support the project would be completed at existing facilities at the CEPA Port.

Events related to hazards and accidents, such as spills, will be responded according to a Contingency Plan, which has been developed to a conceptual detail level (see appendix 9D), and which will be further refined during the detailed design development. The Contingency Plan (see Section 9.4.4) shall describe the measures that should be taken to treat spills, including for example:

- Training of personnel and personal protective equipment available;
- Overfill and spill protection;

- Inventory control and labeling;
- Use of secondary containment;
- Incompatible materials stored in separate locations; and
- Materials for spill response and cleanup readily available

Spills from a major event, such as a ship collision or other accident, are remote possibilities Chapter 9.0 Risk assessment, complete and summarize a risk assessment.

Management measures to minimize hazards include safety restriction zones enforcement (See Section 4.9.6) around LNG tanker, the FSU/FSRU, and avoiding LNG transfers during inclement weather periods. Vessels will be compliant with applicable maritime regulations and personnel will be trained for spill emergencies and the spill-response and clean-up plan implementation in the event of a spill incident.

Depending on the extent, a fuel/oil spill from an accidental event would potentially affect the marine ecosystem, including seawater and marine sediment quality in the site vicinity. The aerial and temporal potential effects extent would depend on wind and wave conditions, currents, water temperature, the spill magnitude, and the cleanup operations success. The potential for a marine disaster involving a significant fuel spill at the Project site is considered remote (as described above). Nevertheless, a Spill Prevention/Mitigation Plan will be developed in cooperation with CEPA.

Ballast, bilge and wastewaters

Potential impacts to seawater quality can also occur from the wastewater discharge (bilge and sewage) and ballast water from the vessels during operations. Depending on ballast realease point or wastewater, it could potentially impact water quality in the vicinity of the vessel.

Regarding ballast water from LNG Tankers is considered low for this site as ships will be arriving loaded (i.e., without ballast water). Ballast will only need to be re-filled once the LNG is transferred to the FSU. However, during the ship to FSU LNG transfer process, the FSU may need to discharge ballast water as it takes on the LNG cargo.

The final plans and control measures for ship wastewater and ballast will depend on the specific FSU and the specific tankers that will be used. Selecting the contractors EDP will ensure that bilge and wastewater releases by the selected FSU and supply tankers be controlled in agreement with the *International Convention for the Control and Management of Ship's Ballast Water and Sediments*. Best International Industry Practice will be used and include a review of vessel sewage and ballast water discharge provisions. Considering the high number of ships currently visiting the Port area, ballast

discharges are expected to be relatively minor and any effects will be limited to short-term, localized events. No significant impact is expected to water quality.

To minimize marine biota accumulation at the sea water inlet pipe, a Chlorine based anti-fouling solution will be used at the seawater intake location. The chlorine concentration will not exceed the IFC limit of 0.2 ppm. No other chemicals will be added to the seawater needed for regasification operation.

Hot & Cold Water Discharge

The Project will require the following warm and cold water discharges:

- Warm water will be discharged from the FSU boiler and from the FSRU cooling engine.
- Cold water will be discharged from the FSRU vaporizer (to convert LNG to NG)

The water amounts to be discharged were previously described in Table 7.1. The discharge warm and cold water delta will not exceed +/- 5 degrees centigrade above the room conditions and will be supervised by the operator.

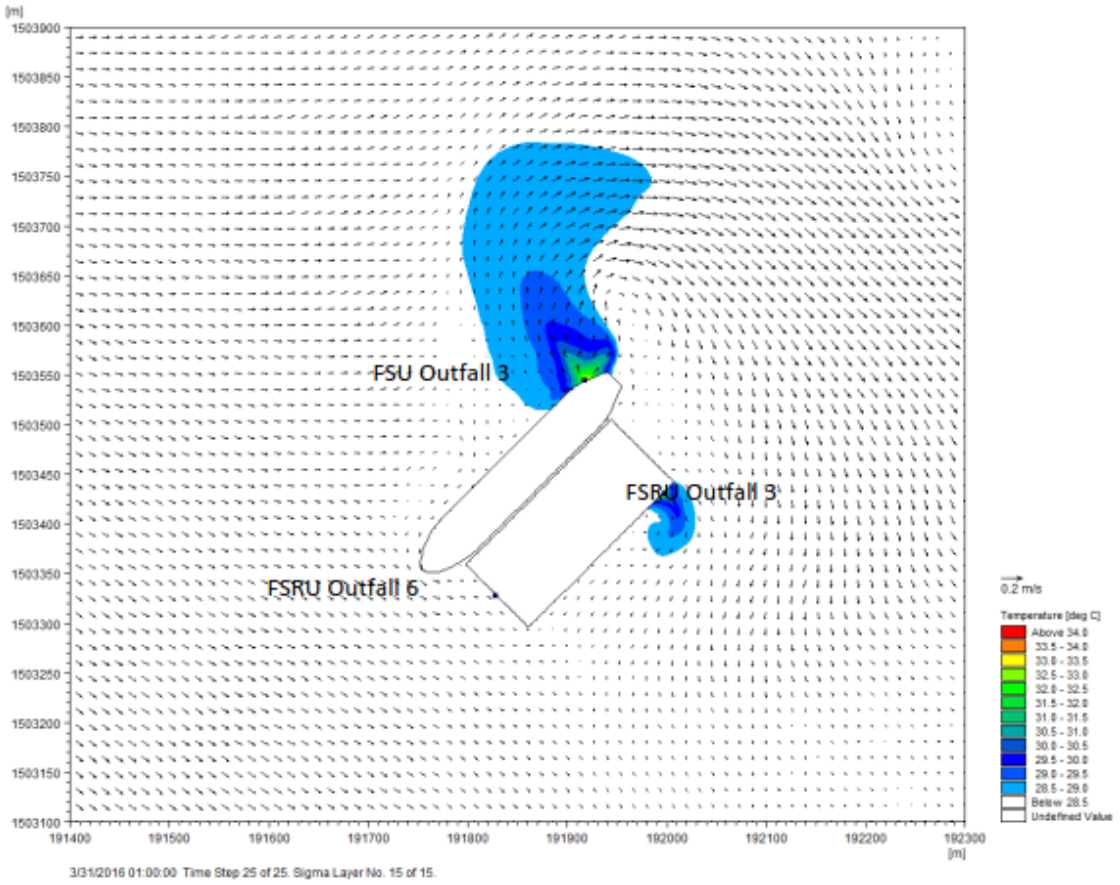
A hydrodynamic (HD) "Mike Flexible Mesh 3D" model was developed to evaluate the thermal plume dispersion. The model is the numerical model set part of the Hydraulics Danish Institute (DHI). The hydrodynamic model is a numerical model that can simulate oceanographic, coastal and estuarine flows, including density variations caused by salinity and temperature. For further details of the model, including key assumptions, please refer to Appendix 7C Thermal Plume Dispersion Analysis Report.

Surface and seabed temperatures were respectively extracted from the upper and lower sigma layers of the 3D simulation. They represent the the thermal plume extension away from the discharge points. The temperatures were plotted in the simulation last period, and represent the conditions in that period, but otherwise would vary throughout the simulation. The graphs are shown in Figure 7.11 and Figure 7.12.

The colors in Figure 7.11 indicate temperatures that are greater than 28.5°C, i.e., 0.5°C above the ambient temperature (+28°C). The warm water plume from the FSRU Outfall 3 (engine cooling water) can be seen to be influenced the most by eddies that are formed on the landward cofferdam side. It is noted that the temperature at the point source, i.e. the outfalls, is 33°C (delta +5°C from ambient). The model results show that temperature was reduced to less than 0.5°C from ambient within 250 m from FSU Outfall 3 and less than 0.5°C from ambient within 70 m from FSRU Outfall 3.

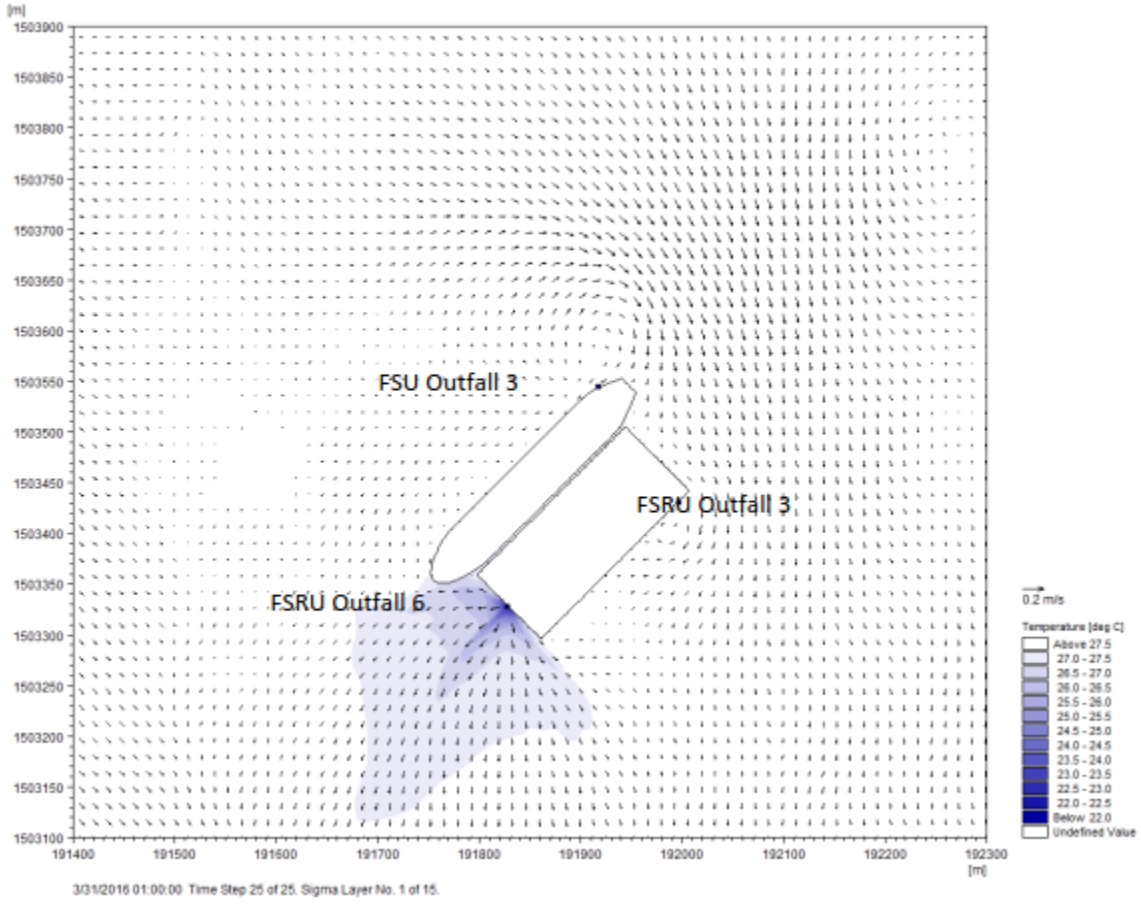
The colors in Figure 7.12 indicate temperatures less than 27.5°C, i.e., 0.5°C below the ambient temperature (+28°C). From the FSRU, the cold water plume temperature was increased to less than 0.5°C from ambient within 250 m from FSRU Outfall 6.

Figure 7.11 – Surface Temperature



Source: Thermal dispersion study

Figure 7.12 – Sea Bed Temperature



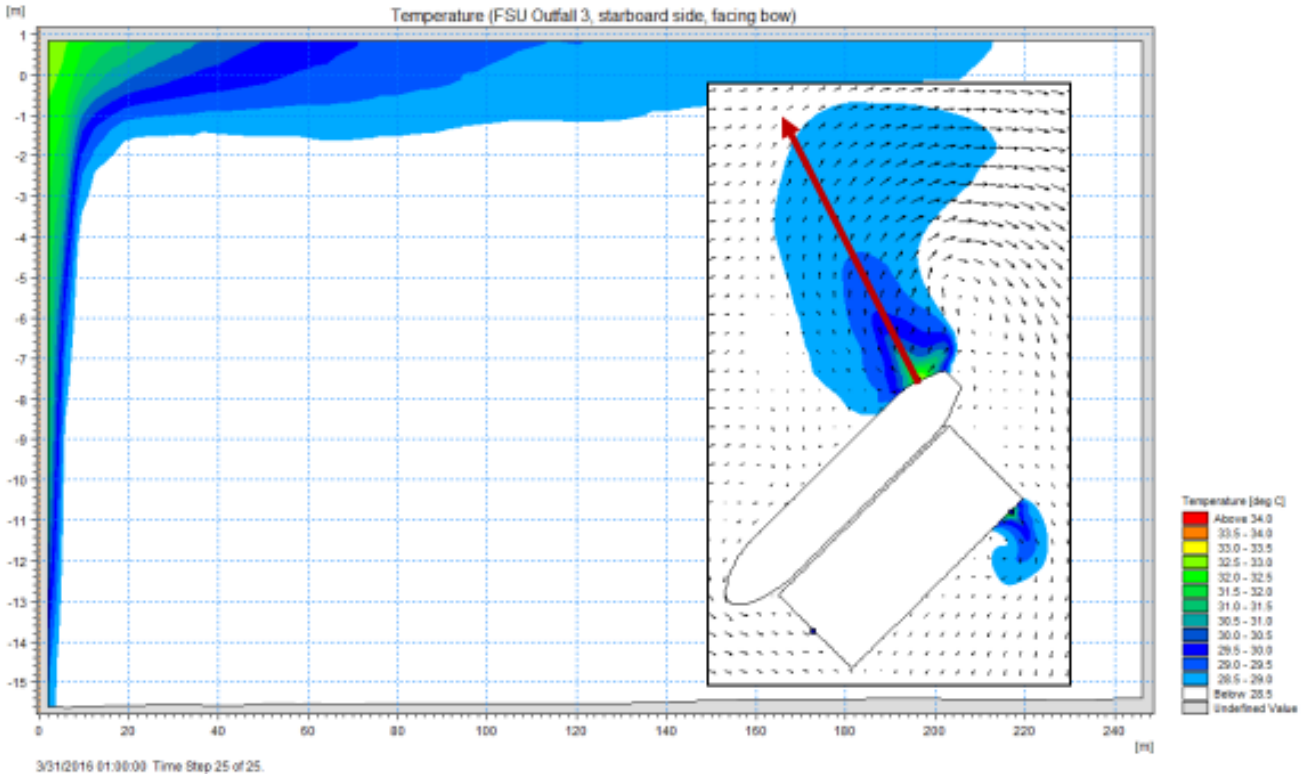
Source: Thermal dispersion study

Vertical temperature profiles were also ploted. The plots are shown in Figure 7.13 to Figure 7.15. The insert in each figure shows the corresponding cross-section. The Figure 7.13 and Figure 7.14 colors indicate temperatures that are greater than 28.5 ° C, ie 0.5 ° C above ambient temperature (+ 28 ° C). Surface temperatures remain elevated near discharge points, but quickly dissipate as they move away from the vessels. The warm water plume is kept within a surface layer of approximately 3 meters and dissipates a few hundred meters from the discharge points.

The colors in Figure 7.15 indicate temperatures below 27.5 ° C, ie 0.5 ° C below ambient temperature (+ 28 ° C). The cold water extends throughout the entire the water column. Coldwater, being denser, tends to sink. The plume stays within a 2-meter bottom layer and dissipates within 200 meters from the outfall. The difference between plume and ambient temperature reduced to 1°C within 80 meters from outfall.

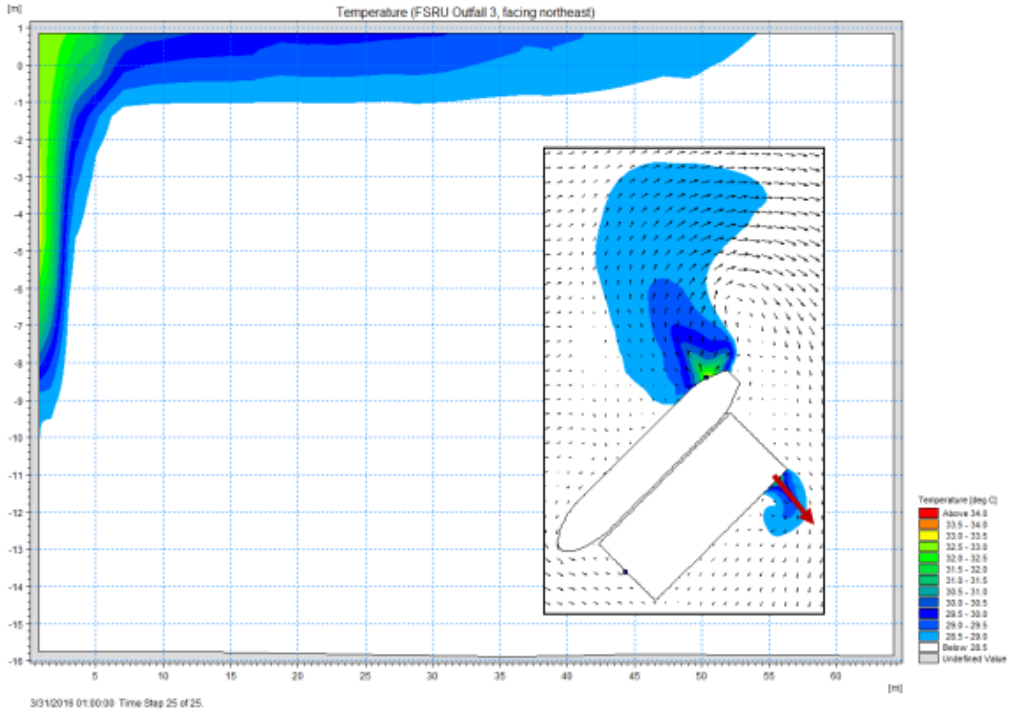
The thermal plume model shows that the plume extension is located in the Maritime Terminal vicinity , and does not extend to any marine habitats or sensitive fishing areas. However, there is a possibility that marine species may enter this area. None of fish species were sensitive to the temperature were the affected area.

Figure 7.13 – Vertical Profile of temperature dischage 3 of the FSU



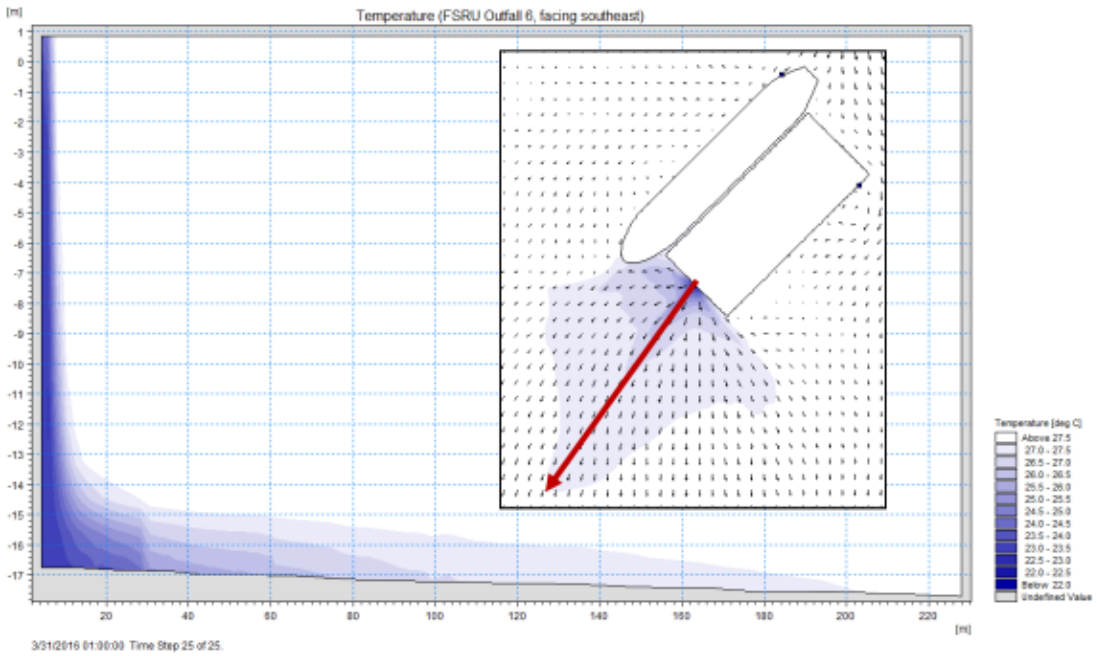
Source: Thermal dispersion study

Figure 7.14 – Vertical Profile of temperature discharge 3 of the FSRU



Source: Thermal dispersion study

Figure 7.15 – Vertical Profile of temperature discharge 6 of the FSRU



Source: Thermal dispersion study

7.4.8 Coastal Dynamics: Marine Currents and Sediments

7.4.8.1 Methodology

The Impact Screening Matrix Table 7.2, Section 7.2 identified the following significant potential interactions between Project activities and characteristics and coastal dynamics:

- Construction phase:
  - Pile Driving; and
  - Construction of Maritime Terminal
- Operations phase:
  - Physical presence of the facilities.

7.4.8.2 Construction phase

The construction and physical the Maritime Terminal presence has the potential to affect marine currents and the sediments movement along the Project area coastline. Sedimentation effects related to dredging activity are described previously in Section 7.4.7.

The installed Maritime Terminal potential effects and the pipeline on long-term sediment transport are described below in the operations phase.

Project construction may require the temporary trestle construction as described earlier in Section 4.5.5. As the trestle will be supported on piles, the ocean waves and currents will be able to pass underneath the trestle. The trestle will also be removed after construction is complete. For this reason, no significant long-term effects are expected on sediment transport from the trestle.

7.4.8.3 Operations phase

The potential Maritime Terminal and the pipeline evaluation to impact sediment transport processes in the study area was carried out. The results of this assessment are described in M & N *Sediment Transport and Scour Study Memo* found in Appendix 7D. The following is a summary of this analysis.

It is proposed that the Maritime Terminal be located approximately in an area with 15 m depth, about 1.25 km from the Acajutla Port coast . An associated underwater pipeline will be installed either by horizontal directional drilling (HDD) or by a conventional trench. It is assumed that the pipeline will have a shallow embedment protruding from the seabed by 0.5 m.

Based on the information various secondary sources review, the area around the Acajutla Port and the proposed EDP LNG terminal is not expected to be an area of significant coastal sedimentation or

sediment transport. The coastline morphology is driven by deposits / fluvial erosion, or by the cliffs contained erosion by the rocky promontories. There is no provision for cross-shore sediment transport near the coastline, nor are offshore movements parallel to the coast. Sediment transport is predominantly near the coast (nearshore).

The terminal footprint is relatively small compared to the open shoreline and longshore transport scale. There may be localized impacts in the immediate the terminal infrastructure vicinity since the cellular structure will block currents in north-south direction, and incoming waves from the SW/SSW. Given the water depths and predicted sediment budget at this offshore location, this is more likely to create localized scour than sediment transport. The project footprint is not predicted to have an impact on cross-shore transport. The depth at the terminal is outside of "depth of closure," which is the seaward limit of effective profile change over long-term time scales.

The subsea pipeline is assumed to protrude from the sea bed by 0.5 m. At the the pipeline outer limits (at the terminal) this protrusion is not predicted to impact sediment transport. The water depths are too great, and the natural undulation of the sea bed is likely to be similar in variation. The connection to the PLEM (PipeLine End Manifold) from the seabed will be too narrow to cause an obstruction to currents. However, as the pipeline reaches land, the emergent line will cause a minor obstruction to sediments on the beach. However, as the potential landfall sites are all beaches between rocky headlands, this is not predicted to have an impact other than localized scour to the pipeline itself. Any disruption to sediment transport will be local between the headlands. The pipeline scour is discussed in the next section.

In conclusion, is predicted to have a small or zero impact in the Acajutla Port vicinity long-term sediment transport as the terminal construction result.

7.5 Impacts on Biological Conditions and Characteristics

As identified in the Impact Screening Matrix, Table 7.2 and Section 7.2, biological environmental factors for a potential interaction or significant problem has been identified are:

- Terrestrial biota;
- Marine biota; and
- Disease Vectors.

Further Chapter 5: Description of the Environment, there are no protected natural areas that are close to the Project. Because of this, none of interaction or major problem has been identified between the Project and the protected natural areas.

7.5.1 Terrestrial Flora and Fauna

7.5.1.1 Methodology

The Impact Screening Matrix, Table 7.2 and Section 7.2, identified the following significant potential interactions between the Project activities and characteristics for terrestrial biota:

- Construction Phase:
  - Clearing (preparation of the site) - vegetation removal, displacement / fauna mortality;
  - Trenching and pipeline Installation;
  - Driving piles (in the sea) - noise disturbance to the fauna;
  - General ground construction activities - dust, noise, and noise disturbance to fauna;
  - Traffic related to construction - dust, noise, and vehicle collisions with the fauna; and
  - Storage, handling, hazardous raw materials disposal use and hazardous waste - Potential interaction only if there is exposure of the flora and fauna as an accidental spill result.
- Operation Phase:
  - The facilities Physical presence (only fauna);
  - General operations activities - noise disturbance to fauna; and
  - Storage, handling, hazardous raw materials disposal use and hazardous waste - Potential interaction only if there is exposure of the flora and fauna as an accidental spill result.

For the EsIA purposes, a significant adverse Project impact on terrestrial flora and fauna is defined as an impact that causes a potential decrease in abundance and / or change in the population. In which, beyond natural recruitment (reproduction and immigration from unaffected areas), the population would not return to its pre-project level, within several (three or five) generations. An adverse effect that does not cause such decreases or changes is not considered significant.
Identification of significant adverse impacts on terrestrial flora and fauna, considered:

- The habitats amount affected during site clearing and preparation;
- Quality and functions (e.g. breeding, feeding, shelter, corridors or linking with other areas); and
- Flora and Fauna exposure Potential pathways to hazardous materials.

There are three Project areas defined in Chapter 5 as "Direct Influence Areas (AID", Section 5.3.2). Within those areas, there is the potential for significant interactions with terrestrial flora and fauna during the construction and operation phase. Those three areas comprise:

- The Power Plant Site;
- The on-shore portion of the pipeline ROW; and,

- The laydown area (see Figure 4.1).

An "Indirect Influence Area ", has also been defined for the Project and consists of those areas that surround the AID (see Figure 4.2). The power plant site is currently undeveloped but surrounded primarily by developed areas that include industrial facilities, storage and warehousing, other port related businesses as well as residential and commercial areas. There are also scrubland areas and agriculture surrounding the Acajutla City and interspersed between industrial areas (see Figure 5.9). Habitat at the Power Plant site has been degraded by human activities including paste clearing, and ongoing garbage dumping and garbage, and fill material stockpiling . See Section 5.3.3 for a description of the existing conditions. The laydown area and pipeline RoW are largely undeveloped with the exception of where they overlap with the Maleacon Waterfront Park that is located on CEPA lands and was developed by CEPA in 2015.

The existing surrounding land uses have influenced the terrestrial habitat and, as such, the terrestrial flora and fauna in the direct areas and indirect influence are generalist species characteristic that are tolerant to the changed conditions. The Acajutla City development has influenced the degradation and habitat fragmentation.

The Project Area is predominantly characterized by flora that represents a transition between dry to hot/humid tropical forest. A species list for each area is provided in Table 5.30 to Table 5.35 (Section 5.3.4).

Two species of trees classified as "threatened" by MARN were identified at the Thermal Power plant site : *Sterculia apetala* and *Maclura tinctoria* commonly known as "castaño" and "palo de mora" respectively. Also, on the property was Dalbergia chontalensis, a shrub that is classified as an endangered species.

In the easement pipeline width, the tree species *Caesalpinia bonduc* "avellana", also a threatened species, was identified. At the temporary storage for construction site, there were two species of trees identified as "threatened" by MARN including: *Albizia niopoides* "Conacaste Blanco" and *Dyphysa Americana* "Guachipilin"; And a species of shrub *Dalbergia chontalensis Standl. & L.O. Williams*.

Regarding fauna, a total of 16 herpetofauna species (amphibians 1 and 15 reptiles) were observed within the Project area, of which 3 are categorized as "threatened" by MARN (common names: "Garrobo (spiny-tailed iguana)" (*Ctenosauria Similis*), "iguna verde" (green iguana) and "falsa coral" (false coral) (*Lampropeltis triangulum*), *Porthidium ophryomegas* "víbora castellana" (Slender Hognose

Viper) and *Leptodrymus pulcherrimus* "bejuquilla de cabeza verde" (Striped Lowland Snake), and one categorized as "least concern" by IUCN (common name: common toad).

Fifty-three (53) bird species and a total of 7 active nests were identified; One of the birds identified in the project area is considered to be threatened according to the MARN list: "Catalnica" (orange-chinned parakeet) *Brotogeris jugularis*. All identified bird species were classified as "least concern" by IUCN. Of the birds that nest in the place, all are considered resident species and typically build their nests in the same place or sites similar to the year. The most common bird species observed at the site was the brown (resident) pelican. Most of the avifauna identified are considered generalists and are tolerant to anthropogenic influences.

Mammals identified within the Project area are characterized as domestic animals (that is, cat (*Felis catus*), musk mouse (unidentified sp), and rats (*Rattus rattus*)] and 8 species of wild animals:

- Domestic rabbit (*Oryctolagus cuniculus*),
- Variegate squirrel (*Sciurus* variegatoides) hooded skunk (*Mephitis macroura*)
- Gray fox (*Urocyon cinereoargenteus*)
- Four-eyed Opossum, ferret (*Philander oposum*)
- Black opossum (*Didelphis marsupiali*)
- White opossum (*Didelphis virginiana*)
- Raccoon (*Procyon lotor*) and long-tailed weasel (*Mustela frenata*)

All mammals observed within the Project area are considered of Least Concerns or Insufficient Data with IUCN and are not considered threatened or endangered by MARN. Details regarding wildlife found within the Project area can be found in Section 5.3.5.

7.5.1.2 Construction Phase

Cleaning

The Project clearing site (including the pipeline section and the temporary storage site) will result in the l vegetation loss present at the site (approximately 18.32 ha). The vegetation within the Thermal Power Plant area is mainly composed by scrubland and dry forest, whereas in the easement section for the pipeline and in the laydown site area, there are mostly fruit trees (coconuts and mangoes). This vegetation clearing will potentially impact the resident fauna in the project area, through direct mortality, habitat loss, and increased fragmentation. The vegetation removal can also result in the wildlife displacement , such as herpetofauna and small mammals, being moved to other nearby areas.

The cleaning impacts mitigation and site preparation will consist of the following programs:

1. **Fauna Relocation Plan:** Prior to the vegetation relocation program removal will be carried out for large terrestrial fauna (e.g., snakes, iguana). Captured individuals will be relocated as appropriate to suitable nearby habitats to be determined in consultation with MARN. In addition, clearing will be completed in a step-wise fashion, to provide wildlife an opportunity to move away from active clearing areas
2. **Planting Plan:** Ten trees will be planted for each tree removed as a Project result, and for endangered / threatened species, 25 trees will be planted. EDP is currently conducting a consultation to determine if there are suitable areas for tree planting. If there are not enough areas available, some trees will be planted on municipal land located near the Project site. Alternatively, EDP will pay to the MARN fund known as the FIAES (Initiative Fund for the Americas). FIAES is an environmental fund that leads with natural resources conservation processes in priority areas in El Salvador. The payment will be equal to the cost of the remaining trees to be planted. More details are provided in Chapter 10.

While Project 10 trees will be planted for each tree removed as a Project result. EDP is conducting consultations to determine if there are areas suitable for tree planting. If the identified areas are insufficient, then EDP will provide a payment to FIAES, equivalent to the trees cost that are not planted. Further details are given in Chapter 10.

While the project will result in the flora and fauna loss to the project site in the long term, restoration and reforestation efforts, and support for the Initiative Fund for the Americas (FIAES), will result in an overall increase in tree coverage in the country.

Pile Driving , general land construction activities, and traffic related to construction

Noise

Noise generated during construction activities, general activity and human presence has the potential to alter the behavior of the local fauna that remains in the area after clearing and site preparation. The fauna sensivity to noise varies by species and season. In general, species present in the area are tolerant to human activities, including noise. Species that are sensitive and mobile will move to more favorable locations. In general, no significant effect on fauna is expected as a noise generated result by the Project and the general activities.

Dust

Dust generated during construction activities, or from related activities, can potentially settle on vegetation and therefore alter or limit the plant capacity for photosynthesis and / or reproduction. A

comprehensive dust management plan will be in place to control its generation (see Section 7.4.1). Therefore, the dust potential impacts generated during construction activities are expected to be short duration, localized, and do not cause any significant impact on the flora located in the Project's area.

Storage, handling, use and raw materials disposal, waste and hazardous waste

There is a possibility that the flora and fauna exposure to hazardous materials released into the environment may result in the gradual vegetation deterioration and the fauna poisoning. Management plans for the storage safe handling, handling, and hazardous materials safe use and for rapid response to accidental releases (as described in Section 7.4.4.3), will limit potential exposure to short-term events. The flora or fauna significant poisoning by the Project is not expected.

Most of the fauna present in the Project's area has adapted to live close to humans, food waste could attract them to the construction area. To avoid fauna being attracted, the following practices will be implemented:

- Food waste will be stored in containers with lids and should be disposed daily to avoid wildlife attraction problems;
- Avoid overloading the garbage or recycling containers, and prevent the waste storage on-site for long periods of time; and
- Keep waste containers and recycling in good operating condition, and keep them free of damage.

Those practices will help to minimize the fauna interactions during the project construction phase.

7.5.1.3 Operation Phase

Physical presence and activities in general

Noise

As described in Section 7.3.4, the central thermal power plant will generate noise. Once in operation, it is expected that the presence and the project noise would have limited impact on the fauna. As noted above, the majority animals within the site, are known to be habitat generalists, species tolerant to human presence and activities. As such, despite the fact that the area is surrounded by other industrial operations in the port area, it is anticipated that most of the fauna inventoried at the project site will be able to move easily to adjacent areas.

The following sub-sections include a broader discussion about the Project potential effects during the operation.

Lighting

Artificial light from buildings and structures can have an impact on wildlife through natural behaviors disruption (like in influencing regular seasonal cycles, day / night), exposure to increased predation, or navigation capabilities disruption. The Thermal Power Plant will require night lighting. Because the Project area is in an area that is already influenced by artificial light, it is anticipated that additional project lighting would not have a significant effect. However, to avoid impacts to wildlife, some lighting management practices should be considered, including:

- Mounting lights close to work areas (if feasible);
- Reducing illumination in non-essential areas of the facility, particularly during the life cycle tecritical periods;
- Lights mounting and orientation to minimize the surrounding sea illumination;
- Light shielding use to reduce the glare amount, as well as reducing visible light to animals, so there is less chance of being trapped, repelled, or their day / night patterns altered; and
- Long wavelength lights installation (like amber) which makes visible light appear less intense for nocturnal animals that primarily use their night vision (State of Florida 2014)[5.]

Storage, handling, raw materials use and disposal, waste and hazardous waste

There is a possibility that the flora and fauna exposure to hazardous materials released into the environment may result in the wildlife vegetation and poisoning gradual deterioration. During the operation, the main concern would be spills along off-site transportation routes. Management plans for safe storage handling , handling, and safe hazardous raw materials use and for rapid response to accidental releases will ensure that flora and fauna exposure to hazardous materials is limited.

EDP will require contractors who are responsible for the delivery or hazardous materials removal, to have spill prevention and mitigation plans, to limit the risk of their occurrence during transportation, and to allow for the rapid containment and cleaning of any event that may occur. In general, no significant flora and fauna exposure to hazardous materials is expected. As many of the fauna present in the Project area are accustomed to habitats in the humans vicinity, food waste could attract wildlife in the Project area.

Because most of the wildlife present in the Project area has adapted to live close to humans, food waste could attract them to the construction area.

[5] State of Florida. 2014. "Wildlife Illumination - About Light Pollution," Florida Commission for Wildlife Conservation and Fish. On the internet: http://myfwc.com/conservation/you-conserve/lighting/pollution/

To avoid wildlife being attracted, the following practices will be implemented:

- Food waste will be stored in containers with lids and should be daily disposed to avoid wildlife attraction problems;
- Avoid overloading the garbage or recycling containers, and to prevent the waste storage on-site for long time period; and
- Keep waste containers and recycling in good operating condition, and keep them free of damage.

Those practices will help to minimize the fauna interactions during the project construction phase.

7.5.2 Marine Flora and Fauna

7.5.2.1 Methodology

The Impact Screening Matrix, Table 7.2, Section 7.2, identified the following possible significant interactions between project activities and marine biota features:

- Construction phase:
    - Pile driving at sea - habitats loss, noise disturbance, vibration and sedimentation;
    - Sediments dredging and disposal;
    - General marine construction activities - Noise, lighting;
    - General ground-based construction activities - Sedimentation; and
    - Storage, handling, hazardous raw materials and hazardous waste use and disposal - Potential interaction only if there is the flora and fauna exposure as an accidental spill result.
- Operation phase:
    - LNG Delivery, Delivery (ships movement , water use / discharge, vessels operation, potential spills);
    - The facilities physical presence (Maritime Terminal will attract flora and fauna);
    - General operations activities (loss of habitat, noise, lighting and collisions with ships); and
    - In-take and sea water release for the regasification process.
    - Storage, handling, raw materials and hazardous wastes use and disposal (potential interaction is only if there is accidental spillage).

Significant adverse effects Identification on marine flora and fauna under consideration:

- Changes / Impacts on marine habitats (Impacts on Craft Fisheries are discussed in Section 7.6.8);

- The marine habitat quality and function and the biotic community;
- Exposing marine flora and fauna to hazardous materials possible ways, increasing ecological risk to a level that provides for long-term effects on the aquatic biota health.
- Impacts from sediment dispersal and disposal. and
- Changes in water temperature during operations, for regasification and cooling systems at the Maritime Terminal.

The possible interactions assessment between the Project activities and the marine flora and fauna in the study area is based on the existing marine environment understanding., The marine flora and fauna assessment purposes includes: corals, fish, mollusks, marine mammals, sea turtles and benthic invertebrates. The marine environment front of the Acajutla coast is compatible with a wide range of marine species (e.g. various corals, fish, shellfish, marine mammals such as dolphins and sea turtles). A species list identified in the study area, together with a marine baseline conditions description, is provided in Section 5.3.8.

The coastal zones around the Project are characterized by various substrates type including: silt, sand and rock, with silt being predominant. There are also coral reefs south of the proposed jetty location, near the existing CEPA Pier (depicted in Figure 5.45). The coastline adjacent to Acajutla has been subject to coastal erosion pressures due to increased storms, strong winds, waves, floods and the abnormal tides influence in recent years. Furthermore, existing port activities and adjacent industrial areas have likely influenced the existing marine environment.

7.5.2.2 Construction phase

Pile driving (sea) / Maritime Terminal Construction

Habitats loss

The habitat within and adjacent to the Project area is composed by sand and silt / clay and a coral reef Maritime Terminal and jetty south area that is closer to the existing CEPA pier (Figure 5.45). This habitat offers an ideal microhabitat combination for a wide marine life variety including: coral benthic invertebrates, eggs, fish larvae and juvenile fish (Section 5.3.8). Larger marine life (such as adult fish, mammals and sea turtles) will be minimally affected, because the habitat that would be affected is not considered critical or for its historical life requirements.

No turtle nesting habitat will be affected, however, it is possible that adult sea turtles could visit the Project area.

The Maritime Terminal construction will have a localized impact on the marine flora and fauna in the immediate area, due to the habitat loss within the footprint to be used. The Maritime Terminal footprint is approximately 20,000 m2 in a sand and silt habitat. The temporary pier will occupy an area of approximately 2,625m2 to 3,400m2, although for the the temporary pier case, the removed seabed area comes strictly from the sinking pills locations.

The species present in the area are not endangered or threatened, and and any disturbed areas or individuals lost during construction would quickly be replaced and recolonized by the population balance.

The pipeline corridor located in the sea, presents / displays different marine habitats; near the beach there are rocky areas with sensitive species like "Sea cucumbers" (Filo Echinodermata) and lobsters. Lobsters are harvested by local fishermen. The rest of the corridor is a silt-clay-sand combination, with no sensitive presence or unique species. The pipeline construction will disturb those areas, but when it is finished, the species will relocate back to those sites. The same will occur with the site of the temporary pier, which has similar characteristics, with rocky sand habitat near the coast. Those areas are suitable for soft corals, but no soft corals were identified during the habitat survey in those areas, only to the south, where no components of the Project will be located.

The direct marine habitat loss due to the Maritime Terminal, and the piles placement the temporary pier, can not be avoided. However, it will be off-set in several ways:

- It is expected that new structures in the water (temporary pier and Maritime Terminal) will create new habitat areas suitable for the marine flora and fauna colonization. Water structures will also provide beneficial habitat for some fish species by providing shelter against predation and sunlight; and
- Once the marine terminal is built, an exclusion area will be implemented around it (see Section 4.9.6) which would mean a reduction in fishing pressure and a long-term benefit for the fish population.

Noise / Vibration

Noise will be generated during construction activities, mainly by installing the temporary peir piles, sediment dredging, and the Maritime Terminal construction. At the source, anthropogenic noise can be broadly divided into two main types: impulsive and non-impulsive sounds (NOAA 2004). Impulsive sound sources are typically brief, have a rapid rise time (large change in amplitude in a short time), and contain frequencies wide range, which is commonly referred to broadband. Impulsive sounds can be either a single event or are repetitive, and sometimes as a complex pattern. The noise coming from the impact

pile driving would be considered a impulsive sound source . The noise impacts behavior on marine mammals (as discussed by *DiIorio and Clark 2010; Parks et al. 2011*) include:

- Changes in habitat use to avoid higher sound levels areas ;
- Diving and surfacing patterns or movement direction; and
- Vocalization intensity, frequency, repetition and duration.

Some of these behavioral responses can affect vital functions such as reproduction and feeding. The physical effects on fish observed by Turnpenny and Nedwell (1994) are as follows:

- Transient stunning at 192 micropascal decibels (db re 1 µpa));
- Internal injuries at 200 db re 1 µpa;
- Egg / larval damage at 220 db re 1 µpa; and
- Fish mortality in 230-240 dB re 1 µPa.

In addition, Pearson et al. (1992) points out that the lower noise threshold (~ 160dB) can cause subtle changes in fish behavior. A study on bottlenose dolphins showed that pile driving has the potential to adversely affect dolphin populations up to 40 kilometers away. Potential impacts interfere with communications, food hunting, eco-localization and breeding (David, 2006).

To prevent and / or minimize the potential noise impact on the marine environment, a noise management plan, in accordance with the Joint Nature Conservation Committee[6] Protocol for Minimizing the Injury Risk to Marine Mammals from Piling Noise (2010), will be developed and include considering of the following:

- Identify and communicate a safe buffer zone for fishermen and divers;
- Consider the low noise techniques use for pile driving (such as vibratory hammer and bubble curtain);
- Search (prior to pile driving), divers and marine mammals in the mitigation zone (Figure 7.16);
- Delaying the start of pile-driving activities, if divers or marine mammals were detected within the mitigation zone;
- Soft start of the machinery for the work, and protocol for restart after breaks (to gradually introduce the new source of sound); and
- Record keeping and reporting.

[6] Public organization which advises the UK Government and decentralized administrations on nature conservation throughout the UK and internationally.

Energía del Pacífico

ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

CONSTRUCCIÓN DE ZONA DE MITIGACIÓN MARINA / CONSTRUCTION MARINE MITIGATION ZONE

FIGURA 7.16 / FIGURE 7.16

191000 192000 193000 194000 195000

1505000 1504000 1503000 1502000

RÍO SENSUNAPÁN

MUNICIPIO DE ACAJUTLA / MUNICIPALITY OF ACAJUTLA

Boulevard 25 de Febrero

Boulevard Coronel Oscar Osorio

Avenida Obando

Carretera a Acajutla

Calle 24 de Octubre Ori

Avenida Las Carabelas

CA 12S

Terminal Marítima/ Marine Terminal (FSU, FSRU and LNGC)

Muelle Artesanal / Artisanal Port

Sitio de Acopio Temporal / Laydown Area

Central Térmica / Power Plant Site

Tuberia / Pipeline

Temporary Construction Trestle Option "B"

Temporary Construction Trestle Option "A"

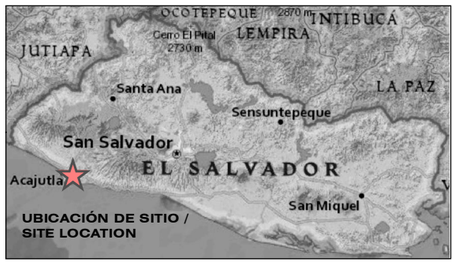
Puerto de Acajutla / Port of Acajutla

OCÉANO PACÍFICO / PACIFIC OCEAN

SITIO DEL PROYECTO / PROJECT SITE

SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA

CONSTRUCCIÓN DE ZONA DE MITIGACIÓN MARINA / CONSTRUCTION MARINE MITIGATION ZONE



UBICACIÓN DE SITIO / SITE LOCATION

0 100 200 400 m

1:16,000

N W E S

FUENTE / REFERENCE
VISIÓN DEL MUNDO 2 IMÁGENES DE ALTA RESOLUCIÓN / WORLDVIEW 2 HIGH RESOLUTION IMAGERY (2014-02-12)

MAPA CREADO POR / MAP CREATED BY: PFM
MAPA REVISADO POR / MAP CHECKED BY: MW
PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONE 16 WGS84

ARCHIVO / FILE: I:\GIS\163489 Acajutla\GIS\MXDs\Reporting - 2016\7-5 - Construction Marine Mitigation Zone.mxd

PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL / FINAL
FECHA / DATE: 12/7/2016

DILLON CONSULTING

ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

Suspended Sediments

The required sediments dredging and potential trenching for pipeline installation will generate a sediment plume. As previously described in Section 7.4.7.2, modelling was undertaking to determine the concentration and spatial plume extent . As shown previously, Figure 7.5 illustrates the predicted the sediment plume extent , with sediment concentration levels less than 10mg/l expected over the area majority with the 7-day scenario; and for the 30-day scenario, concentrations are below 100mg/l. Exceedances of 100mg/l will be present only within close proximity to the marine terminal. Due to their lack of mobility sessile creatures (e.g., benthic invertebrates) and juvenile fish (and eggs) may be subject to impacts from fine sediments suspended in the water column. Suspended sediments can impact marine species through disruption of food web dynamics through decreased predator feeding success and enhanced prey survival. Sediment in the water column could disrupt migration (due to decreased visibility) and when the sediment settles, spawning could be disrupted if spawning areas are covered.

Sediments Re-suspension also reduces visibility for predators that rely on visual cues for hunting. Filter[7] feeder may be particularly affected due to impaired filtering, leading to reduction in foraging ability and survival. There is an oysters area at the pipeline north, near the shore (see Figure 7.6) that won't be affected by suspended sediments, according to the plume modeled.

Fish and mammals visiting the area will not be affected, considering that they can move within the area, and the temporary sedimentation effect during construction. During the rainy season, there is a greater sediment concentration in the area, mainly around the water discharge rivers point, such as the Sensunapan. The levels found in the reference baseline are around 180 to 300 mg / l.

Corals are especially sensitive to sedimentation impacts, due to the suffocation likelihood, burial and shadowing. There are soft coral areas located in the pipeline south , closer to the existing CEPA pier and to the coast, with endangered species (MARN 2015), Filo Echinodermata "Pepino de Mar" and Filo Cnidaria "soft corals". Due to currents moving northwards and using the measures listed below, impacts to nearby corals are expected to be minimal. In addition, sediment deposition will be less than 8 cm in the area with sensitive species throughout the construction period, and taking into account currents and waves present, the sediments deposited on the rocks are likely to be removed very quickly.

[7] For example, Clams, krill, sponges, bearded whales, and many fish (including some sharks). Some birds, such as flamingos and some duck subspecies. This species type can play an important role in water clarification, and therefore are considered ecosystem engineers.

In general, in the areas around the Project site, the material deposition during construction will be less than 20 cm in total. For the clay environment and species found in the general areas, no significant impact is expected.
To further minimize impacts on marine flora and fauna due to sedimentation, the following practices will be implemented:

- Whenever it is possible to operate the equipment from the ground or in the water (from a barge) in a way that minimizes the potential disturbance to the coast and seabed;
- Do not "ground" barges used during construction works;
- A qualified Environmental Supervisor will observe the works to determine the need for mitigation and confirm that the measure applied works as expected; and
- Sediments in the water column will be monitored at selected locations including sensitive habitats. Turbidity criteria will not be exceeded, alternating dredging hours and rest hours.

General Construction Activities (Off-shore), Lighting

Ambient lighting is required during construction. The artificial light presence in the marine environment could have an adverse effect on the flora and fauna. Benthic invertebrates, such as phytoplankton and zooplankton, use light to give vertical migration signs within the water column for food. The artificial lighting presence in the marine environment may prevent or hinder the vertical migration causing a decrease in power in the dark. The construction plans must take into account the intensity and the lighting duration in order to minimize the impacts.

Due to the short construction duration and the temporary lighting needs, and impacts by lighting during construction would be considered mild and localized. The sea turtle nesting areas are far to the south of the project, so that they are not expected to have an impact on this activity.

The mitigation measures that could be implemented to minimize the impacts include:

- Reduction of lighting in non-essential areas of facilities, particularly during critical life-cycle time periods;
- Lights Mounting and orientation to minimize the surround sea lighting ;
  Lights Protection use, to reduce the radiance quantity, as well as to reduce the visible light to the animals, in order that exists a minor opportunity for them to get trapped, repelled, or have their day/night patterns altered ; and
- Installing long wavelength light (i.e. ambers) makes the light that is visible seem dimmer to nocturnal animals that primarily use rod vision (State of Florida 2014)[8].

General Construction Activities (on the ground), sedimentation

The construction staging area will be located along the coastline within the port facility (see Figure 4.2). In addition, to access the temporary trestle, it will be necessary to cut a section of the shoreline bluff. ThOse activities have the potential to impact the marine environment, from the sediments on the ground migrating to the adjacent marine habitat. The potential sedimentation impacts to the marine flora and fauna are described in the Section 7.4.7.2.

To mitigate this interaction, the following was considered:

- Erosion effective measures installation and sediment control before starting the work to prevent sediments form entering the water. This includes the construction activities isolation near the coast;
- Measures for the water management that flows on the site, as well as the water that is pumped/ diverting from the site, in such a way that the sediment is filtered before entry into the marine environment. For example, the water pumping to an area with vegetation, a settling pond or other filtration system before entering the ocean; and
- Stabilize the shoreline or banks disturbed by any activity related to the project to avoid erosion and/or sedimentation, preferably through revegetation with native species suitable for the site.

Storage, handling, hazardous materials and hazardous waste use and disposal

There is a possibility that the exposure of the marine flora and fauna to hazardous materials released to the environment may result in the progressive death of the flora and the poisoning of marine fauna. The management plans for the handling, storage and the hazardous materials use, as well as to respond quickly to an accidental release (as described in Section 7.4.7.2) will limit the potential for exposure to short-term, minor events.. No significant marine flora or fauna poisoning is expected as a result of this project.

[8] State of Florida. 2014. "Wildlife Lighting - About Light Pollution" Florida Fish and Wildlife Conservation Commission. Online: http://myfwc.com/conservation/you-conserve/lighting/pollution/

7.5.2.3 Operation Phase.

LNG receiving terminal, Physical Presence, and General Operation Activities

Sea water intake for the regasification

Sea water will also be required for the LNG regasification process (for warming of the LNG to convert it to NG). The water intake for regasification will be located within the marine enclosure. The marine enclosure openings (1.5 m x 1.5 m) will allow sea water to flow into the enclosure. The openings will be covered with a course grate/screen to prevent larger sized species from entering the enclosure. It was determined that the target species to keep out of the terminal enclosure are adult and juvenile hawksbill turtles which are known to frequent the project area. There is a hawksbill turtle nesting area to the project south area. Recently hatched/very young turtles are not expected in the project area. Typical size for hawksbill turtles is 20 cm for juveniles and 40 cm + for adults. As such it is recommended the screening/grates in the openings be no larger than 20 cm.

Water drawn from inside the marine terminal enclosure will be though a "sea chest". The sea chest will be located in the enclosure approximately 1 meter below "Lowest Astronomical Tide". The intake velocity of the sea chest will not exceed 0.5 ft/sec. A grating/screen will be placed at the sea chest opening to keep biota from being drawn in. Screen size is to be confirmed but is expected to be in the 30-50 mm range. In addition, the suction lines will include replaceable/cleanable strainers, with normally an opening size of 2-3mm.

Water curtains use

The LNG transfers process between the FSU and carrying vessel may include the use of a "water curtain". This "water curtain" allows for a safe LNG transfer between the two vessels by helping to dissipate any fugitive LNG emissions that might accidentally leak onto the ship's hull. About 20m3/hr. of water would be drawn from the sea to create a water curtain down the ship's hull side. In order to protect fish and other pelagic marine fauna, pumps used to take in water should be equipped with an appropriately sized mesh screening to prevent the marine biota entrainment.

Process Water Release

As previously described in Section 7.4.7.2, warm water used in the FSU/FSRU engines/ boiler operation will be discharges at a temperature up to 33°C, and will disperse less than 250m from the marine terminal. The hot water moves up in the water column, so seabed species will not be affected. No effects on fish and mammals are expected, the fish are tolerant to the changes in temperature and the

mammals (turtles, dolphins, sea lions) that may avoid the area are not comment in this zone. This level temperature is present in the area, reported in Fonseca Gulf, to the south-east.
As previously described in Section 7.4.7.2, cold water created through the LNG regasification process will be discharged at a temperature no lower than 23°C, and also will disperse from the marine terminal less than 250m. The cold water will move down in the water column, decreasing the water temperature near the seabed. The species identified in the marine terminal area, located in the clay-lime seabed, will not be affected by this change in temperature, it is expected that the animals will increase in size, by the effect of the coldest water present. Due to the cold temperature the benthos present increase their biomass, however mortality or decrease in population are not expected.

Sediment and Biota movements

As previously described in Section 7.4.7.2, the marine terminal physical presence is not likely to cause significant changes to sedimentation patterns in the area. Some scouring may occur adjacent to the facility as a wave action result and tidal influence. This could potentially affect the benthic biota that is attempting to re-colonize the impacted area (during the construction phase), however this would be a very localized affect

While considered unlikely for this project, marine facilities can impact fish movements along the marine coastline (e.g., creation of potential barriers to fish migration patterns). Given the relatively small marine terminal footprint, such effects are not expected.

Habitat Creation

The Maritime Terminal and the piles or mooring posts can provide a solid substrate that can be colonized by marine flora and fauna. There will be four openings at the Maritime Terminal to allow water to flow into it. The grids at these openings will prevent larger wildlife such as adult turtles and dolphins from entering, but allowing smaller wildlife to enter the terminal. In general, in the long term, the physical Maritime Terminal presence will benefit the flora and fauna of the Project area.

Noise

Noise generated during LNG transfer to the tanker to the FSU will mostly be caused by ship movement activities (propellers, docking noise, ship unloading, etc.). Ship noise may cause changes to behaviour of fish and marine mammals such that they avoid the area. Those effects are considered to be short-term and localized, and incremental compared to the high level of existing ship activity in the port area. For those reasons, no additional mitigative measures are required. FSRU will also require the engines

operation for the LNG regasification process. This noise will be mitigated by the engines placement within enclosures and therefore noise in the marine terminal vicinity will be greatly minimized.

Lighting

The Maritime Terminal will require night lighting. As noted above (in Section 7.5.1.3) excessive lighting may influence local marine biota. During installation operations mitigation measures should be implemented as required to minimize the facilities illumination and possible impacts on marine fauna (for example, to minimize / avoid fish banks resulting in increased predation). Measures could include:

- Reducing illumination in the facility non-essential areas, particularly during critical life cycle periods;
- Lights Mounting and orientation to minimize the surrounding sea illumination;
- Light shielding use to reduce the glare amount, as well as reduce visible light to animals, so there is less chance for them being trapped, repelled, or that their day / night patterns are altered; and
- The long wavelength lights installation(like amber) makes visible light appears less intense for nocturnal animals that primarily use their night vision (State of Florida 2014)[9].

Storage, Handling,Hazardous Waste Use and Disposal

There is a possibility that the marine flora and fauna exposure to hazardous materials released into the environment may result in the die flora back and potentially fatal damage to marine fauna. Plans Management for the handling, storage and hazardous materials use, as well as to respond promptly to accidental release (as described in Section 7.4.7.2) will limit the potential for short-term, minor events. It is not anticipated the marine flora or fauna poisoning occurrence is expected as a project operation result.

7.5.3 Disease Vectors

7.5.3.1 Methodology

The Impact Screening Matrix on Table 7.2, Section 7.2, identified the following significant potential interactions between the Project's activities and characteristics with disease vectors:

- Construction phase:
  - Earthworks;
  - General ground construction activities; and
  - Traffic related to construction.

- Operations phase:
    - Facilities Physical presence;
    - General operations activities; and
    - Stormwater management..

The effects on transmitting vector borne diseases from the LNG construction and operation facility have been assessed qualitatively, with the potential effects consideration on vulnerable or at-risk populations[13] during both the construction and the Project operations phases. Considering the vector born diseases transmission effects, a prevention and attenuation approach has been adopted. This approach implements best management practices and management controls.

Vector-borne diseases include those acquired through the bite of an infected arthropod, such as a mosquito, a tick or a flea, which carries pathogens from one host to another. Vector-borne diseases through the bite of a mosquito are particularly critical because they are bacterial and viral diseases, contributing to epidemics in humans and animals. Table 7.12 identifies the status of diseases transmitted by key vectors with relevance to the Project.

Table 7.11 – Endemic Vector-Borne Diseases in El Salvador Relevant to the Project

Disease	Estimated Number of Estimated Cases at National Level	Vector and Mobility Range
Zika Virus	Zica suspected cases registered in El Salvador since the virus entered the country in November 2015 reached 11,321 at the end of October 2016, which 420 were found in pregnant women, according to the Health Ministry Epidemiological Bulletin of El Salvador (MINSAL). The cases registered between January 1 and October 29 totaled 7,485, which sum up to 3,836 in 2015.	The main vectors in El Salvador are *Aedes Aegypti* and *Aedes albopictus*. The mobility range from the origin point is 200 m.
Chikungunya	Chikungunya first appeared in El Salvador in June 2014, and by Sept. 2014 had been reported almost 30,000 cases.	The main vectors in El Salvador are *Aedes Aegypti* and *Aedes albopictus*. The mobility range from the origin point is 200 m.
Dengue Fever/ Hemorrhagic	Dengue Fever and Dengue Hemorrhagic fever is the fastest-growing vector-borne disease in the world. In El Salvador, the classic dengue fever incidence has fluctuated since 2008 and 2013, with its highest	The main vectors in El Salvador are *Aedes Aegypti* and *Aedes albopictus*.

Table 7.11 – Endemic Vector-Borne Diseases in El Salvador Relevant to the Project		
Disease	**Estimated Number of Estimated Cases at National Level**	**Vector and Mobility Range**
Dengue	peak reported in 2012 with 41,793 cases. In 2014, there were 27,074 cases reported nationwide resulting in 1 fatality. Hemorrhagic Dengue included 1,920 cases in 2012 and 429 cases in 2013. While dengue case have occurred throughout El Salvador, it is a risk in Sonsonate (according to the International Society of Infectious Diseases September 2014). Dengue is also the eighth leading cause of the disease affecting children from age 1-4 years old.	The range of mobility from the origin point is 200 m.
Malaria	The malaria incidence has been low (11 cases in 2013) in El Salvador, five of them in the municipality of Acajutla (Metalío). Malaria cases have been reported between May and October. The incidents have been limited to the Santa Ana, Ahuachapán and La Unión rural areas , on the Guatemalan border. Malaria is not a risk in Sonsonate (according to the International Society of Infectious Diseases September 2014).	The main vectors in El Salvador are *Anopheles albimanus* and *An. Pseudopunctipennis*. The mobility range from the origin point is 4.5 km.

Source: Statistics obtained from Infectious Diseases and Global Epidemiology Network (Gideon) Computing. Consulted on September 2, 2014. Symptoms and transmission of information from the Centers for Disease Control and Prevention. The results illustrate that dengue affects the Sonsonate region. Pan American Health Organization, information online, April 2016.

7.5.3.2 Construction phase

The Project's construction could have an impact on the prevalence of mosquito-borne diseases by increasing the mosquito population and by, inadvertently, introducing diseases by infected workers.

The Project could increase mosquito populations by creating water stagnant pools, including very small water pools, such as water that accumulates inside a used tire, bucket, or other container leftoutside. To limit EDP mosquito breeding, efforts to reduce or eliminate habitat reproduction will be carried out by:

- The site will be graded and drainage system developed to eliminate areas where water might collect Adequate drainage system to eliminate areas where water can accumulate;
- Dispose or recycle unnecessary water containers;
- If empty containers or other large objects that could accumulate water, including tires, buckets, barrels, pipes, etc., must be stored, this shall be turned over or placed indoors, so that no water can accumulate.

EDP will monitor for inadvertent breeding areas, as well as mosquito larvae presence in unavoidable standing water (e.g., storm-water management pond). The interest mosquitos are capable of

compleiting their larval phase (i.e., egg to adult) in 7 to 9 days, the monitoring will be completed twice a week (or at least once every 6 days). Frequency may be reduced during dry season. The monitoring is about the visual site inspection for pooling water, containers that might hold water and hidden water (e.g., water in a covered culvert) – when possible sources will be eliminated. For the areas where the water cannot be eliminated (e.g., storage pond), samples will be taken to inspect larvae. Those waters will be treated with a larvicide approved by the local Health Ministry.

The workers majority to be employed during construction shall be Salvadorian. Given the existing people frequent movement between Acajutla and other parts of the country due to the high activity port and associated trucking, other industry in the area, agriculture, and tourism, it is not expected that the presence of the domestic workforce will be a significant source of disease or impact disease prevalence in Acajutla. To ensure foreign workers do not introduce disease a health screening should be completed prior to arrival, including screening for vector borne diseases.

The breeding control measures, together with the monitoring and larvicide treatments, are expected to minimize project effect on vector-borne disease.

7.5.3.3 Operation Phase

To monitor mosquito populations during operations, EDP will continue to conduct regular inspections and removal of potential mosquito breeding habitats including drainage problems, containers, buckets, ponds, puddles etc. to see that they are removed, emptied or keep them covered. EDP will also monitor larval reproduction in areas where water stagnation is unavoidable, and treat them as necessary.

7.6 Impacts and Characteristics on Socioeconomic and Cultural Conditions

As identified in the Impact Screening Matrix on Table 7.2, Section 7.2, the socioeconomic environmental factors for which impacts have been identified and assessed include:

- Community Safety and Security;
- Demography;
- Landscape and Views;
- Community Health;
- Recreation;
- Relocation and Eviction;
- Land use;

- Highways, traffic, and Public Services;
- Artisanal Fishing Pier and Commercial Fishing;
- Puerto de Acajutla (CEPA);
- Economy;
- Cultural, archaeological, ceremonial and historical resources; and
- Health and security.

7.6.1 Security and Community Protection

7.6.1.1 Methodology

The Impact Screening Matrix, Table 7.2, Section 7.2, identified the following possible significant interactions between project activities and features and the protection and security of the community:

- Construction phase
    - Clearing;
    - Earthworks;
    - General activities of construction on land and at sea;
    - Traffic related to construction;
    - Storage, handling, use and disposal of raw materials and hazardous wastes;
    - Clearing and pressure testing of tanks and pipes;
    - Construction Management of the workforce.
- Operation phase
    - LNG delivery;
    - Facilities Physical presence;
    - Operations activities in general;
    - LNG Storage handling and regasification;
    - Storage, handling, use and raw materials and hazardous wastes disposal ;
    - Workforce management; and
    - Security establishment.

This section provides an assessment of potential community safety and security issues associated with the construction and the project operations. Considered in this assessment were the facility construction and operation activities (see Section 4.0), the project area characteristics and surrounding lands (Section 5.4), and input received through stakeholder engagement activities.

Other related topics discussed in this EsISA include Community Health (Section 7.6.4), Roads, Traffic and Utilities (Section 7.6.8), Health and Safety (Workers' Health, Section 7.6.12), and the Risk Study (Chapter 9.0). The following is the potential effects description on community safety during construction and operation periods.

7.6.1.2 Construction phase

The potential for impacts to the community safety during construction can be described by key project components, including: Maritime Terminal (FSU / FSRU), Natural Gas Pipeline, Thermal Power Plant, and Temporary Collection site, and temporary trestle for construction. Also the related possibility off-site safety impacts of construction traffic, which are described in Section 7.6.8. The following describes the potential community safety risks associated with each of these three project components.

With any project, within the proposed plant location and laydown areas there is a potential for accidental events involving construction equipment and contact with electrical facilities that has the potential for serious injury. The project site portions are within secure areas of the Port Authority property and are not generally open to the public. As an effective preventative measure to limit unauthorized entry in areas where fencing does not already currently exist, perimeter security fencing will be erected in the early construction phase(Figure 4.7 shows the project site location/boundary). The Access into the site will be restricted to authorized persons only. Security personnel will be hired to monitor and enforce site access. They will work/coordinate with Port Authority security. There will be 24 hours' security presence at the site. It is noted that security personnel will be subject to the Grievance Mechanism program (Appendix 7A) to ensure that their authority position is not taken advantage. Signs will be posted warning the construction dangers on the site. With those measures in place the potential for on-site construction related safety impacts to the public is considered to be minimal.

During construction there is potential risk to public safety from the municipal roads use to access the project location with construction vehicles and for material delivery. This would include the equipment delivery, building materials, fuel, and possibly fill/rock material for the cofferdams (if not delivered by barge). Roads to be used to access the site are the same roads used for heavy trucks to access the port, and currently have regular port related truck traffic; as such the community would be accustomed to truck traffic on these roadways. To prevent community safety impacts related to construction traffic, construction access roads for equipment and material delivery will be designated and enforced. The street "Calle 24 de Octubre Poniente", will be opened to facilitate access to the laydown area, so the construction related traffic wont has to pass in the residential areas in the city. The road is located at

north of the marine laydown area, between the laydown area and the cemetery. A few years ago the street was occupied by informal houses that were relocated, and then was closed by CEPA to prevent new houses to be built there. The road only needs to be improved with new pavement.
Qualified drivers will also be hired and provided with standard road safety training. Further, communication with the municipality and local communities regarding any required road closures or anticipated heavy usage periods will be made in advance for those activities. Road closures are anticipated for oversized loads delivery including the engines and generators. Effects and mitigation related to traffic are further detailed in Section 7.6.8 Roads, Traffic and Utilities.
Construction will also require the storage, handling potentially hazardous materials modest amount use that could pose a risk to public health and safety. Such materials are typical on construction activities and include fuels and lubricating oils for machinery, paints, solvents,and batteries. The accidental such hazardous materials spillage could pose a risk to human health and safety if not managed properly. Risk management description and spill response contingency measures to minimize and public health effects are provided in Section 7.4.4 – Soils, Section 7.4.5 - Surface Water, and Section 7.4.6 Ground Water.

The project requires the development of an approximate 1.8 km NG pipeline that would extend from the LNG FSRU at the Marine Terminal to the power plant site. About 1.25 km of the pipeline length will be underwater and the remainder will be on-shore and buried. The pipeline route will be in an easement on Port Authority lands. Figure 4.1 shows the proposed routing for the pipeline. The pipeline Installation will require the heavy equipment use and could pose some safety risk to the general public.The pipeline alignment is open to public access. The pipeline route crosses Boulevard Coronel Oscar Osorio (Colonel Oscar Osorio Boulevard), and while the road is within Port Authority property, it is open to the public at the proposed pipeline road crossing location. The road users would include the public accessing to the Port Authority sports fields as well as Port Authority workers/staff. To manage risk during pipeline installation, EDP will coordinate activities with CEPA, who controls access to the area.

There are also potential Project impacts related to safety and community protection in the Maritime Terminal and the temporary pier construction. Section 4.5.5 provides a pier description including its location, extension, construction, and uninstallation. Ships and / or construction barges will be required to construct the Maritime Terminal, including pile installation activities.

Prior to construction EDP Consult with CEPA and the Port Authority to develop a safety plan, including consideration for: Safety perimeter marking boundary ; Security patrols/Enforcement; and Communication with and local fishers education and other boaters active in the area. It is noted that

about the half pier length is within the existing Port Authority craft/vessel restriction area (See Figure 5.50). And while small craft are permitted to pass through this restriction area, fishing in this area is technically prohibited (See Section 7.6.9 for description of effects to Fishers).

Finally, the project construction will result in a greater people number in the area. The project will require during the peak construction workforce of approximately 1,200 people. This could attract new people to the community which could give rise to problems, crime and community safety. It may also inadvertently create a safety and security hazard from job seekers assembly at the facility gate. While potential for impact is considered to be low, as local hires will be existing residents, and non-local hires are expected to commute to the project site on a daily basis and not reside in the local community, EDP will further manage influx by:

- Putting in place a local employment officer to assist EDP and contractors with qualify identification, local workers;
- Expand off-site office in Acajutla for use by EDP and contractors as local hiring centre;
- Publicise that employment will target local persons and that no hiring will be made at the facility gate.

7.6.1.3 Operation Phase

Under typical operating conditions, the Project will have less potential for community safety impacts than during construction. All power plant facilities pose some safety risks in the form of potential human contact with high voltage electricity and potential conflicts with on-site motorized equipment (e.g. maintenance equipment). The area will remain fenced and security personnel will ensure site access is restricted to authorized personnel only. Under normal operating conditions, the potential for community safety risk events to the local community is considered to be very low. Overall, the QRA found that the public and the environment are not exposed to any unacceptable risk. The entire NG pipeline is located on Port Authority property. Most of the pipeline length will be buried, with the potential for a small section of the pipe to be exposed near the ocean/land interface. Overall, the pipe has low potential for community safety impacts once installed. The closest residential community to the pipeline is about 350 m away to the north. There is also a school (Liceo De Acajutla) about 500 m to the north (see Section 9.0 for a description of potential for major project Risk events including from equipment malfunction and/or failure).

With respect to the FSU/FSRU, there is some potential community safety risk associated with the tanker ships manoeuvring to supply the FSU and the movement of the FSU during storm events. It is expected

that up to approximately 32 ships per year (under the scenario of NG being sold to other users) would bring LNG to the FSU. The power plant operation would require only about 8 LNG deliveries per year. The FSU would need to be moved out to sea during major storm events, such as a hurricane, unusual tide events, or a seismic event with potential for a tsunami (see Section 4.8.2 for a description of FSU movement activities). While local vessels/fishers could be at some risk during supplying LNG periods , as the Project is located in a port facility, local boaters/fishers would have some experience with the movement of large ships to/from the Port. Given the ship movements low number per year required to supply LNG and that the Project is located in an active Port, potential safety risks to the general public under normal operating conditions is considered to be low.

A 300-meter exclusion circle centered around the marine terminal has been discussed with and preliminarily approved by CEPA's operational staff. This exclusion circle will apply to all vessels, including port commercial traffic. This 300-meter exclusion circle provides a clearance of approximately 150 meters from the closest dolphin. Full mission bridge navigation simulations verified that this exclusion allows sufficient space and time (assuming active tug escort) to intercept errant vessels before collision with the moored vessel or the structures. CEPA noted and the project agreed that a new range marker, tangential to the exclusion circle and on a northeasterly track would need to be installed in order to aid inbound commercial traffic maintain clear of the exclusion circle. The project will formalize this exclusion circle with the Autoridad Maritima Portuaria with CEPA's concurrence.

A Port Facility Security Assessment has been undertaken in accordance with ISPS guidelines which identified that an additional safety exclusion zone with a minimum 500-meter radius, applicable to all non CEPA or EDP marine terminal vessels is to be instituted. During the detail design phase, a project security plan will be developed which will include a risk assessment and consideration of final security measures in order to determine the final safety exclusion zone distance. Typical safety exclusion zones range from 500 to 1000 meters. The project will formalize this exclusion circle with the AMP with CEPA's concurrence.

To specifically address safety to nearby fishers and boaters, EDP will establish through it's local office a Community Safety Outreach Program including:

- safety brochures for fishers and boaters and for schools;
- communications regarding established boating restriction areas; and
- safety meeting and further communication releases to the municipality and boating/fishing community regarding the area of restriction and dangers associated with the jetty and FSU/Tankers.

7.6.2 Demography

7.6.2.1 Methodology

The Impact Screening Matrix Table 7.2, Section 7.2, identified the following possible significant interactions between the project's activities and the characteristics and demographic data:

- Construction phase:
  - Construction Workforce Management Operations phase:
  - Workforce Management.
- Operations Phase
  - Labor Force Management

This section provides a description of the Project possible effects on the local base population, as well as the consequent changes in the demand for local services. Considered in the demographic assessment were the project description (see section 4.0) and the Project location characteristics (see Section 4.2). The thermal power plant, temporary storage site and NG pipeline will be located in unoccupied areas all owned and under the control of CEPA in Acajutla. In th Project development, there will be no physical people displacement. In addition, land affected by the Project is not being used for income-generating activities (with the possible exception of the Marine Terminal - see Section 7.6.9 for possible impacts on local fishermen and Section 7.6. 5 - Relocation or eviction).

The following is a description of the potential effects on demographics during construction and operation periods.

7.6.2.2 Construction phase

The Project construction period is anticipated to last 33 months and the construction personal number required during that period will peak at close to 1,200 workers. About a 12 months construction period will see 600 or greater construction workers at the project site. As previously described in Section 5.4.2.1, the Acajutla Municipality has a population of about 52,000 (2007) and a labor force of about 21,000 people. The sector that employs the largest number of people is agriculture (5,000). The local industrial sector employs about 1,500 peoples. The population for the Sonsonate Department is about 71,000 (2012). If the area is extended to included San Salvador (San Salvador is approximately 80 km away), then a population of approximately 2.6 million people is located within commuting distance of the project site (Ministerio de Economía, 2007).

With a large population and employment base located within a daily commute distance of the Project site, it is expected that most of the construction labour force can be sourced from the surrounding region. The interest main topic to date regarding the project from local people has been related to future job openings. Compared to the regional population/employment base, the construction labour force demands for the project are relatively modest. It is not expected that there will be challenges to fulfill construction jobs from the local region. The project is not expected to be a major draw for migrant workers that would require local accommodation and draw on local services. Some of the challenges associated with worker influx that can occur with major construction projects are not expected in this case. Noticeable changes to the local population base and resulting changes on local service demands are not expected. Measures to minimize influx related effects are set out in Section 7.6.2.

7.6.2.3 Operation Phase

To operate the project, it is estimated that about 100 permanent staff will be required plus possible additional temporary workers and service contracts. Many of permanent staff will be skilled positions such as engineers and mechanics. However, the total staff number required to operate the facility is modest compared to the local and regional population/employment base, and therefore the Project is not expected to attract large people numbers to permanently move to Acajutla, no noticeable impact on local demographics are expected to result from the long term project operations period.

7.6.3 Landscape and Views

7.6.3.1 Methodology

The Impact Screening Matrix in Table 7.2, Section 7.2, identified that the facilities physical presence could affect the landscapes and views.

The Project is located within an existing industrial zone in the Port of Acajutla. The current landscape is characterized by several port facilities, including the existing dock facility which extends over 900 m from the coast. Immediately north of the port is Acajutla city, which includes a low-rise development to the coast edge. There are some small coves with small beaches on the property of the port and then to the north, the Acajutla beach stretches for about 2 km and then beyond the city limits. The coastline in the Project vicinity does not present unique views compared to the rest of the coast in a larger area and has no pictures landscape designation. In addition, there are no known views or views along the coast in the Project area.

A minimum impact is expected on the Project landscape nature area or on views since the Project is going to be located in the port area that has similar facilities. On-shore lands are within the area designated for industrial use and surrounding land uses are industrial in nature. The marine terminal will be visible from the Acajutla beach when looking to the west. The terminal views will be consistent in character with views of the Port pier to the south.

7.6.4 Community Health

7.6.4.1 Methodology

The Screening Matrix Impact on Table 7.2, Section 7.2, identified the following possible significant interactions between the activities and the communities security and safety project characteristics.

- Construction phase
  - Clearing
  - Earthworks
  - Pile Driving
  - Removal of marine sediment
  - General activities of construction on land and at sea;
  - Traffic related to construction;
  - Storage, handling, use and disposal of raw materials and hazardous wastes; and
  - Workforce management in construction.
- Operations phase:
  - LNG delivery;
  - General operation activities;
  - LNG storage, handling, and regasification;
  - Transfer of NG (pipeline)
  - Power generation;
  - Storage, handling, use and disposal of raw materials and hazardous wastes;
  - Wastewater discharge; and
  - Workforce management.

This section provides an community health issues assessment related to the Project construction and operation. The facilities construction and operating activities (see section 4.0), area Project characteristics and the surrounding lands (Section 5.4), health conditions assessment (Appendix 5Z) and data received through community involvement activities and other interested parties.
Other related topics discussed in this EsIA and considered in this health assessment include: Air Quality (Section 7.4.1), Noise and Vibration (Section 7.4.3), Disease Vectors (Section 7.5.3), traffic In the streets

and Public Services (Section 7.6.7), Health and Safety (Section 7.6.12), and the Risk Study (Chapter 9.0). Issues identification in relation to community health assessment includes a consideration numbers that are described in Section 7.1 of this EsIA report. The community health assessment also considers additional guidelines and procedures, such as the following:

- The World Health Organization (WHO) Health Impact Assessment International Principles of Best Practices (2006);
- IFC Environment, Health and Safety (EHS) Guidelines Performance Standard 4 - Health and Safety (2007);
- Environment, Health and Safety World Bank guidelines on Pollution, Prevention and Reduction Manual (PPAH) (1999);
- International Association for the Environmental Conservation of Petroleum and International Association of Oil and Gas Producers. Guide for Health Impact Assessment in the Oil and Gas Industry (2005); and
- Health and Safety (HSE) 's risk criteria for Land Management in the major industrial lands vicinity (1989); And the Environmental Impact Study Reference Terms for the preparation of the LNG Power Project - as proposed by MARN in the reference terms for the environmental impact assessment.

A literature review was undertaken of HIA specific literature, existing systematic reviews of HIA, academic and medical journals, and completed HIAs for similar projects (LNG facilities) to provide an community health understanding related concerns and potential impacts. The literature review is presented in Section 5.4.3and 5.4.2.7 provides health concerns indications that are relevant elsewhere and that may be relevant to the Project.

Additional information regarding potential and perceived health issues were obtained from consultation with local stakeholders. The Stakeholder Engagement Plan (SEP) (see Section 8 and associated Appendices) provides an engagement activities description that were undertaken and the input received. Specific community health concerns associated with existing industry in the study area as cited by stakeholders include:

- Stress and psychosocial effects resulting from noise and noise-induced vibration;
- Hearing problems resulting from increase in noise;
- Increase in respiratory diseases and skin allergies resulting from air pollution and dust;
- Strain on existing medical facilities to treat emergencies; and
- Concerns regarding public health infrastructure (drinking water).

Health outcomes are assessed and categorized as per the International Diseases Classification (ICD). This categorization is common in HIA and is summarized below in Table 7.13.

Table 7.12 – Health Results Categories in EIS	
Health Results Categories	**Examples**
Communicable diseases	Respiratory infections, HIV / AIDS, malaria[10]
Non-communicable diseases	Cardiovascular and pulmonary disease induced by dust
Nutritional problems	Food security, nutritional deficiencies
Injuries	Injuries related to traffic, violence
Mental illness and psychosocial disorders	Depression, stress, fear to disasters, suicide
Well-being	Achievement, happiness, support communities

Source: Birley, Martin (2011). Health Impact Assessment: Principles and Practice. Oxford: Earthscan.

HIA generally considers how health determinants are changed by a project or proposal. The Project considers the impacts that the project or proposal has for people living in proximity to the proposed facility site, particularly their exposure to health risks, noise, injury from motorized vehicles/equipment, dust, air emissions or other social issues associated with presence and interaction with workers required for the facility. The health determinants assesments is commonly expressed as having: no change, direction increased change or a decreased change of direction. The following Table 7.14 illustrates health determinants that are typically considered under an HIA. The analysis considered whether those determinants could be impacted by the proposed EDP project. Determinants that are marked by an asterisk (*) have also been assessed under other socio-economic considerations and are described under Section 7.6 of this EIA Report.

[10] Vector-borne diseases such as malaria, dengue, etc. are assessed in Section 7.5.3 of this EIA report.

Table 7.13 – Health Determinants Affected by the Project			
Principle/ Category	**Subcategories**	**Examples of Health Determinants[11]**	**Possible Health Considerations**
Individual/ Family	Psychological	Age, nutritional status, disability, gender immunity, ethnicity	• Health impacts consideration associated with the environment pollution, construction-related discomfort and accidents, in the population vulnerable groups(e.g. young people, older adults, people with disabilities, people living in poverty). There is a close relationship between vulnerability and inequality
	Behavior *	Risk-taking behavior, occupation risk perception	• Poorly trained effects consideration and overworked workforce and consequent vulnerability to infection.
	Socioeconomic circumstances *	Poverty, unemployment, education, social status	• The economic opportunities increase, are the health improvement. However the income loss of the ressources expropriation can contribute to poverty and uncertainty.
Environmental	Physical	Air, water and land, traffic, pollution, noise, dust, changes to the natural environment, burning, light, water use, land grabbing, housing, crops and food, vectors	• Traffic generation consideration, exposure to traffic, traffic accidents. • Increased respiratory diseases resulting from increased exposure to vehicles. The air quality from the heavy leaks equipment ,motor vehicles and internal combustion engines • New chemical emissions introduction or other hazards that could be exposed the local community • Changes in the environment and the effects on vector-borne diseases • Consideration of discomfort during the construction and the impacts on mental illness • public safety with regard to the contact with construction equipment, storage
	Social*	Family structure, community structure,	• The consideration of temporary immigration or immigration of male

Table 7.13 – Health Determinants Affected by the Project			
Principle/ Category	**Subcategories**	**Examples of Health Determinants[11]**	**Possible Health Considerations**
		culture, crime, gender, inequality	workers and the need for temporary housing.
	Economic*	The change in employment status	• The consideration of improving mental well-being for people entering the employment • Consideration for psychosocial stress associated with low-grade/schooling or temporary employment
Institutional	Organization of medical care	Primary care, specialized services, increased pressure on health services, access to health, availability of medicines, quality of care	• Capacity consideration (e.g. the personnel and equipment availability), capacity (knowledge and skills to deal with possible injury), and the health institutions jurisdiction (responsibility agency area). • The agencies that are already well endowed and organized, in the delivery of services to the community will be better prepared than agencies that are not.
	Policies	Regulations, jurisdictions, laws, goals, thresholds, priorities	• adherence to policies and local standards, national and international.

Source: Consulting Team

The evaluation considers the Project components on the population health. The effects on the community health from the construction and the LNG facility operation have been evaluated qualitatively, with the potential effects consideration on the vulnerable or in populations at risk[12] both during the construction and Project operation. In considering the effects on community health, a prevention and attenuation approach has been adopted. This approach implements best management practices and management controls at both the Project construction and operation phases.

[11] Examples of determinants adapted of Birley, Martin (2011). Impact health evaluation: Practice and Bases. Oxford: Earthscan.

[12] Vulnerable poblacions define by the world health organization includes the people most affected by their physic status (kids, Elder and handicapped) or social status (poor people, women and etnics minoritys.

The following is a description of the potential effects on the community health during construction and operation periods.

7.6.4.2 Construction phase

It is expected that the Project construction phase will last about 33 months. During this period there will be varying activity levels and construction intensity that have the potential to produce effects on the the community health. The following is a summary of the key effects on health that may occur and the measures that would be put in place to minimize those effects:

- The community "Ciudadela CEPA" (192 houses) is the residential area closest to the main location of the Thermal Power Plant and is 250 meters away (the edge of the property of the Thermal Power Plant is about 200 m away). Various community representatives cited the noise of existing industrial operations in the area as a fundamental concern. Noise generated by construction has the potential to affect sleep patterns, productivity, work performance, and use / enjoyment of the property. As described in Section 7.4.3, the noise levels for the nearest receivers will meet the criteria and noise limits of the IFC. It is expected to minimize the effects of noise as a result of (1) the existing separation distances and the best construction management practices use (like the use of materials in good working order and appropriate sound suppression devices), and 2) the noisy activities limitation for daytime hours. EDP will advise the community who to contact in case of experiencing unreasonable construction noise levels and to be able to respond to those concerns;
- Project construction can have a short-term impact on air quality conditions in the study area through the air pollutants emission and the particulates release (e.g. dust). The main air pollution sources during construction include the diesel-burning construction equipment operation such as trucks, excavators, motor graders, etc. The particulate matter potential sources include exposed soil areas associated with deforestation, landfills and excavation, soil storage, road transport activities and the vehicle operation / equipment on unpaved surfaces;
- Particulate material generated by the construction equipment operation could contribute to acute respiratory illnesses of community residents (like acute bronchitis, or asthma). A environmental monitoring History of air quality were carried out to see the key indicators in the study area indicating that the quality of the background air for carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxides (NO_x) and particulates $PM_{2.5}$ within the allowable concentrations according to the air quality relevance criterion of El Salvador. Background levels for total suspended particulate matter and PM_{10} particles exceed the air quality criterion in some cases (see Section 7.4.1). Local residents have commented that the air quality conditions may be poor

and indicates that the health effects are a concern for them. Taking into account the project separation distance to the nearest residential communities, recognizing the AQ mitigation measures availability for construction, and it is expected that those measures to be effective, the significant effects on the respiratory local communities health during the construction are not anticipated;

- The public risk exposure to solid and liquid wastes, drilling fluids, fuels, hydraulic fluids and / or other contaminants and hazardous materials in soil and / or groundwater is considered low. There are no nearby drinking water sources, and there are no obvious paths to exposure. Measures specified elsewhere to address the storage, use and management of such materials will further limit that risk;
- During the pier construction, there is potential for the hazardous materials realease as a result of accidents effects as noted above. These spills, if not controlled can affect human health through the sea pollution . As specified in Section 7.4.7, in addition to the general procedures for the storage and hazardous materials handling is defined in another section, EDP will use biodegradable oils and lubricants for the construction team on the high seas; spill kits will be available for immediate deployment in case of a spill (sorbent booms, containment barriers of floating oil skimmers); workers who will be present during construction activities will receive training in the prevention of marine spills, response and immediate cleaning;
- Potential for traffic accidents with the public by construction vehicles with access to the Project site. (See Section 7.6.1- Community Safety and Security) and
- The Project is expected to require up to 1,200 construction workers in the peak period of 12 months requiring 600 or more construction workers. Large construction projects of this nature can sometimes attract migrant workers and give rise to conflicts / health social effects with the local population. EDP for the project it is expected that the construction labor force can be obtained from the surrounding region perhaps up to San Salvador, which is a daily distance in displacement. The Migrant workers flow temporarily residing in Acajutla is not expected because of this. As such, the potential for social and health effects is not expected to be affected.

7.6.4.3 Operation phase

The following describes the possible health community effects that could occur during the Project's operations period:

- Noise levels in the Project surroundings were determined by noise level monitoring. Daytime levels at the monitoring sites ranged from about 48 to 55 dBA (against the daytime noise criterion in the BM guidelines of 55 dBA) and night levels ranged from about 40 to 47 dBA (For

all three recipients the levels coincide or are below 45 dBA and the fourth is below the base of the environment). Noise levels, including low frequency noise from existing power plants / industries are a local communities concern. Based on the noise monitoring results, communities in the vicinity of the Project area noise levels that exceed applicable guidelines - particularly at night time;

- The EDP facility will generate noise levels below the standards / criteria (El Salvador and IFC) in daytime and night conditions (see Section 7.4.3). There are no residential communities located within the 55 dBA level curve during the day, or the 45 dBA night noise level curve (see Figure 7.2 and Figure 7.3). As such, no noise effects from the EDP facility are expected to result in community health effects on the baseline conditions. The planned noise monitoring activities will ensure that the Thermal Power Plant operates within these criteria. In addition, EDP will respond to community concerns about facility operations noise complaint (See complaint mechanism in Appendix 7A);
- Low-frequency (LF) noise from the existing power plant has been expressed as a concern for local residents. LF noise can be a health problem, as it can lead to people in disturbances that affect their sleep, cause headaches, etc. Analysis provided by the Power Plant manufacture shows that the LF noise generated from the EDP Thermal Power Plant will be 10 dB quieter than the existing plant, and below the threshold to induce vibrations[13]. This is considered to be a significant decrease;
- Various operating equipment at the off-shore marine facility will generate noise including possibly compressors and fan units on the topside and engines, fans and boiler within the haul of the FSU. Top side equipment will be enclosed. Silencers will be placed on exhaust outlets as required. Noise from the terminal will not result in significant noise impacts at shoreline receptors (i.e. ambient levels will not exceed 55 dB day-time /45 dB night-time levels or if greater, background ambient noise levels by 3 dB);
- Burning fuel (natural gas) to generate electricity will generate emissions into the atmosphere that have the potential to affect the community health. The main concern parameter is in nitrogen dioxide (NO_2). As shown in Table 7.4 and described in Section 7.4.1, the Project will not result in ground level ambient air quality exceeding regulatory the applicable El Salvadoran norms. As such, long-term health effects from the power plant operation are not expected. Planned air quality monitoring activities will ensure that the plant operates within these criteria.

Furthermore, EDP will respond to community concerns should there be any air quality complaints from facility operations

- The Central Thermal Power Plant operation has solid and liquid wastes leakage risk , fuels, hydraulic fluids and / or other contaminants and hazardous materials into the soil and / or groundwater. The potential for public exposure to such materials is low as there are no clear exposure pathways. The additional control measures, as well as the monitoring activities to detect spills and leaks will further limit the risk of exposure;
- The use of chemicals (like pesticides) for the management of the landscaping of the site has the potential to affect the health of the community. The use of chemicals for purposes of landscaping will be reduced to a minimum and used within the local regulatory requirements. ; Long term community health effects from their application are not anticipated;
- The domestic wastewater from the Thermal Power Plant will be treated through an on-site treatment plant before discharge. Water that comes in contact with the oil, which could include cleaning water, will pass through an oil separator prior to discharge. (See Section 4.11.3 for the description of the facility). The receiving body of water is a drain that runs through CEPA lands and discharges to the ocean. Therefore, even if there is an alteration in the treatment plant, and there is an involuntary release of contaminated wastewater, there is no clear path of significant public exposure to this contaminating material;
- Domestic wastewater generated in the off-shore Marine Terminal will be treated prior to discharge into the ocean (see Section 4.11). The treated effluent will comply with the applicable standards.
- Traffic volume to be generated from the power plant facility during operations is small compared to the existing traffic levels in the area. The project poses minimal change in risk for traffic accidents. (See Section 7.6.1- Community Safety and Security).
- Long term workforce demands are projected at about 100 permanent staff. While there could be some new residents attracted to Acajutla because of long term job opportunities, the number compared to the local population is relatively small and as such, no significant social/health effects are anticipated.

7.6.5 Recreation

7.6.5.1 Methodology

The Impact Screening Matrix in Table 7.2, Section 7.2, identified the following potential significant interactions between the characteristics of the Project's activities and recreation:

- Construction stage:
    - Clearing and stripping
    - Pile Driving (on land and at sea);
    - General ground construction activities;
    - General activities of construction at sea;
    - Marine sediment removal; and
    - Traffic related to construction.
- Operation stage:
    - General operation activities.

The following section identifies and evaluates the potential impacts on recreation and tourism activities in the study area during the construction and operation stages of the Project.

The Project is located within an existing industrial zone in the Port of Acajutla and there is recreational land with limited uses near the Project site. The popular recreational beaches and tourist facilities are located south of Acajutla in Los Cóbanos, which is about 4 km south along the coast of Acajutla. Water sports, such as sport fishing, take place off the coast of Los Cóbanos and the area is one of the most popular diving and sporting destinations in El Salvador. Closer to the project's location is Acajutla Beach, which is located about 800 m north of the project's dock. The local community mainly uses the beach of Acajutla. There are some restaurants along the beachfront in the city which attracts visitors who are staying in beach houses or hotels located along the coast. There are no hotels in the city to attract tourists during the night, although there are some smaller guesthouses.

The proposed area for the trestle was not identified as being used for recreational activities. Approximately half of the length of the facility is within the existing port restriction area. Nor is there a marina in Acajutla to attract recreational boaters, with the exception of the artisanal fishing pier that is run by the local fishing cooperative. However, there is a possibility that the area may have been or could be used for recreational activities based on navigation.

The recreation facility closest to the Project's location is the sports complex that is located within the CEPA property and is located directly south of the pipeline route and one of the temporary construction staging area (see Figure 4.2). This sports complex is used by CEPA workers for sporting events such as football matches, and CEPA also makes it available to the community. For the public to be able to access the sports field, they must have the authorization from CEPA and must pass through the CEPA security door.

The assessment methodology for the review of impacts on recreational activities, in general, follows the overall impact assessment process that was established for this EsIA as described in 7.1. Potential effects of the Project were assessed according to the basic conditions described in Section 5.4.5 Land Use. The methodology for the identification and assessment of impacts is qualitative. Interviews with municipality staff did not raise any specific concerns related to recreational activities as a result of the Project's development. Below is a description of the potential effects on recreation and tourism facilities during the construction and operation periods.

7.6.5.2 Construction stage

As the off-shore project area is not known to be used by recreational boaters, the potential for impacts to navigation for recreation is considered low. In the event that the boat tours occur in the area, it is expected that these recreational boats can use other areas and avoid the project areas with construction activities.

The recently built Parque Malecón, located along the coastline within the CEPA lands, will be affected by the temporary construction staging area and by the pipeline. The park was built for CEPA's internal use, but can be visited by local people at a cost. At the moment it is not visited often by the people of the city. The park will have to be closed. EDP will replace the Park, probably in a new location to be determined in consultation with CEPA.

There is also a sports and complex field that is located within the CEPA property and is located directly south of the pipeline route (see Figure 4.2). This sports complex is used by CEPA workers for sporting events such as football, and CEPA also makes it available to community groups. In order for the public to enter the sports field, they must have the authorization of CEPA and must pass through the Port Authority's security door.

The popular recreational beaches and tourist facilities are located south of Acajutla in Los Cóbanos, which is about 4 km south of the coast from the Port of Acajutla. Water sports, such as sport fishing, take place on the coast of Los Cóbanos and the area is one of the most popular destinations for diving activities in El Salvador. Closer to the project location is Acajutla Beach, which is located about 800 meters north of the pipeline route / staging area. The beach of Acajutla is mainly used by the local community. There are some restaurants along the shore of the beach in the city that attract visitors who stay in beach houses or in hotels situated along the coast. There are no hotels in the city to attract tourists to spend the night, although there are some smaller guesthouses.

As described in Section 7.47, there is a potential for temporary increase of sediment loads close to the coast. It may be possible that the increase in the sedimentation is visible, and can have a temporary impact on the use of the beach. It should be noted, that due to the discharge of sediment from the rivers in the area, the high sediment loads in the water are not unusual.

There is no marina in Acajutla which attacts recreation boaters with the exception of the artisanal fishing dock which is managed by the local fishing cooperative. However, there is the potential that the area has been or could be used for recreational boating activities.

There may be some limited and temporary noise effects for beach users during the construction of the Project. If it is determined that pile driving causes noticeable noise effects for beach users, EDP will explore corrective measures such as limiting pile driving activity during weekends and holidays. In addition, a Grievance Mechanism will be established (Appendix 7A). This will be monitored and complaints will be responded to in relation to such effects. It is not expected that other beach facilities will be affected by the construction of the project, including the tourist zone of the beach located about 4 km south of the Port.

The construction will require the use of fuels, oils and lubricants. Although it is possible, there is the possibility of spills of these materials during the construction that could contaminate the water of the sea and have an impact on the recreational use of the nearby beach of Acajutla. It is expected that any spill that may occur be of low volume.. Contingency clean-up efforts (see Section 7.4.7) are expected to be effective and significant impacts on recreation features and activities are therefore not expected

In the land area, the construction of the pipeline and the Thermal Power Plant may temporarily affect the use of the sports comple.g. which is located directly south of the pipeline route (see Figure 4.2). Potential effects include restrictions on access to the sports field due to traffic related to construction and its activities. Noise and dust disturbance due to the operation of construction equipment, and safety concerns during test activities (e.g. hydrostatic test). The use of sports facilities by local communities is authorized by CEPA and users must pass through the CEPA security gate to access the sports field. Sports fields are used only for organized events. It is expected that at the time of construction of the pipeline and the use of the sports field can be coordinated so that the impacts to access, use and enjoyment of this facility are not significantly affected.

7.6.5.3 Operation Stage

The impact on recreational equipment and / or activities is expected to be minimal during Project operations. The use of the beach area of Acajutla is not expected to be affected. The "Malecon Acaxual" park will be replaced / relocated. The only anticipated effects of the operations are the restrictions on the use of boats / vessels within a defined restriction area around the Maritime Terminal. It is not expected that this effect is significant taking into account that the area is not identified that this area is used by recreational boaters and/or fishermen and part of the area of restriction for vessels proposal would be within the area of existing restriction by passage of ships by CEPA. The area to be restricted is also small relative to the larger coastline and would not affect navigation along the coast. At sea, under typical operating conditions, the pipeline / thermal power plant operation is not expected to impact the sports field. No specific mitigation is displayed.

7.6.5.4 Relocation and Eviction

The power plant is located on unoccupied land under the ownership and control of CEPA. The lay down areas and LNG pipeline will require the replacement of the Maleacon Park as previously noted. The location for the park replacement is to be confirmed by CEPA. No other land parcels are needed and no physical displacement or relocation of people will be needed. Further, most of the project affected lands are not being used for income generation activities (with the possible exception of the trestle location – see Section 7.6.8 and 7.6.5 regarding potential impacts on local fishers and the park). EDP has an agreement with CEPA for the use of the properties, generating an income to CEPA.

There will be no loss of private land for the construction and operation of the Project.

7.6.6 Existing and Planned Land Use

The Project is proposed within the jurisdiction of the Port of Acajutla. As shown in Figure 5.8 Land Use Planning, the lands affected by the Project are designated for industrial uses. The Project is of industrial use and is consistent with the land use permits in the destination, which is industrial. The pipe servitude is also within the industrial zone and is called for industrial use. As such, for the construction and operation of the Project there are no changes in land use already proposed.

The Project is surrounded by other industrial uses and is consistent with the current activities of the area. It is expected that these uses of industrial land in the surrounding area will not be affected by the construction or operation of the Project.

As to the potential effects on land use in the construction traffic, see Section 7.6.7 below.

7.6.7 Roads, traffic and Utilities

7.6.7.1 Methodology

The Screening Matrix Impact in Table 7.2, Section 7.2, identified the following possible significant interactions between the project's activities and the conditions of roads, traffic and public services:

- Construction stage:
    - Construction related to traffic, including traffic on earthworks.

- Operation stage:
    - Traffic related to general activities of operations.

This section identifies and assesses potential impacts on the road network infrastructure, traffic and public services (including water supply and sewerage) in the study area during the construction of the Project and stage of operation. The potential impact on traffic safety was also evaluated. It is noted that the local community during the consultation activities did not raise the possibility of disruption of traffic being a concern. The assessment methodology used generally follows the overall process of impact assessment that was established for this by EsIA as presented in Section 7.1. The potential effects of the project were evaluated according to the basic conditions of infrastructure as described in Section 5.4.3

Infrastructure conditions and current traffic described in Section 5.4.3.1 provide the point of reference for the analysis of the road, traffic, public services and the potential effects of road safety. The entrance to and from the planned Thermal Power Station will be located at 24 de Octubre Street at a distance of approximately 0.7 km east of Highway 12S. Figure 4.3 shows that if coming from the east, north, south or from the port, the main access road to the Thermal Power Station will be from the existing paved road, Calle 24 de Octubre, which extends west of Highway 12S. The land access to the trestle will be off the Calle 24 de Octubre Oriente. Calle 24 de Octubre Oriente will also provide access to one of the temporary deposition zones. The development of new roads or the improvement of existing municipal roads is not required for this project.

Below is a description of the possible effects appearing in the highways and public services during the periods of construction and of operation. Other potential environmental effects related to the road network include personal injuries (traffic accidents) or material damages are also identified. For an assessment of the potential effects of the transport of dangerous materials, see sections 7.4.4 to 7.4.6.

7.6.7.2 Construction stage

This section describes the potential for impacts on highways, traffic operations and municipal public services during the Project's Construction Stage.

Roads and Traffic

During construction, a variety of land-based activities will require the movement of equipment, materials and personnel to and from construction sites along existing public roads. There will be an increase in the volume of traffic, made up of cars, light trucks and heavy trucks. This increase in road traffic can affect road infrastructure conditions, annoy users of adjacent properties, lead to delays by traffic, and possibly have public safety implications. A construction period of 33 months is expected. The volume of heavy truck traffic generated will vary over this period. Potentially high volume periods are expected to occur at the start of construction with the transport of building material to the site andmovement of unsuitable soils off-site and fill material on site. Most of the manufactured components for the Project will be delivered to the site through the Port. This will reduce long distance truck travel requirements to delivery project materials. Bulk goods, such as cement and fill material, will be sourced from the local market.

In general, truck traffic is expected to be similar to those generated previously for industrial-type construction projects in the project area, such as the nearby Duke Energy Thermal Power Plant. The roads used to access the site (for example, Highway 12 S - See Figure 4.3) are also the same roads used to access the Port, as such, heavy trucks along these routes are common. Traffic counting data is presented in Section 5.4.3.1. Near the entrance to the Project site, counts of 30 to 40 trucks (2 way) were observed over a period of 90 minutes in the morning. Counts of 140 to 200 trucks (2-way) were observed for the same time periods in the Port entrance area. Near the Port entrance truck traffic constitutes over three quarters of total traffic volume. Based on this traffic count data, the project access roads have relatively high truck volumes and the local community would be accustomed to this. Traffic delays and congestion does not typically occur and there is observed available capacity on the roadways to be used to access the project site.

With an estimated maximum of 1,200 workers at the Project site during construction, there is also the potential to generate a greater volume of traffic of cars on the roads in the area.

Land use along the Project's access roads (Calle 24 de Octubre, 12S and 24 de Octubre Oriente) mainly consists of industrial uses and vacant lots. Therefore, there is a low potential for disturbances to the adjacent lands due to a greater volume of traffic and trucks.

The additional construction traffic to be generated does raise the potential for accidents to occur. This may also result in the risk of a potential hazardous material or fuel spill. Roadway specific accident data is not available (see Section 5.4.3.1 for municipal accident data). Consultations with the municipality did not identify the access roads as having higher than typical accident rates. Considering that access road condition is generally good, road capacity is available, the roads have been design to accommodate heavy trucks, unusual roadway geometry was not observed, and the predominance of vacant/industrial adjacent land uses, the increase in truck volumes is not expected to result in higher than normal accident rates. There is some pedestrian traffic along Boulevard Coronel Oscar Orsorio (used by Port area employees that live in Acajutla) that crosses Calle 24 de Octubre Oriente (at the traffic circle). As such, there is some potential for pedestrian-truck conflicts.

The construction of the pipeline will require the temporary closure of some road lanes on the Blvd. Coronel Oscar Osorio. Traffic will be diverted onto lanes that will remain open or be diverted to a temporary detour section, to keep traffic flowing along this street as much as possible.
EDP will develop for Project use a Traffic Management Plant and implement a traffic management plan that will include

- Use of mass transport for workers (buses) to reduce movements of personal vehicles;
- Specification of designated haul routes;
- No heavy goods vehicles on local roads;
- Drivers to receive training on Project Traffic Management Plan;
- Advertise and schedule closures or major blockages to off-peak traffic times;
- Appropriate signage and traffic controllers;
- Consult with municipality, local communities, and local schools on traffic plan and traffic dangers.

High volume movements of heavy vehicles can accelerate the deterioration of the main access roads including Calle 24 de Octubre Oriente and Calle 24 de Octubre Poniente. EDP will conduct a pre-condition survey as well as follow-up inspections every three months along Calle 24 de Octubre Oriente to detect road damage that could be caused by the Project and may require repair works.

Other Municipal Services

During construction, water will be obtained from the groundwater well to be built on site. The potable water will be brought on-site for the consumption of the construction workers. As such, the Construction Stage will have no impact on the local municipal water supply system. See also Section

7.4.6 – groundwater. In addition, the wastewater will be managed by an on-site facility and there will be no impact on the municipal sewerage network or CEPA.

EDP will use urban solid waste management facilities for the disposal of non-hazardous solid waste (See Appendix 4E). An authorized private waste management contractor will transport hazardous waste for off-site for disposal.

7.6.7.3 Operation stage

Roads and Traffic

During the Operation Stage, traffic related to the Project will be generated for worker access, material delivery and maintenance / service activities. The Project Operation Stage will result in much less traffic than in the Construction Stage. Volumes during the operation stage of operation will be low in relation to the existing traffic / truck volumes associated with the port facility. Given the low traffic volumes generated during operations, and recognizing that existing highways are operating below capacity, it is unlikely that the project's operating activities will result in any material impact on road service levels in the town. Delays in traffic are not expected under typical conditions.

While the addition of traffic operations raises the possibility of accidents, which could also lead to spills of hazardous materials and fuels, it is not expected that these rates are substantial. This is due to the good state of the road, low volumes of traffic to be generated, and truck driver training which EDP and its contractors will require.

Other Municipal Services

Taking into account other municipal public services, during the operations, required water will come from the groundwater well that is to be built, so that the Operation Stage will not have an impact on the local municipal water supply system. In addition, wastewater will be managed by an on-site facility and there will be no impact on municipal sewerage services. Drinking water will be brought on site for consumption by operations staff. See Section 4.12 for a description of the consumption of water resources.

7.6.8 Artisanal Pier and Fishery

7.6.8.1 Methodology

The Impact Screening Matrix in Table 7.2, Section 7.2, identified the following possible significant interactions between project's activities and the artisanal pier and fishery:

- Construction stage:

- Pile driving; and
- Construction Activities in the sea.

- Operation stage:
  - LNG Delivery;
  - Physical presence of the facilities;
  - General operating activities; and
  - Storage, Handling, and LNG regasification.

This section provides a description of the possible effects of the project on the pier of Acajutla and in local fishery. Considered in this assessment was the design of the project and its description (see Section 4.4), and the characteristics of the location of the project (see Section 4.2). The proposed marine terminal will be located about 1.25 kilometers into the ocean and is located about 500 m north of the northern end of the existing pier of the Port of Acajutla (see Figure 4.2).

As documented in Section 5.4.2.3, small-scale fisheries (artisanal fisheries) account for 50% of El Salvador's total fish production. It is estimated that the country has some 13,000 marine fishermen with 5,700 boats, as well as 34 cooperatives and two federations. Boats from 18 to 25 feet long with outboard motors are usually used. Fishing without boats (by diving or by the use of floating equipment ("Tuberos", see Photo 7.2) is also practiced for the fishing of shellfish, lobsters and fin fish.

Photo 7.2 – Tuberos Performing Artisanal Fishing Near the Acajutla Dock

Source: Consulting Team 2014

It is estimated that about 189 individuals are engaged in local fishing:

- ~ 34 members of the Asociación Cooperativa de Producción Pesquera del Puerto de Acajutla (ACOOPPAC DE RL), of which between 25 and 30% fish from the vessels and the rest operate at the artisanal dock, associated infrastructure and management of the facilities;
- ~ 29 members of the "Asociación Cooperativa de Producción Pesquera Rederos de Acajutla (ACPPRA DE RL)", are active fishermen. (Note members share boat usage - not all members own their own boat);
- ~ 29 members of the Asociación Cooperativa de Producción Pesquera Tiburoneros de Alta Mar (ACPETAMAR); they carry out most of their fishing activities in the open sea, away from the Project area.
- ~ 16 members of the Asociación Cooperativa de Producción Agropecuaria y Pesquera Camaroneros de Acajutla (ACOOPESCA), primarily engaged in shrimp fishing, in areas far from the Project area.
- ~ 6 Oyster fishermen, working in near shore areas by swimming / shallow diving; and
- ~ 51 "Tuberos" fishermen use floats as a means of fishing up to about 500m kilometers from the coast. Tuberos, as they are known, have the habit of "paddling" buoys (such as Cenergica's discharge installation buoys), where they can tie and fish.

The coop fishers that fish from boats travel up and down the coast to fish. The main fishing area of the group is large, about 5 km south and about 25 km to the north Figure 5.35).The fishers noted that the southern area of their fishing grounds is used more frequently. Through consultations as part of this EIA the fishers have indicated that in recent years, overall, catches are down, and as a result incomes are also down.

The evaluation methodology used generally follows the overall impact assessment process that was established for this EsIA as presented in Section 7.1. Potential effects of the Project were assessed according to the baseline conditions as described in Section 5.4.2.3. The following is a description of the potential effects on local fishing and related facilities during the construction and operation periods.

7.6.8.2 Construction stage

Effects on Boat Based Fishermen

While boat based fishermen report fishing in the Project area, which includes an area known as "El Pedrero", located in the restricted fishing area of the Port of Acajutla (see Figure 5.48 and 5.50 showing the proposed Maritime Terminal and existing port restriction areas), observations amade as part of this

EsIA indicated that little or no fishing take place in this area by co-op members. Thus, the Project does not expect to have a significant impact on fishing activities by boat based fishers.

During marine construction, a boating restriction area will extend from the Marine Terminal to the coastal area where the temporary trestle will be located (See Figure 4.10). This will prevent fishing in the coastal area, near this area (for example, "Tuberos" fishermen). The physical presence of the Dock and FSU will require fishermen to take a longer route when sailing from or to the south. This route would add more time for each trip and additional fuel. At present, fishermen are allowed to cross port restriction zones and do so when they travel to fishing areas to the south (about 5 km away). The construction of the Maritime Terminal, and the associated 500m restriction zones, would add approximately 1,800 m (each way) for fishermen traveling from or to the south. Fishermen heading west or north along the coast, would not be affected by the areas of the facility or restriction. It is not known how many of the fishermen usually head south to fish and the importance of fishing sites to the south for their total catch. Despite the relatively short additional travel distance that would have to be traveled, additional distance would be added to fuel costs. Given the reduced income and marginal performance of fishermen this could have a significant impact. During the consultations held as part of this EsIA the cooperative provides a number of projects that EDP could finance or implement that would compensate the members of the cooperative. These projects include (See Appendix 10C):

1. Dredging of the artisanal fishing harbour - currently portions of the harbor have settled and limit the useful surface;
2. Replacement of the Winch - one of two winches used by members of the cooperative is disfunctional;
3. Installation of fish aggregating devices (FAD) near the artisanal jetty - A FAD is an object used to attract oceanic pelagic fish. They are usually composed of buoys or floats tied to the bottom of the ocean with concrete blocks. More than 300 species of fish gather around the FDA;
4. Support to cooperatives for the on land cultivation of tilapia fish; and
5. Support to the cooperatives for the cultivation of shrimp on the high seas.

The activities 2 and 3 have been identified by EDP as actions that effectively compensated for the effects of the project. These measures are considered fair, in which all fishermen will benefit equally, and that these projects can be effectively implemented before the starting of the construction. EDP's local community communications office will support cooperatives to assist them in requesting support for projects 4 and 5 from the social development fund.

Effects on Lobster Fishersand Tuberos

The development of the Project will result in a loss of fishing grounds for groups of independent fishermen, those who collect oysters and the tuberos. During construction, fishermen will be restricted from using waters near the temporary trestle during construction and the open waters between the trestle and the Marine Terminal where the marine pipeline will be installed. (See Figure 4.49 - Note that only one of the two proposed trestle sites would be used). The area with the greatest impact is where the lobsters are collected.. This restriction is expected to last up to 33 months. It should be noted that there will still be other local fishing areas near the coast available for the tuberos fishers during construction, although during construction, areas available to themwill be reduced.

Offsets for these impacts include the installation of fish aggregating devices (FADs) or other structures that attract fish, to be located north of the artisanal dock. Additionally, an artificial reef will be constructed in the nearby area, to attract oysters to grow on it. See Figure 10.9 for the location of the FAD and artificial reef. Combined, these measures will benefit the fishers as they will not need to travel so far in order to fish.

To further compensate both oyster fishermen and tuberos, EDP will provide these fishermen with an option to receive support and training to remain in fishing, or to make a switch to an alternative form of livelihood. The support will consist of the following:

1. **Remain in fishing:**

a. Participate in the construction of a rowboat to replace the "tubes";
b. Receive training including safety, marketing of fish, and food safety
c. Receive better fishing equipment.

2. **Leave fishing:**

a. Receive support for training in an alternative line of work / employment skills; and
b. Eligible for ongoing guidance related to finding a job.

It is expected that any of these options may provide opportunities for improvement for affected fishermen to improve their livelihoods compared to the existing situation. Skills development programs will be carried out, through a third party, possibly an NGO, which will be selected by EDP. If the above options are not suitable for an individual, alternative compensation will be explored on a case-by-case basis.

7.6.8.3 Operation stage

During operations, the main effects on fishermen will be the additional distance they will need to travel to fishing areas, as described in the previous section. This is because the combined zone of navigation exclusions around the Maritime Terminal and the current CEPA dock exclusion zone will restrict navigators from heading in a direct south-west direction.

The mitigation measures identified for boaters (members of Cooperatives) and fishermen without vessels or independent (oyster fishermen and tuberos) will effectively compensate the affected parties.

7.6.9 Port of Acajutla: CEPA Dock, Port Operations, Security and Access

7.6.9.1 Methodology

The Impact Screening Matrix in Table 7.2, Section 7.2, identified the following significant potential interactions between the Project activities and the CEPA port:

- Construction stage:
  - Pile driving (at sea);
  - Removal of marine sediment;
  - General construction activities; and,
  - Traffic related to construction.
- Operations stage:
  - Receiving LNG; and
  - Physical presence of the facilities.

The following section identifies and assesses the potential impacts to the Comisión Ejecutiva Portuaria Autónoma "Autonomous Port Executive Commission" (CEPA) in the Port of Acajutla, with reference to port operations, security and access (including roads and boat navigation) during the stages of construction and operation of the Project. This section addresses the MARN requirements presented in TOR, Sections 41, 42 and 43.

Built in the early 1960's, the Port of Acajutla now represents one of the main points of commerce and industry in El Salvador. The dock operations area contains eight spaces through three modern piers (A, B, and C) and is equipped to receive all types of vessels. There is also a buoy system used for tankers for the supply of RASA, Cenergica and Alba Petroleos terminals, through existing underwater pipelines.. Ships accessing the port follow a 330m-wide dock access channel on the seaward approach to the pier. Between the dock operations area and land, there is a marine shelter area and on-shore there are CEPA

port area facilities. The Port facilities include on-land storage areas and weigh scales. Both commercial vessels and holiday cruise ships use the Port as a docking point. Monthly ship volume at the Port ranged from 58 to 70 ships per month in 2013. Further description of the Port of Acajutla is outlined in Section 5.3.2.3.

It is noted that as part of the EIA consultation activities that an interview was conducted with a Port Authority representative. Documentation of the interviews conducted for the Project is available in Appendix 8B: Consultation Summary Report. No specific concerns relating to Port operations were raised in relation to the Project. EDP has had extensive discussions with the Port Authority in the planning of the project which has influenced the design of the proposed facility

The assessment methodology for the review of impacts in the Port of Acajutla generally follows the overall process of impact assessment that was established for this EsIA as described in Section 7.1. The potential effects of the project were assessed in accordance with the basic conditions which are described in Section 5.4.2.3. The methodology for the identification of these impacts is primarily through a qualitative assessment of the possible effects of the port operation, security and access that may be due to the construction and operation of the project.

7.6.9.2 Construction stage

The construction of the various project facilities will require a variety of activities to be carried out on land and at sea in the vicinity of of the Port's operations both on-shore and at sea . Considering the activities at sea, there will be a number of marine vessels related with the construction that will operate north of the existing Port pier. At its closest point, the Maritime Terminal is located approximately 600m from the end of the existing pier facility of the port. Additional vessels will be delivering project components to the port during construction. On-shore, these deliveries along with pipeline and power plant construction will use the existing roads used to transports goods in and out of the Port, and may temporarily disrupt other Port activities (e.g. potentially delay road traffic accessing the Port). During the construction of the Marine Terminal, boats not related to construction and boats in general will be restricted access to the area as shown in Figure 4.10. It is expected that additional vessel traffic during the construction stage will be limited and can accommodate existing shipping / vessel management procedures that CEPA currently has. The Marine Terminal is outside the port access channel (see Figure 5.50). Construction vessels will be kept outside this area. It is unlikely that construction-related maritime traffic will significantly disrupt the operations of the Port of Acajutla.

Construction related to the activity of ships in the Port area increases the possibility of marine accidents - including collisions with other vessels and / or collisions with port infrastructure. Such an event could significantly impact port activity. The potential for a maritime accident event during the Project construction period is considered to be low for the following reasons:

- The Project's Marine Terminal is located outside the Port designated access / restriction areas;
- The operation of large vessels in the vicinity of the port is a well established practice, governed by approved shipping policies and procedures that oversee marine vessel movements operating in a safe manner while within Port Authority jurisdiction; and
- Operations of the vessels must comply with the established procedures, including communicating planned vessel activity to the Port Authority.

In addition to the above, there will also be a close communication between the construction contractor and Port Authority regarding the timing and movement of all vessel activity in the vicinity of the Port. With these measures in place, the risk of significant accident is considered low. The activities of vessels were considered in the Qualitative Risk Assessment, as described in Section 9.2.

7.6.9.3 Operations stage

This section describes the potential impacts for the operations of the port of Acajutla, security and access during the operation stage of the Project.

Potential impacts of the operations of the Project to port operations are related to the increase of vessels for the transport of LNG to FSU. During the operation, the annual vessel activity for the Project is estimated to be eight arrivals (8) of LNG tankers per year, and up to 32 tankers per year, if there is demand for others for natural gas. . In addition, the FSU will be able to release from the jetty and go out to sea during storm/high wave events. The vessel activity, along with the new and the exclusion zone around it has the potential to impact approach and manoeuvring routes for vessels using the Port of Acajutla.

An exclusion radius of 300 meters centered around the Marine Terminal has been preliminarily discussed and approved by the operational staff of CEPA. This circle of exclusion shall apply to all vessels, including the commercial traffic of the port. This circle of exclusion of 300 meters provides a space of approximately 150 meters from the nearest docking point. Comprehensive navigation simulations verified that this exclusion allows sufficient space and time (assuming active tow escort) to intercept wandering ships prior to collision with docked vessel or structures. CEPA approved and the Project agreed that a new range marker, tangential to the exclusion circle and on a northeast trajectory

would need to be installed to help incoming commercial traffic keep away from the circle of exclusion. The Project will formalize this circle of exclusion with the Port Authority with the agreement of CEPA.

In addition, the total additional activity of vessels around the port as a result of the Project represents only about 4% of the annual port vessel related traffic (at 750 vessels / year). Finally, it is expected that the activity of the vessels related to the Project that operate in the vicinity of the Port will comply with the operational procedures of the Port Authority. As a result of the above, the potential for disturbance effects on port activity from Project operations is considered to be low.

As described in more detail in Chapter 9 - Risk Study, the potential for a marine accident events during the Project's operation period is considered to be low for the following reasons:

- The Project's Marine Terminal is outside of specific port access / restriction areas;
- Compared with the volume of vessels entering the port on an annual basis (700-800 vessels per year), the volume of vessels required for Project operations is not significant (up to 32 deliveries of tanks per year);
- The operation of large vessels in the vicinity of the port is a well-established practice, governed by proven shipping policies and procedures that oversee marine vessel movements operating in a safe manner while within Port Authority jurisdiction; and
- The traffic associated with the LNG tanker and the vessels required to access the Marine Terminal will comply with the established procedures including communicating planned project related vessel activity to the Port Authority.

7.6.10 Economy (Employment and Economic Activity)

7.6.10.1 Methodology

The Impact Screening Matrix in Table 7.2, Section 7.2, identified the following possible significant interactions between project activities and the economy:

- Construction stage:
    - Management of the construction workforce; and
    - Procurement supply chain.
- Operations stage:
    - Management of the construction workforce; and
    - Procurment supply chain.

The economic base of Acajutla and the surrounding region has been described in Section 5.4.2.3. There are about 21,000 people in the local labor force and the government reported unemployment rate for the municipality is 8.63%. The sectors that employ the largest number of the labour force are trade (30%) and agriculture (25%) (based on data from 2004). Although these sectors employ the largest portion of the workforce, wages per capita of these sectors are relatively low. In spite of the presence of the port in the municipality, the industry sector employs only 7.5 per cent of the labor force.

Suppliers of goods and services that can benefit from the project include:

- Transportation;
- Hotels/food service;
- Waste management;
- Construction materials; and
- Construction services.

This section provides an assessment of potential impacts on employment and the local economy for the construction of the Project and the operation period. Other benefits of the Project are discussed in Section 7.3. Impacts on the local Artisanal Dock and Fishing are described in Section 7.6.8.Considered in this assessment, were the construction of the facilities and operation activities (see Section 4.0), the characteristics of the project area (Section 5.4.2), and input received through stakeholder engagement activities.

Following is a description of the possible effects on the local economy during the construction and operation periods.

7.6.10.2 Construction stage

As noted previously, the estimated construction period is 33 months. The number of construction workers estimated to be on-site will range from about 50 to 1,200 in any given month. About 12 months of the construction period will see 600 or greater construction workers at the project site. Many of the construction workers are expected to commute to the site from the surrounding region – including San Salvador which is about 80 km away. As such, the project is not expected to result in a significant increase in the local population base that might result in further economic spin-offs to the local area (i.e. for local spending of new attracted residents). Some amount of the required construction workforce will be sourced from the local community. EDP is committed to using local people/companies as much as possible subject to the availability of workers having the necessary skills. EDP will direct its construction contractors to do the same. The hiring of local people will provide economic benefit to the

local area by providing new/additional income, if only for a temporary period. Wage rates for those employed in project construction are expected to be higher than the Agriculture and Trade sectors which employ the largest proportion of the local workforce. Initiatives to be taken by EDP to encourage local hiring include setting up a local employment office where people can go to find out about job opportunities and skill requirements. Also to be provided is information on where people can get the required training/ education.

There are limited services available in Acajutla that might benefit from the increased workforce in the local area. There are no rental accommodations that might attract the workers. There are some shops and restaurants that might see an increase in business from the construction workforce and it can be expected that some new local businesses could emerge to take advantage of the project, even if temporarily.

Construction workforce hiring and spending will benefit the larger region over the 33 month construction period. The benefit to the local community will depend on the availability of a suitably skilled labour supply (there is an estimated total local labour force of about 21,000 people). EDP is committed to hiring locally and will support this through the establishment of a local job office. EDP will work with the Acajutla Municipality economic development office to seek their input on how to optimize local hiring.

7.6.10.3 Operations stage

The operations phase is expected to require about 100 full time staff. As in the case of the construction period, EDP is supportive of hiring local people and/or local service contractors, subject to the availability of required skills. Based on consultations with the municipality and local stakeholders, it was noted that there is a relatively few local people employed at the Port and/or local industries. This might be indicative of limited available skill sets of the local labour force. Training opportunities for local people may improve increase the potential for the hiring of local workers to fulfil operations positions. Due to the permanent nature of these positions, there may be potential to attract some people to live in the local area, although some can be expected to commute from other locations in the larger Region (as is reportedly done for the Port and existing industrial facilities). It is also possible that the facility could attract other skilled/semi-skilled workers from other local industries/employers. It is not expected that the operating facility would attract new local service based companies but existing companies may be able to take advantage of new business opportunities through required service contracts (e.g. landscaping, general maintenance, etc.). Considering the above, the Project is expected to have a small, positive impact on the local economy.

7.6.11 Cultural, Archaeological, Historical and Ceremonial Resources

7.6.11.1Methodology

The following section identifies and evaluates the possible impacts for cultural, archaeological, ceremonial and historical resources during the construction and operation phases of the Project. The evaluation methodology used generally follows the overall impact assessment process that was established for this EsIA as presented in Section 7.1. Potential effects of the Project were assessed based on the cultural and archaeological aspects described in Section 5.4.4.

Below is a description of the potential effects on the archaeological and cultural elements during the construction and operation periods.

7.6.11.2 Construction stage

There are no archaeological sites identified within the footprint of the Project. The closest installation to the known Project is the "Ruinas del Muelle". They are located about 200 m south of the proposed pipeline route. Taking into account the separation distance, no impact is expected on these buildings. As far as is known, no archaeological features have been found in the development of other existing port facilities and industries in the area. In addition, the marine survey work completed for the Project did not identify any marine archaeological features. In the event that such elements are found during the construction of the Project, the Secretaría de Cultura (Secretariat of Culture) of the Presidency will be notified and their input sought on how to proceed.

7.6.11.3 Operations stage

No effects to cultural features are foreseen in the operations period.

7.6.12 Worker Health and safety

7.6.12.1 Methodology

The Impact in Table 7.2, Section 7.2, identified the following possible significant interactions between project activities and the health and safety of workers:

- Construction stage:
- All construction phases have the potential for worker accidental events Operations stage:
    - LNG Delivery;
    - General operating activities;
    - LNG Storage, handling, and regasification;
    - Transfer of NG; and

- Storage, handling, use and disposal of raw materials, waste and hazardous waste.

The following section identifies and assesses potential impacts to the health and safety of workers during the construction and operation stages of the Project. The workers, for the purposes of this assessment, are employees or contractors of the construction or operation of the Project. It is noted that the potential health impacts of the community are addressed in a separate section of this EsIA report (see Section 7.6.4).

Most regulations on occupational safety and health in El Salvador are under the Ministerio de Trabajo y Previsión Social (Ministry of Labor and Social Welfare) and cover a wide range of aspects and / or activities such as working at heights, handling of chemicals, general construction activities construction noise, general health, protective equipment, etc. Applicable IFC performance standards include the Environmental, Health and Safety General Guidelines, in particular Chapter 2.0 - Occupational Health and Safety. Taking into account applicable local and IFC provisions, EDP and its contractors will develop and implement specific health, safety and environmental (HSE) projects. The plans will be developed before the start of construction of the Project.

The Proponent of the Project is dedicated to the concept that all accidents are avoidable and philosophically unacceptable and is committed to develop throughout all Project activities continuous improvement practices that pursue the following objectives:

- Eliminate all preventable illnesses;
- Eliminate all injuries;
- Promote safe working conditions as a priority and as a major concern;
- Expand health, safety and environmental plans so that they are effective throughout the organization; and
- Control on a daily basis, the safe practices applied on site by all employees and subcontractors.

Throughout construction and operation, project management will instruct and support to the greatest extent possible all conditions for a "Zero Accident" program. All Project employees are required to constantly strive for the goal of zero accidents and all site personnel and contractors will be required to participate in safety-oriented behavior.
To achieve these commitments, the Project proponent will carry out the following actions:

- Exercise of corporate leadership and direction through the General Management;
- Establish effective communications flow and discussions on HSE matters at all levels;
- Setting and monitoring personal safety objectives throughout the project where appropriate;

- Fulfilling the duty of having contractors and visitors follow the safety rules;
- Complying with customer and local HSE laws and regulations; and
- Ensuring adequate instruction, training and supervision to enable continuous improvement.

The evaluation methodology for the review of impacts on the health and safety of workers generally follows the overall impact assessment process established for this EsIA as described in Section 7.1. The methodology for the identification of these impacts is mainly through a qualitative evaluation of the possible effects to worker health and safety that may result from the construction and operation of the Project. A significant adverse residual effect is considered to be a serious injury or death that may arise during normal construction or operations or due to an accident, malfunction, or unforeseen event.

The following is a description of the possible effects on the health and safety of workers during the construction and operation periods.

7.6.12.2 Construction stage

Routine construction activities that have the potential to affect worker health and safety relate to increased marine and on-shore vehicular traffic and construction activities at the various construction sites. These activities include the potential for exposure to noise, dust and hazardous materials and general hazards related to working around heavy equipment, confined spaces, heights, etc.
With the implementation of the HSE management plans and adherence to local and IFC health and safety procedures, health and safety effects during construction are expected to be within applicable standards. Standard safety procedures will include requirements for personal protection equipment (PPE), hazardous materials handling procedures, fire prevention and protection, fall protection systems, incident near miss and incident investigation reporting, and other safe work practices for construction phases.
The potential for unplanned risks or accidents will be mitigated by the implementation of HSE management plans. With the implementation of this plan, under typical conditions, significant impacts to construction workers are not anticipated.

7.6.12.3 Operations stage

During operation, project activities will be governed by the HSE Management Plan and safe operating procedures. Activities will include routine industrial workplace hazards, such as potential exposure to noise, hazardous materials and other conventional operational hazards. Unique hazards posed by handling and processing of LNG will also are considered as part of HSE Plan.

With the implementation of the project specific HSE management plans and adherence to local and IFC procedures, health and safety effects during operation are expected to be within applicable standards. Standard safety procedures will include requirements for personal protection equipment (PPE), hazardous materials handling procedures, fire prevention and protection, fall protection systems, incident near miss and incident investigation reporting, and other safe work practices during operations.

The potential for unplanned risks or accidents will be mitigated by the implementation of the HSE management plans. With the implementation of these plans, under typical conditions, significant impacts to facility workers are not anticipated.

7.7 Associated Facilities

The electric power generated by the Project will be delivered to the ETESAL Ahuachapan 230kV and Acajutla 115kV substations. The Acajutla substation is located immediately adjacent to the southeastern boundary of the Project site. Currently, the capacity of the transmission line is insufficient to transmit power from the Acajutla Substation to the main load centers located closer to San Salvador. As such, an additional 230 kV transmission line will provide electricity to an existing ETESAL substation in Ahuachapan, which is interconnected with the Sistema de Interconexión para los Países de Centroamérica (Interconnection System for Central American Countries) (SIEPAC), with a voltage of 230 kV. The project includes the construction of a double-circuit transmission line of 230 kV totaling about 44 km in length. The transmission line that starts from Acajutla will have a double-level voltage capacity with 230 KV for the interconnection with Ahuachapán and 115 kV for the interconnection with the Acajutla substation. The 230kV line passes through the communities of Sonsonate, Santo Domingo, San Pedro Puxtla, Apaneca and then arrives at the Ahuachapan substation located near the Geothermal Plant of Los Ausoles. The following components of the Project are required to connect the power plant to El Salvador's electricity grid:

- Extension of the Sub-station of Ahuachapán (230 kV) and Acajutla (115kV);
- Construction of a new substation in Acajutla, within the site of the thermal power plant.
- Construction of a new 115 kV Transmission Line between the thermal power station and the Acajutla substation; and
- Construction of a new 230 kV Transmission Line between the Acajutla substation and the Ahuachapán substation.

The EIA transmission line EsIA included a consultative process involving local stakeholders, including the land owners directly affected by the construction of the transmission line and also the communities of

the municipalities of Ahuachapán, Apaneca, Acajutla, Santo Domingo de Guzmán, San Pedro Puxtla, Sonsonate and Las Tablas.

The Acajutla Transmission Line Project to Ahuachapán and the "LNG TO POWER" Project are closely associated, since the transmission line would not be built without the "LNG TO POWER" Project, and without the transmission line, this project would not be viable.
At the time of writing this EsIA, the EsIA for the transmission line project had been submitted to MARN (In November 2016).

In addition, as described above in Section 7.3.3, the EDP Energy Project will invest the fixed costs necessary to establish the LNG Terminal. Once the terminal is built, the excess capacity of the terminal can be used to supply gas to other customers. At the time of drafting this EsIA report, no firm plans have been developed for the additional sale and use of gas. However, based on the current availability of fuels and prices in El Salvador, there appears to be the potential of existing power plants using imported liquid fuels to switch to natural gas. Other energy-intensive industries that depend on imported liquid fuel, such as cement production, may also consider switching to natural gas. These uses will require the development of the necessary infrastructure to transport and measure gas to these large consumers. These potential future developments would be subject to the applicable permit and planning regulatory processes.

Other gas markets that would require the Government to establish new regulatory regimes include the development of gas distribution services for municipalities and gas exports to distant markets, including Guatemala. Again, such projects would be subject to the applicable authorization and planning processes.

7.8 Assessment of Ecosystem Services

IFC Performance Standard 6 (PS-6) requires IFC to consider, as part of it's overall impact assessment of a project, ecosystem services that might affect, or be affected by, that project. PS-6 defines ecosystem services as "the benefits that people, including businesses, obtain from ecosystems" (IFC 2012), which aligns with the definition provided by the Millennium Ecosystem Assessment (MA) (Millennium Ecosystem Assessment 2005). While there is no single system for categorizing ecosystem services, the MA framework is widely accepted and, as acknowledged in PS-6 (paragraph 2), provides a useful starting point. The MA identifies four broad categories of ecosystem services:

- **Provisioning services**: the goods or products obtained from ecosystems, such as food, timber, medicines, fibre, and freshwater;
- **Regulating services**: the benefits people obtain from the regulation of ecosystem processes, such as climate regulation, disease control, erosion prevention, water flow regulation, and protection from natural hazards;
- **Cultural services**: the nonmaterial benefits obtained from ecosystems, such as recreation, spiritual values, and aesthetic enjoyment; and,
- **Supporting services**: the natural processes that maintain the other services such as soil formation, nutrient cycling, and primary productivity.

Ecosystem services are the benefits that people receive from a particular ecosystem. The benefits of ecosystems are discussed at many scales and often to multiple different beneficiaries:

- Local Level: ecosystem services are frequently the basis for rural livelihoods and subsistence, and particularly in developing countries for the poor. For example, artisanal fishing can provide both cash income and food for fishers and their families.
- Regional/National Level: for example, in aggregate a fisheries can contribute to the gross domestic product (GDP) of a country
- Global Level: ecosystems regulate climate and support the biodiversity which underpins all biological production.

Ecosystem services also work over temporal scales, such as:

- Annual production of crops;
- Soil formation cycles; and

- Climate regulation cycles.

Businesses and projects may also benefit from ecosystem services through, for example, the direct use of inputs, such as water, or through protection from natural hazards. Identifying and protecting such services can have further benefits such as avoiding punitive regulation and negative publicity, strengthening the organization's reputation and, in some cases, providing effective natural alternatives to more expensive engineering solutions.

This section presents an assessment of the potential impacts and dependencies on ecosystem services resulting from the construction, operational, and decommissioning phases of the Project. In addition, mitigation measures discussed in previous sections of this chapter were reviewed to ensure that they will avoid, minimize and, where residual impacts remain, to compensate and offset impacts on priority ecosystem services are proposed.

7.8.1 Review of Ecosystem Services

This Ecosystem Services Review (ESR) has utilized the conceptual framework and tool of the World Resources Institute (Landsberg et al., 2011). The WRI conceptual framework for consists of 3 stages, as outlined below.

Scoping Stage: this stage provides an opportunity to identify the key ecosystem services that could be impacted by or constrain the successful implementation of the project. This stage involves the prioritization of ecosystem services that need to be addressed in future stages of the EIA do to either project impact or project dependence.

Impact Analysis Stage: Once the priority ecosystem services relevant to the project are identified during scoping, the impact analysis stage of the EIA involves an assessment of impact and dependence on these ecosystem services across biophysical and socio-economic disciplines.

Mitigation Stage: The mitigation stage ensures that the project design and environmental management plan take into consideration the identified ecosystem services. The intent is that the mitigation will enhance or at least maintain beneficiaries' well-being at levels they deem acceptable, and to manage project dependence on priority ecosystem services or enhance or at least maintain project performance at levels the project developers deem acceptable. This stage proposed relevant biophysical and/or socio-economic options to enhance or at least maintain the well-being of affected beneficiaries and project performance at acceptable levels.

The scope of this ecosystem services assessment is limited to the LNG to Power Project and does not include an assessment of project dependencies or impacts from the supplier or customer.

7.8.2 Scope and Identification of Priority Ecosystem Services

Through use of the tools provided by Landsberg et al (2011), the following tools were used to identify priority ecosystem services:

- Questionnaire to identify drivers of ecosystem change likely to be associated with the project
- Questionnaire to identify potentially impacted ecosystems and ecosystem services, and potentially affected beneficiaries
- Questionnaire to assess project impact on ecosystem services
- Questionnaire to assess project dependence on ecosystem services

Definitions associated with these tools have been provided in Appendix 7D.

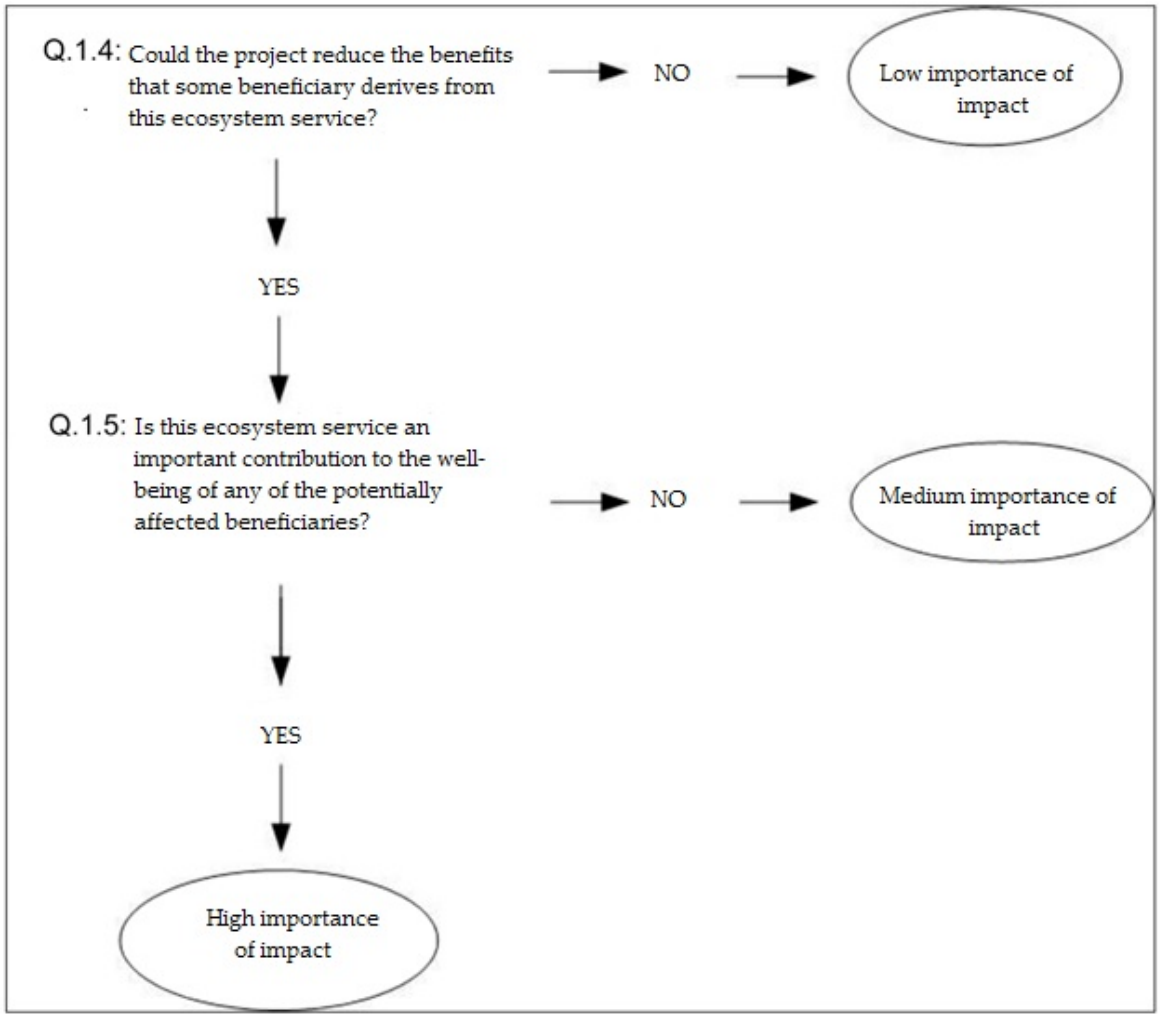
Project Impact

Through use of the "Impact Scoping Tool" (Landsberg et al., 2011), the change in local land use and cover was identified as the single, direct driver of ecosystem change. The ecosystems that have the potential to be impacted include the terrestrial ecosystem (both flora and fauna) in the area of the power plant and pipeline, the marine ecosystem in the area of the Navy terminal, groundwater and the atmospheric basin. It was also identified that as a result of impacting these ecosystems, the following ecosystem services could be impacted:

- *Food from capture fisheries*: Wild fish captured through trawling and other non-farming methods
- *Freshwater (groundwater)*: Inland bodies of water, groundwater, rainwater and surface waters for household, industrial and agricultural uses
- *Regulation of local, regional and or global climate*: Influence ecosystems have on the global climate by emitting greenhouse gases or aerosols to the atmosphere or by absorbing greenhouse gases or aerosols from the atmosphere. Influence ecosystems have on local or regional temperature, precipitation, and other climatic factors.
- *Regulation of water timing and flows*: Influence ecosystems have on the timing and magnitude of water runoff, flooding, and aquifer recharge, particularly in terms of the water storage potential of the ecosystem or landscape.
- *Habitat*: Natural spaces that maintain species populations and protect the capacity of ecological communities to recover from disturbances.

Figure 7.17, Represents the scope tool that was used to determine the significance of Project's impact.

Figure 7.17 – Scope Tool for Project Impact Significance



Source: Landsberg et al., 2011

Of the ecosystem services that were identified as having the potential to be impacted by the project, the majority were found to be a medium significance of impact as they are not major contributors to the well-being of potentially affected beneficiaries. A summary of the impact scoping tool questionnaire results have been provided in Appendix 7E.

Project Dependence

Based on the results of the "Dependence Scoping Tool" (Landsberg et al., 2011), the LNG to Power project has a medium to low dependence on freshwater (primarily as groundwater) as well as the regulation of water timing and flows (includes aquifer recharge). These are not high dependence ecosystem services as the Project has minimized water need by using air cooling systems the project has one ecosystem service that has been identified as a high dependence. This ecosystem service is the use of the Ocean for the transport of LNG. This ecosystem service is considered high dependence as the Project cannot substitute this service in a cost-effective way. As such, a summary of the dependence questionnaire results have been provided in Appendix 7F.

7.8.3 Impact Analysis Stage

The impacts of the project to the ecosystem service of food capture (fish, lobster and oyster) were evaluated taking into consideration the direct and indirect drivers of ecosystem change as well as understanding how this priority ecosystem services contributes to the beneficiaries' well-being. A detailed analysis of this can be found in Section 7.6.8.

The projects dependence on the Ocean for the ecosystem service of providing transportation was also analyzed. As per the guidance of Landsberg et al. (2011), to analyze the impact of the projects dependence on priority ecosystem services, the following was taken into consideration; the supply of the ecosystem service over the duration of the project, the extent that the service will be able to meet the projects demand over time and how the Project's performance might change as a result of changes to the ecosystem service. Given the depth of the Ocean near El Salvador, it is not anticipated that the dependence on the Ocean for the delivery the fuel supply will impact the project performance over time.

7.8.4 Mitigation Stage

Through consultation with the artisanal fishers, a mitigation / compensation plan has been developed for the impacts of the Project on the collection of fish, lobsters and oysters within the area of the Marine Terminal, the pipeline route, and the temporary construction trestle. Compensation commitments are found in Section 7.6.8 and Section 10.2.23. As a result of this mitigation, no significant impacts on the use of the marine ecosystem by fishermen are anticipated.

7.9 Assessment of Cumulative Effects

Cumulative effects can be defined as "the impacts on the environment that result from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions" (Council on Environmental Quality, US 1978).

IFC's Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts recognizes that "because of the increasing significance of system wide risk factors such as climate change, water availability, decline of species biodiversity, degradation of ecosystem services, and modification of socioeconomic and population dynamics, among others, cumulative impact assessment and management (CIA) is an essential framework for risk management."[14] What a CIA needs to address during the process of identifying environmental and social impacts and risks are[15]:

a) identifying the actions, activities, and/or projects that may contribute to cumulative impacts on valued environmental and social components on which other existing or future developments may also have detrimental effects, and
b) identifying the actions to avoid and/or minimize these impacts to the greatest extent possible.

According to IFC, through the EIA process, project sponsors need to address whether their development may contribute to cumulative impacts and/or may be at risk from cumulative effects of other existing or future developments. Determining and evaluating the significance of cumulative effects requires an understanding of future conditions. This includes the identification of other projects that exist or are realistically planned and defined to occur during the construction and/or operation of the project sponsor's development.

The following sub-sections identify and present the cumulative effects assessment for the Project and provide a strategy for the minimization or elimination of these effects for the life the Project.

[14] The International Finance Corporation. Manual of Good Practices: Assessment of cumulative impacts. Retrieved on 24 September 2014. http://www.ifc.org/wps/wcm/connect/3aebf50041c11f8383ba8700caa2aa08/IFC_GoodPracticeHandbook_CumulativeImpactAssessment.pdf?MOD=AJPERES

[15] Idem

7.9.1 Methodology

The methodology used for the evaluation of the cumulative effects of this project considered the IFC good practice guide in the CIA and included the following[16]:

- Identification of the environmental and social components that the CIA focuses on;
- Identification of other existing and reasonably anticipated and / or planned and potentially induced developments that could affect selected components;
- Identification of natural environmental and external social drivers that could affect selected components;
- Assessment and / or estimation of the future condition of the selected environmental and social components, as the result of the cumulative impacts that the Project is expected to have, when combined with those of other reasonably predictable developments, as well as those from the natural environment and external social drivers;
- Evaluation of the future condition of the environmental and social components relative to established or estimated thresholds or to comparable benchmarks;
- Strategies for the avoidance and minimization of the Project's impact on the selected environmental and social components for the life of the Project or for as long as the impacts continue to be present;
- If required, identification of monitoring and management required if there are risks to the environmental or social components' viability or sustainability over the life span of either the Project or its effects, whichever lasts longer;
- If required, recommendations for the provision of the Project-related monitoring data to governments and/or other stakeholders for the life of the Project, and material support for the development of collaborative local monitoring and resource management initiatives; and
- Opportunity provided to the affected communities to review the results of the CIA.

7.9.2 Assessment of Social and Environmental Components

The full list of environmental and social components assessed in the EsIA is found in the screeming matrix, Table 7.2 in Section 7.2. They include:

- Physical Environment Components:
    - Air quality;
    - Greenhouse Effect Gas Emissions and Climate Change;
    - Noise and vibration;
    - Soils;

    - Surface water;
    - Groundwater;
    - Sea water and marine sediments; and
    - Coastal dynamics.
- Environmental Biological Components:
    - Terrestrial Biota;
    - Marine Biota; and
    - Disease vectors.
- Social, Cultural and Economic Components:
    - Security and protection to the community;
    - Demography;
    - Landscape and Views;
    - Community Health;
    - Recreation;
    - Relocation and eviction;
    - Land use;
    - Roads, traffic and public services;
    - Artisanal dock and commercial fishing;
    - Port of Acajutla (CEPA);
    - Economy; and
    - Cultural, Archaeological, Ceremonial and Historical Resources.

The draft ESIA results were presented to the public on 18 October 2014 at a public assembly and at a second assembly held on November 2, 2016. The previous EsIA report was also available for review with the delivery of this EsIA report. . As explained in Section 7.1, the timeframe for the assessment of these effects was for both the construction and operational periods of the project. Also outlined in Section 7.1 is a description of the area of influence which provides the basis for the geographic scope for the assessment of each of the environmental and social components. It is noted that the geographic scope of the assessments varied by component which are described in the impact assessment result descriptions in Chapter 7.0.

7.9.3 Relevant Existing or Planned Developments

This impact assessment considered existing and anticipated near-term baseline conditions of the project location. The project is located within the port lands area of Acajutla. This is the main port facility for El Salvador and in addition to the port itself there are a number of other industrial faculties located in the

area. There also exists other land uses in the local area including residential communities which experience effects from the operation of the Port and from the other facilities located on the CEPA lands. CIA requires the consideration of other existing and reasonably anticipated and/or planned activities and/or projects. With the identification of these potential future activities, we are then able to determine what effects they might generate and potentially combine with the anticipated effects of the proposed EDP project.

Other existing and reasonably anticipated and/or planned activities and/or projects were identified through discussions with representatives of CEPA and the Municipality of Acajutla. Also considered was the 2013-2020 Strategic Plan for the Municipality of Acajutla. From these information sources, the following was determined:

- We are not aware of other planned or proposed major projects within the CEPA lands or in in-proximity to the project location. And while there are vacant industrial designated lands in the vicinity of the project, the project team is not aware of any planned facilities for these lands at this time. See Section 5.4.5 for a description of surrounding land uses;
- We are not aware of a long range plan for the CEPA lands. The only proposed development that we are aware of is the potential relocation of the CEPA administrative offices. Proposed locations include vacant lands located to the north of the proposed EDP power plant site. This proposed building relocation has not been approved by CEPA. It is assumed that CEPA's decision on where to relocate the administration office would be made considering the proposed EDP power plant project;
- The only known near-term planned project in the Town of Acajutla is for the beach area at the north end of the Town with plans for a park, walking path and restaurants and other general improvements intended to attract tourists to the area;
- The Acajutla strategic plan provides long range direction for the Town with recommendations related to: municipal services, management of settlement areas, rural sanitation, competiveness, ecosystem restoration, disaster risk management, and tourism facilities;
- The Acajutla Strategic plan does not identify any specific projects in the vicinity of the project location;
- The development and operation of the planned EDP power plant could influence the operation of existing HFO fuelled power plants (Duke Energy International and Termopuertos) that are located in the local area, both of which contribute to local baseline air quality and noise conditions. While EIA for the planned EDP facility assumes the continued operation of the existing HFO power plants, power system forecasting by EDP indicates that the operation of the

HFO facilities will drop to low levels once the LNG facility is running. This forecast could change if new equipment is introduced that allows operation on natural gas;

- Project development can create conditions and put in place infrastructure to enable other power plants and other energy-intensive industries to switch to choosing natural gas versus other hydrocarbon fuels such as HFO or gasoil. These facilities could be located in the port area or elsewhere if the pipeline infrastructure is installed;
- The associated transmission project will have to be built in a similar period to the EDP Thermal Power Plant. As such, there is potential for some construction to overlap with that of the Project.

7.9.4 Natural Social and Environmental External Factors

CIA requires the consideration of natural environmental and external social drivers that could influence the project study area through the introduction of new stresses which could potentially interact with the anticipated effects of the proposed project. This might include for example, wildfires, droughts, floods, predator interactions, human migration, and new settlements. The following provides commentary regarding the potential for such events:

- The power plant and LNG pipeline are located on lands under the control of CEPA. The topography of the area is flat and there are no major rivers located nearby. The project site is not prone to natural disaster events such as wildfires, floods and landslides are not likely. The area is well removed from active volcanoes, the closest active one being about 28 km away. El Salvador, as is much of Central America is prone to earthquake activity and the project has been designed to accommodate the earthquake standard applicable for the site;
- With the project being in a coastal location, there is some susceptibility to marine risks including major storms and tsunamis. The to accommodate the maximum projected wave generated from a tsunami, and the FSU is able to put to sea to avoid hurricane class storms;
- Lands that are in the immediate vicinity of the project location are either within the control of CEPA and/or are industrially designated. There are no vacant designated residential lands in the project vicinity that could be developed. It is not expected that current designated industrial lands in the project vicinity could be changed to residential designated lands; and
- The development of infrastructure to allow for the provision of natural gas to the project location could attract other industries to the Port area if natural gas could be made available to them. The ability of the EDP infrastructure to accommodate additional demand for LNG/NG has not been assessed.

7.9.5 Assessment and Evaluation of Cumulative Impacts

The Project is located in an existing port-based, industrial area that has been subject to previous disturbance. There is well developed infrastructure to provide access to the site and no new roads or access routes are required. Overall, the analysis of impacts completed as part of the EIA indicate that no Project-induced impacts, in combination with the effects caused by existing and previous projects, will exceed any key sustainability threshold. Instead, the majority of effects can be generally categorized as incremental impacts to already degraded or otherwise previously affected conditions. There are three exceptions to the above conclusions, which are:

- Air quality;
- Noise and noise induced vibration;
- LNG Sales;

Air quality

A plant dispatch model developed by EDP indicates that there once the Project is running there will be a corresponding significant drop in the operation of existing HFO fired plants, including the nearby facility operated by Duke Energy International (Duke Plant). Compared to the Duke Plant and other, similar HFO-fired plants, EDP's natural gas fired plant will have significantly lower emissions of NOX, and very-low to nil emissions of SO2 and PM10/PM2.5.

A drop in the operations of existing HFO fired plants would, therefore, result in a cumulative net decrease in emissions of important air pollutants, and a similar, overall cumulative positive effect on ambient air quality.

Should existing generators switch to natural gas, or should other energy intensive industries switch or otherwise choose to use natural gas instead of other hydrocarbon fuels; there would then be additional net cumulative reduction or avoidance of emissions of air pollutants, and improvement or protection of air quality.

Noise

In the vicinity of the Project noise levels are dominated by noise generated from the existing Duke Plant. This includes reports of low frequency noise induced vibration from stakeholders. The proposed power plant has been designed to use silencers capable of controlling low frequency noise, and use other equipment to control noise to levels well below the noise levels contributed by the existing Duke Plant. Therefore, if there is a reduction in the operations of the Duke Plant, then there will be a corresponding positive cumulative improvement in noise levels at the nearest residential receptors.

LNG Sales

In the future there may be interest in other energy-intensive industries to convert or otherwise use natural gas as fuel. Although the marine terminal has been sized to receive additional LNG shipments (considered in this EA) and generate greater volumes of NG than specifically required for the power plant, there may be a need for additional infrastructure for the sales of excess NG. The Project includes provisions for the possible future sale of NG that can be transported by trucks or local pipelines. This would not require any new land or site extension. It is assumed that any new infrastructure required to support sales would comply with applicable environmental approvals and permits. In general, the development of off-site LNG sales is not expected to result in significant and deleterious cumulative effects and may result in benefits through reduced air pollutant emissions if other carbon fuels are replaced.

7.9.6 Cumulative Effects Management

Based on this CEA, no additional mitigation measures and/or impact management measures are required. The mitigation and impact management measures proposed for the project are expected to be sufficient to address any potential cumulative effects that might emerge from the construction of the power plant and associated transmission line project over the same time period. Potential changes to the operation of the existing HFO power plant (reduced frequency of operations) will be watched by EDP although these changes are expected to result in benefits to the local area and as such additional mitigation/impact management measures would not be warranted.

7.10 Decommissioning Phase Effects

The LNG to Power Project will operate under the regulations and requirements of EDP or its successor, as specified in the power purchase agreement (PPA). The PPA for the Project has an established term of 20 years, subject to revision and extension. However, with regular maintenance of the Project facilities they could have a much longer shelf life extending for several decades beyond the initial PPA.

The decommissioning phase of the Project would therefore take place based on factors related to ongoing productivity and sustainability of the Project as an energy resource for the area. Given the uncertainty as to the definite end point for project operations, it is recommended that at the future point of closure, an assessment be undertaken to evaluate prevailing conditions at that time in order to develop a detailed and context-specific environmental and social management plan for this phase. The options for ultimately managing the infrastructure assets of the Project would therefore include, but would not be limited to:

- Conversion of facility machinery and operations to meet requirements of a future energy strategy;
- Sale of the facility to a third party;
- Demolition and removal of all project infrastructure; or,
- Decommissioning of the facility and infrastructure without demolition.

Should the decision be made to remove the facilities, then decommissioning would likely proceed as a reversal of the construction process. Buildings would be dismantled with material sorted as appropriate for recycling or reuse (e.g., metals, concrete, etc.), or disposal. All metal, including engines, tanks, wiring, and metal piping would be disputed and scold as scrape. Building foundations would be broken and removed. Piles might be pulled, or cut below surface and exposed portion removed. Eventually, the site would be graded, and cleaned up as appropriate for the next planned land use.

As decommission is basically construction, it is anticipated that most of the impacts of would be similar to those experienced during the construction phase. This would include parameters such as air quality (e.g., dust), noise, soil and landscape, water quality, traffic, and health and safety. To adequately mitigate impacts at minimum a waste management plan, including hazardous wastes, transportation management plan, noise and dust management plan, and worker health and safety plans would be required.

The economic and community development impacts of the Project closure will also be explored at the time of decommissioning and efforts made to attenuate these impacts as far as possible. Testing of soil, water, and air samples will be undertaken to determine if remediation is required. Measures will be put in place to mitigate residual impacts from the Project. Rehabilitation works would also be undertaken to re-vegetate the site and protect exposed areas from erosion should this be determined necessary. At a minimum, machinery and equipment would be cleaned, dismantled, and removed from the facility, with removal of hazardous materials.

Energía del Pacífico

Project: LNG to Power

Chapter 8: Participation of Social Actors (Stakeholders)

December 2016 – 16-3489

ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

DILLON CONSULTING

8.0 Social Actors (Stakeholders) Participation

8.1 Introduction

This chapter summarizes the previous citizen consultation process and opinions systematization obtained from the actors involved in the project **"LNG TO POWER"**.

The chapter is structured as follows:

- **Section 8.2: "Objectives"**, of the local actors participation.
- **Section 8.3: "Methodology"**, Which describes the Stakeholder Engagement Plan (SEP), which determines the consultation activities with the stakeholders (also known as social actors), to be completed as part of the project planning and implementation Of "Electric Power Generation, LNG to Power" techniques for collecting qualitative information collected. It also details each processes applied to the activities, the actors involved and the role they play in the territory.
- **Section 8.4: "Identification of stakeholders"**, Here we describe the process of identifying social stakeholders carried out and listing them.
- **Section 8.5: " The participation results of social stakeholders at the national level".** This section presents the general perception activities and a brief summary and concerns encountered as a rapprochement carried out different activities result with the main social stakeholders at the national level. Mostly, governmental institutions with interest or some type of relationship with the Project.
- **Section 8.6: "The participation Results of local social stakeholders to the year 2014"**, There is a description of the activities carried out, and the results corresponding to the first EsIA delivery time submitted to MARN in December of 2014.
- **Section 8.7: "The participation results of local stakeholders years 2015 and 2016"**, There is a the activities carried out description , and the results from the moment in which they began to incorporate changes to the draft, until November 2016.
- **Section 8.8: "Follow-up activities to the public consultation",** It describes the participation activities, which will continue during the present study assessment , and then along the Project construction and operation stages

8.1.1 Objetives

8.1.1.1 General Objetive

The social stakeholders participation process overall objective, is to inform and consult with the different actors identified in the Acajutla municipality on the Project development.

8.1.1.2 Specific Objectives

- Inform the different social stakeholders about the Project and its components;
- Publicize the participation process and the different means by which they can inform themselves about the Project and communicate their concerns;
- Communicate to local communities and government institutions the purpose, nature and scale of the project, as well as the project's proposed activities duration.;
- Disclose relevant information about the risks and impacts on communities;
- To know the current population views in relation to the positive and negative experiences they have had with the industries that are already operating in the Acajutla Port ;
- Identify the major preoccupations and social stakeholders/actors concerns in relation to the project "LNG TO POWER" development;
- Identify communities closest to the project, or vulnerable groups that might be affected by the same;
- Ensure that the Communities consultation could be considered as affected and the other social stakeholders external communications are adequately answered and handled;
- To promote adequate communities participation and provide the means for such participation throughout the project cycle, in matters which might affect them, and to ensure that known and disclose relevant environmental and social information; y
- systematically present the views obtained by the various activities carried out means, such as assemblies, interviews and workshops with actors involved in the project in reference.

8.1.2 Methodology

8.1.2.1 The Methodology General Description

A specific "The Social Actors Consultation and Participation Plan(Stakeholders)" was elaborated for the project. The Stakeholder Engagement Plan (SEP), determines the stakeholder consultation activities to be completed as part of the ESIA and also during the Project development in its Construction and operation phase. Therefore, this plan includes the activities to be carried out, prior to the start, during and after the Environmental Impact Assessment (EsIA preparation of) for the project. And it is closely linked with another consultation similar process that applies to the project "Acajutla-Ahuachapán Transmission Line", which has been developed in parallel.

The Consultation Plan is a complementary component to the project's Environmental Management Program (PMA), and is fully integrated with project planning, design and implementation process. This will be subject to a constant revision and periodic updating, in all the stages, until the stage of operation. The consultation and participation activities described in this Plan will be subject to review by EDP depending on the contributions received.

EDP Consultation and Participation activities, are guided by the following principles:

- The main actors and citizens must be properly informed about the project, prior to their involvement in the participation process;
- The public consultation will be done in a timely manner, prior to making key decisions for the project;
- The Consultation and Participation Plan will be inclusive for all affected people, and will be conducted in a culturally appropriate manner;
- All queries and information published will be in a form and language understandable for citizens;
- The consultation process will be interactive, generating feedback with participants on how their input influenced the process;
- The process will lead to the constructive relationship formation between EDP and local communities; and
- A transparent grievance program will be carried out, which will allow the identification and resolution of any concerns or concerns that arise.

Similarly, all the laws, regulations and policies applicable to the "Public Consultation" activities, both for El Salvador Republic were taken into account through the guidelines given by MARN in the "Reference Terns" (TDR) for the Project, as well as the international financing institutions requirements for projects, especially those stipulated by the International Finance Corporation (IFC). The last are described below.

8.1.3 International Financing Institutions Requirements for Projects

To finance the Project, EDP will involve international funding institutions such as the International Finance Corporation (IFC), which is the World Bank Group member. Therefore, the project has been planned and designed to address IFC's Environmental and Social Safeguard Policies, as well as to meet its performance standards. In other, the World Bank's environment, health and safety guidelines.

The International Financial Corporation (IFC) Performance Standards on Social and Environmental Sustainability and relevant guidance material, associated with the Social Actors, or Stakeholders participation and consultation plan, are as follows:

Performance Standards on Social and Environmental Sustainability of the International Finance Corporation (IFC):

- *Performance Standard 1- Evaluation and Management of Environmental and Social Risks and Impacts, January 1, 2012 (Participation of Social Actors Sec.25-36).*

- Guidance Note 1, on Performance Standards 1, on Environmental and Social Sustainability IFC:
  - *Assessment and Management of Environmental and Social Risks and Impacts, January 1, 2012.*
- IFC Handbook - Relations with the community and other social actors:
  - *Handbook of Best Practices for Companies Doing Business in Emerging Markets, May 2007.*
- Note of the Manual of best practices of the IFC:
  - *Responding to Claims of Communities Affected by Project, September 2009.*

In the development of this " Social Actors Consultation and Participation Plan," the following standards, defined in Performance Standard 1, have been taken into account: (See Appendix 8A):

- The need to identify the social actors types that may be interested in their actions and to consider how external communications could facilitate a dialogue with all of them. *(Page. 14 of "IFC's Social and Environmental Sustainability Performance Standards").*
- A social stakeholder participation plans appropriate to the risks and project impacts and its development phase and adapted to the characteristics and interests of the Affected Communities will be developed and implemented. (P*age 14 of "IFC's Social and Environmental Sustainability Performance Standards").*
- The relevant information disclosure about the project will be provided to the Affected Communities and other social actors. (*Page 14 of "IFC's Social and Environmental Sustainability Performance Standards").*
- A consultation process will be undertaken so that Affected Communities are offered opportunities to express their views on the risks, impacts and mitigation project measures, and the client can consider and respond to them. (*Page 14 of "IFC's Social and Environmental Sustainability Performance Standards").*
- In the case of projects that have significant adverse impacts on the Affected Communities, an informed consultation and participation (ICC) process will be carried out. (*Page 15 of "IFC's Social and Environmental Sustainability Performance Standards").*
- In the case of a project that produces adverse impacts on Indigenous Peoples, a CPI process should be carried out for them. (*Page 15 of "IFC's Social and Environmental Sustainability Performance Standards").*
- The need to implement and maintain a procedure for handling external communications that includes methods for receiving and recording external communications from the public; Give the

corresponding answers, follow up and document them. (*Page 16 of "IFC's Social and Environmental Sustainability Performance Standards*").

- A complaint mechanism will be established to receive the concerns and complaints from affected communities, the client's environmental and social performance and to facilitate their resolution. (*Page 16 of "IFC's Social and Environmental Sustainability Performance Standards*").
- Periodic reports will be provided to Affected Communities where they will describe progress in the project implementation action plans. (*Page 16 of "IFC's Social and Environmental Sustainability Performance Standards"*).

8.2 Identification of Social Actors (Stakeholders)

As a national interest project, the methodology is directed toward two types of actors. The "local actors", which are those who will be directly involved or affected by the project, whose analysis was given greater level of detail and relevance (the results of this analysis are described in paragraph 8.6.3). And, the "Actors", which refers to those national importance actors, such as governmental institutions that could be related in one way or another in the Project development.

8.2.1 Analysis of National Social Actors at the National Level

Identified national interest Instances , which was vital importance to submit more to fund the project "LNG TO POWER". It was established taking into account the institutions with some relationship in the project development such as paperwork, permits, technical advice, feasibility, and those related to issues such as risk control, supply and electrical energy generation to the nation, among others, that also showed interest in the project. Table 8.1 provides a list and description of Those actors at the national level.

Table 8.1 – General Social Actors at the National Level

Organization or institution Name	Role they play
1. Comision Ejecutiva Portuara Autónoma (Autonomous Executive Port Commission)	Autonomous institution dependent on the Government that is in charge of the administration Ports, Airports and Railways.
2. Cuerpo de Bomberos de El Salvador (Fire Department of El Salvador)	Public Service Institution that is in charge of the Prevention, Control and Extinction of all types of fire, as well as evacuation and rescue activities; the Persons protection and their property ; Cooperation and assistance in case of disaster and other related activities.

Table 8.1 – General Social Actors at the National Level	
Organization or institution Name	**Role they play**
3. Administración Nacional de Acueductos y Alcantarillados (ANDA) (National Administration of Aqueducts and Sewers)	Provide water suitable for human consumption with the quality and quantity that the population demands; As well as the residual waters treatment, the maintaining ecological water resources balance
4. Autoridad Marítima Portuaria (AMP) (Maritime Port Authority)	Regulate and control maritime and port activities in the technical, economic and administrative aspects, as well as represent El Salvador in international organizations, contributing to the country development.
5. Consejo Nacional de Energía (CNE) (National Energy Council)	Establish and promote an energy policy and strategy that contributes to the sustainable development of El Salvador.
6. Ministerio de Medio Ambiente y Recursos Naturales (MARN) (Ministry of Environment and Natural Resources)	Reversing environmental degradation and reducing risks by leading an energetic, articulate, inclusive, accountable and transparent public environmental management.
7. Ministerio de Agricultura y Ganadería (MAG) (Ministry of Agriculture and Livestock)	To facilitate and stimulate the sustainable development process of the sector in the Agricultural, Forestry, Fishing, Aquaculture and Rural areas, through effective services, in order to contribute to the population well-being.
8. Ministerio de Obras Públicas, Transporte, Vivienda y Desarrollo Urbano (MOP y VMVDU) (Ministry of Public Works, Transport, Housing and Urban Development)	To lead, rectorate and manage public works, housing and transport, to boost human development, in an orderly and sustainable territory, integrating the public, private and citizen effort, with ethics and transparency, from a regional perspective.
9. Ministerio de Economía (MINEC) (Ministry of Economy)	Strengthening the productive capacities of all business sectors; Deepening regional economic integration; The trade liberalization consolidation ; The sectoral policies prioritization in territories with high growth potential; And the internal market strengthening based on clear rules and the local initiatives accompaniment.

Table 8.1 – General Social Actors at the National Level	
Organization or institution Name	**Role they play**
10. Comité Interinstitucional para la Introducción de GN (CNE) (NG Interinstitutional Committee for the Introduction)	At the end of 2013, the CNE Board of Directors agreed on the institutional Committee creational for the Natural Gas Introduction. As the winner of the tender for the 355 MW energy purchase which has the responsibility of presenting a proposal that incorporates an action plan that the different State institutions involved in the issue that they can react accordingly.
11. SIGET	It exercises effective regulation to promote access and ensure the efficient public provision electricity and telecommunications services to the population, with respect for the environment.
12. Universidad José Simeón Cañas	The knowledge production and research as instruments placed at the service to search for fair and equitable solutions to regional and national problems.

Source: Own Elaboration ECO/DILLON, 2014

8.2.2 Analysis of Local Social Actors

In order to determine the "Social Actors" to participate, the Influence Project Area was taken into account. IFC Performance Standard [1] (January 1, 2012) states that in cases where the project includes physical elements, aspects and facilities specifically identified that are likely to generate impacts, environmental and social risks and impacts are Analyzed in the context of the influence project's area. This influence zone comprises, as appropriate:

a) The area likely to be affected by: (i) the project and activities and facilities directly owned or operated by the client (including contractors) and which are the Project components. (Ii) impacts of unplanned but predictable events caused by the project, which may occur later or elsewhere. (iii) indirect project impacts on biodiversity or ecosystem services on which the Communities Affected depend on Obtain their subsistence means.

[1] Standards of Performance on Environmental and Social Sustainability
Examples include the site of the project, the immediate atmospheric or hydrographic basins or the transport corridors.
[2] Examples include corridors for energy transport, pipelines, canals, tunnels, relocation and access roads, lending and disposal areas, construction camps and contaminated land (eg, soils, ground and surface waters, and sediments).

b) Related facilities, which are facilities not financed as part of the project, which would not have been built or expanded in the project absence, and without which the project would not be viable[1].

c) Cumulative impacts [2] (resulting from the incremental impact) on areas or resources directly or indirectly employed by the project, produced by other existing, planned or reasonably defined constructions in the opportunity to carry out the risk and impact identification process.

The following Table 8.2 summarizes the influences area for the "LNG TO POWER" project, as defined by IFC and stakeholders.

Table 8.2 – Influence Area & Local Social Actors Identification

Influence Area	Key Social Actors
A (i)-- Project Activities and Facilities	
1. Land and Sea areas permanently occupied by Floating Storage Unit (FSU), marine terminal and pipelines, storage tanks on land and generation plant's general facilities Site	LOCAL FISHERMEN / RESIDENTS/NEARBY COMMUNITIES
2. Terrestrial areas, temporarily occupied for materials stockpiling areas during the construction phase.	N/A
3. Maritime corridors and maneuver areas for LNG tankers and Floating Storage Unit (including the seabed areas that can be affected by jet of the propellers and the creation of waves).	LOCAL FISHERMEN / CEPA
4. Off-site areas that could be affected by air emissions, noise, surface runoff, sewage and sediment discharges, as well as changes to coastal processes, and areas that could be affected by major hazards such as spills, fires and explosions.	LOCAL COMMUNITIES / RESIDENTS
5. Off-site facilities and infrastructure that could be used by the project (quarries that provide materials, land disposal areas from landfills,	MUNICIPAL CITY HALL

1 Related facilities may include railways, roads, transport lines or own power plants, pipelines, utilities, warehouses and logistics terminals.

2 Cumulative impacts are limited to those impacts that are generally considered to be important on the basis of scientific criteria and on the basis of the concerns expressed by the Affected Communities. An example of cumulative impact is the additional contribution of emissions of gases in an air basin.

Table 8.2 – Influence Area & Local Social Actors Identification	
Influence Area	**Key Social Actors**
solid waste disposal areas, access roads).	
A (ii)- Unplanned but predictable developments triggered by the project	
1. No unplanned or foreseeable developments to be triggered by the Project.	N/A
A (iii)- The project Indirect Impacts on biodiversity or on ecosystem services	
1. Potential effects of the maritime terminal, floating storage unit, and marine activities on local fishery resources (fish and crustaceans).	LOCAL FISHERMEN
B. Related Facilities	
1. Influence Area for the further the Project Transmission Line development (This will be treated as a separate project and its documentation will be presented in a separate document).	
C. Cumulative Impacts	
1. Cumulative effects on air quality and current noise emissions from industrial activities and other existing sources.	LOCAL COMMUNITIES / RESIDENTS
2. Cumulative effects on land, water, and marine conditions, considering the current industrial development of the Port and the Areas or lands belonging to it.	LOCAL COMMUNITIES / RESIDENTS / FISHERMEN

Source: Own Elaboration ECO/DILLON, 2014.

For the identification, a rapprochement with local authorities was carried out. In the first instance contact was established with the Acajutla Municipality, for being the local municipality, it received the Unit for Social Projection support , through this area was created an actors list present in the territory would be determined on the incidence basis in the municipality social, economic and environmental. In the same way, it was determined the actors involvement from the influence area where you will build the project "LNG TO POWER". In this case, it was determined that the communities adjacent to this area could provide relevant information, in the sense that its inhabitants are those who live on a daily basis the impacts generated by those plants, whether they are positive or negative impacts.

8.2.2.1 The Local Social Actors Description

The following sections provide local stakeholders brief description that participated in various consultation activities.

a) Local Government Institutions

Local Government Institutions are shown in Table 8.3.

Table 8.3 – Local Actors Involved in the Project	
Organization or social institution Name	**Role they play**
Alcaldía Municipal de Acajutla (City Hall of Acajutla)	Inclusive local government, which projects citizen participation. Through the progress achieve a better life quality for its inhabitants. It has the capacity to administer public funds for the municipality sustainable and competitive development.
Centros Escolares Locales (Local Education Centers)	Provide educational instruction to children and young people in the area. In addition, to work together with the inhabitants for social development: **Comunidad and Liceo de Acajutla..**
Centros de salud pública: Unidad de Salud, Seguro Social Locales (Public Health Centers: Health Unit, Local Social Security)	Provide the health service to the population of the municipality and ensure the health services provision such as vaccinations, controls for children and general services: **Unidad de salud comunitaria y Clínica del seguro social Acajutla.**
Other Local Government Institutions	Having any impact on the developing process the Project or can provide relevant information for the EIS development, such as: **CEPA, Cuerpo de Bomberos de Sonsonate, Autoridad Marítimo Portuaria**.

Source: Development of the consultant on the basis of methodology for the identification of actors involved

b) Local communities

The Project will be located within the Autonomous Port Executive Commission (CEPA), within the Acajutla City jurisdiction. There will be no physical or economic relocations or relocations as a Project result. However, several communities were identified in the surroundings reason why a 700m-influence radius was estimated to carry out consultation activities[2]. Table 8.4 provides a communities list that participated in various consultation activities. The population living within that radius is approximately 6,805 people according to data from the Acajutla Municipality. See Figure 8.1.

Table 8.4 – List of Local Communities and their Population		
THE COMMUNITY NAME	**Households**	**Population**
Comunidad “La Raza № 1”	23	115
Comunidad “La Raza № 2”	83	415
Comunidad Ciudadela CEPA	192	960
Comunidad “Zona Industrial”	45	80

[2] Some communities outside this 700m radius were also taken into account, and the community closest to the Project is the CEPA Citadel, which is approximately 200m away.

Table 8.4 – List of Local Communities and their Population			
THE COMMUNITY NAME		**Households**	**Population**
Comunidad "Bendición de Dios"		25	105
ADESCOMAR-Integrated by :	ACAXUAL	82	230
	Los Morritos	59	295
	La Reyna	60	300
Barrio La Playa		241	1,205
Comunidad San Roque		44	207
Comunidad El Barquito		22	110
Comunidad La Obrera		60	300
Lotificación Alvarado		300	1,500
Comunidad Obelisco		68	408
Barrio Las Peñas		79	395
Colonia "Brisas de Acajutla 1"		45	90
Colonia "Brisas de Acajutla 2"		47	90
TOTALES:		**1475**	**6,805**

Source: Own Elaboration ECO/DILLON with data from the Social Projection unit of the Municipality of Acajutla, updated 2016

a) Companies / Associations

Different approach types were also carried out with the companies surrounding the Project, as well as consulting activities with local commercial associations, such as fishermen's cooperatives. Those actors are listed in Table 8.5.

Table 8.5 – List of Commercial Associations, Cooperatives or Others	
NAME OF ORGANIZATION OR SOCIAL INSTITUTION	**ROLE THEY PLAY**
ACOOPPAC DE R.L.- Asociación Cooperativa de Producción Pesquera del Puerto de Acajutla(The Acajutla Port Fishing Production's Cooperative Association) *It has 57 partners.*	The commercialization of the fishing is destined to the local territory, among restaurants, local food businesses and for family consumption.
ACPPRA- Asociación Cooperativa de Producción Pesquera Rederos de Acajutla.(The Acajutla drift netters Fishing Production's Cooperative Association) *It has 34 partners*	
ACPETAMAR- Asociación Cooperativa de Producción Pesquera Tiburoneros de Alta Mal. *It has 29 partners (The hight sea shark Fishing Production's Cooperative Association)*	

Table 8.5 – List of Commercial Associations, Cooperatives or Others	
NAME OF ORGANIZATION OR SOCIAL INSTITUTION	**ROLE THEY PLAY**
ACOOPESCA- Asociación Cooperativa de Producción Agropecuaria y Pesquera Camaroneros de Acajutla. *It has 16 partners. (*The Acajutla shrimp fishing and Agricultural Production Cooperative Association)	
OSTREROS- Group of 6 people identified	
TUBEROS- Group of 51 people identified.	
ORGANIZACIONES DE MUJERES DE LOCALES	They participate in the activities carried out by the municipality. They manage projects to improve the life quality for their families and their self-development.
DUKE ENERGY	Development of Energy Generation Projects.
EMPRESA SALVADOREÑA PORTUARIA DE ACAJUTLA S.A. DE C.V. (ESPAC)	Staff Recruitment for the Port services Provision in the Acajutla Port .
ESTIBADORES (COPORSAL)	Workers Association engaged in cargo loading and unloading from vessels.
ESTIBADORES DE EL SALVADOR S.A. DE C.V. (ESTISAL)	Workers Association engaged in cargo loading and unloading from vessels.
PUMA ENERGY	Fuel terminal
BRIDGE INTERMODAL TRANSPORT (BIT)	Local and regional cargo transportation for exports and import, repair and maintenance services for dry and refrigerated equipment, Patio service containers loading parking, containers rental.
OPERADORES PORTUARIOS SALVADOREÑOS, S.A. DE C.V. (OPSAL, S.A. DE C.V.)	Port support company specialized in storages, warehouses.
LUBRICANTES TEXACO, S.A	Lubricant terminal
SERVI-MAR	Company providing port support services.

Source: Own Elaboration ECO/DILLON, updated 2016.

b) Non-Governmental Organizations and Associations of Interest.

There are some local NGOs, as well as non-profit interest associations working in the locality. In Table 8.6. a list of those that were consulted is provided.

Table 8.6 – List of NGOs and other associations of interest	
NAME OF ORGANIZATION OR SOCIAL INSTITUTION	**Role they play**
Centros de salud privado, AGAPE Sonsonate, cruz roja. (Private health centers, AGAPE Sonsonate, Red Cross.)	Provide the health service to the municipality population and ensure the health services provision such as vaccinations, controls for children and general services.
Churches	It is recognized at local level and has an impact on communities. They promote the communities and the municipality development through the support of various vulnerable sectors. The Catholic Church and an Evangelical Church were identified.
Asociación Pan y Vida	Assists elderly people in food and medical care. It caters for an estimated 60 to 70 people.
Centro de Bienestar Infantil CBI (Children Wellbeing Center)	Provides day-care services for children from families working in the local market or other areas and who are characterized by not having the resources to pay for their children care.
Movimiento Cultural Atonal (Cultural Movement)	Cultural movement that promotes culture in the Acajutla municipality

Source: Own Elaboration ECO/DILLON, Updated through activities in 2016

c) Cultural Groups

Indigenous groups were not identified in the project vicinity or within Acajutla Municipality. Indigenous communities closer, however some are located outside the project influence area, provided in Table 8.7 and Figure 8.2.

Table 8.7 – Nearby Indigenous Communities	
SONSONATE	1. Cuisnahuat
	2. Santa Isabel Ishuatán
	3. San Antonio del Monte
	4. Santo Domingo de guzmán
	5. Nahuilingo

Source: Dirección Nacional de Pueblos Indígenas y Diversidad Cultural (National Directorate of Indigenous Peoples and Cultural Diversity)

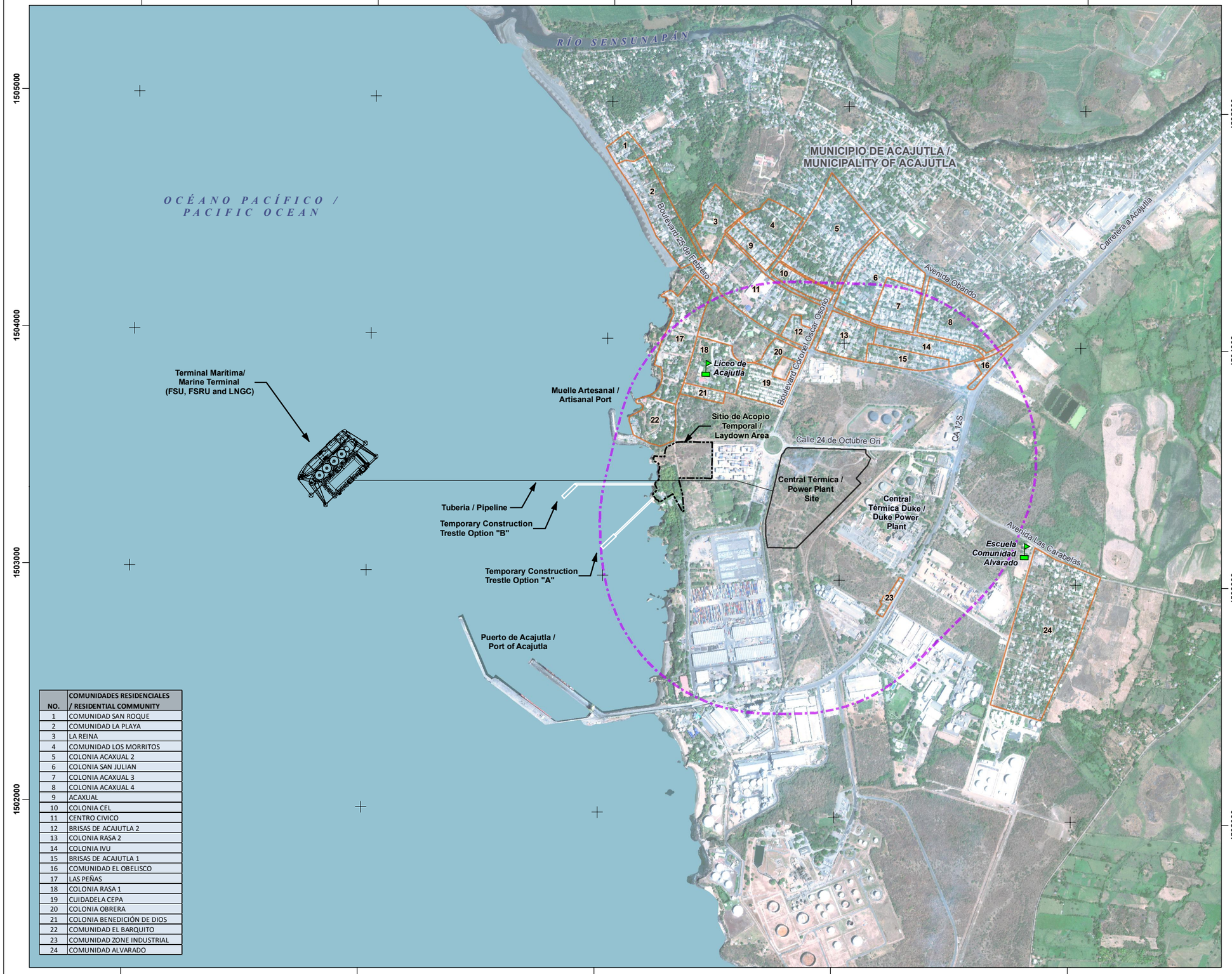
Energía del Pacífico

ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

MAPA DE COMUNIDADES CERCANAS AL PROYECTO/NEARBY COMMUNITIES

FIGURA 8.1 / FIGURE 8.1



NO.	COMUNIDADES RESIDENCIALES / RESIDENTIAL COMMUNITY
1	COMUNIDAD SAN ROQUE
2	COMUNIDAD LA PLAYA
3	LA REINA
4	COMUNIDAD LOS MORRITOS
5	COLONIA ACAXUAL 2
6	COLONIA SAN JULIAN
7	COLONIA ACAXUAL 3
8	COLONIA ACAXUAL 4
9	ACAXUAL
10	COLONIA CEL
11	CENTRO CIVICO
12	BRISAS DE ACAJUTLA 2
13	COLONIA RASA 2
14	COLONIA IVU
15	BRISAS DE ACAJUTLA 1
16	COMUNIDAD EL OBELISCO
17	LAS PEÑAS
18	COLONIA RASA 1
19	CUIDADELA CEPA
20	COLONIA OBRERA
21	COLONIA BENEDICIÓN DE DIOS
22	COMUNIDAD EL BARQUITO
23	COMUNIDAD ZONE INDUSTRIAL
24	COMUNIDAD ALVARADO

- ESCUELAS / SCHOOLS
- COMUNIDADES / RESIDENTIAL COMMUNITIES
- RADIO DE 700 m SITIO DEL PROYECTO / PROJECT SITE 700 m RADIUS
- SITIO DEL PROYECTO / PROJECT SITE
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA

0 100 200 400 m

1:16,000

N W E S

FUENTE / REFERENCE
VISIÓN DEL MUNDO 2 IMÁGENES DE ALTA RESOLUCIÓN / WORLDVIEW 2 HIGH RESOLUTION IMAGERY (2014-02-12)

MAPA CREADO POR / MAP CREATED BY: PFM
MAPA REVISADO POR / MAP CHECKED BY: MW
PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONE 16 WGS84

ARCHIVO / FILE:
I:\GIS\163489 Acajutla\GIS\MXDs\Reporting - 2016\8-1 - Nearby Communities.mxd

PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL / FINAL
FECHA / DATE: 12/7/2016

DILLON CONSULTING

ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

PAGE FOR PRINTING

Energía del Pacífico

ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

MAPA DE UBICACIÓN DE PUEBLOS INDÍGENAS MÁS CERCANOS / ABORIGINAL COMMUNITIES

FIGURA 8.2 / FIGURE 8.2

SITIO DEL PROYECTO / PROJECT SITE

FUENTE / REFERENCE
VISIÓN DEL MUNDO 2 IMÁGENES DE ALTA RESOLUCIÓN / WORLDVIEW 2 HIGH RESOLUTION IMAGERY (2014-02-12)

MAPA CREADO POR / MAP CREATED BY: PFM/SFG
MAPA REVISADO POR / MAP CHECKED BY: MW
PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONE 16 WGS84

ARCHIVO / FILE:
I:\GIS\163489 Acajutla\GIS\MXDs\Reporting - 2016\8-2 - Mapa de Ubicación de Pueblos Indígenas más Cercanos.mxd

PROYECTO / PROJECT: 163489
ESTADO / STATUS: FINAL / FINAL
FECHA / DATE: 12/5/2016

DILLON CONSULTING

ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

PAGE FOR PRINTING

8.3 Description of Activities with Actors (*Stakeholders*) at the National Level (2014)

The following stakeholder participation activities were developed at the national level:

a) **Presentation Meetings:** To present and inform about the Project to be developed and create communication channels to obtain valuable information for the project, consult about related procedures, and also, to determine their interest level. The technical team in charge carried out project presentations for 3 consecutive days, the dates March 31 and April 2, 2014. A field visit was also made to the site where the project will be developed, carried out on April 1, 2014, in which CEPA, IFC, Wärtsilä and EDP authorities participated.

b) **Natural Gas Seminar:** Due to the project novelty for the Country, it was considered appropriate to hold a seminar to create communication links with all the above mentioned institutions, and at the same time to train on the "ELECTRICITY GENERATION LNG TO POWER" Project. Through this event sought to report on the progress and the same characteristics, as well as the natural gas use benefits for the electrical energy generation. Similarly, the event sought to provide training in the natural gas use, management and security measures. The event was held on Wednesday, 16 July 2014.

c) **Event on the official project presentation : The** Official Project presentation held on August 20, 2014, with the government authorities accompaniment , as well as executives and the Energía del Pacífico technicians . The event purpose was to publicize the project on a national scale and to present its relevance to the Country and the Central American Region. As part of it, a field visit was made to the site where the plant will operate to know the EDP operations details, and explained the Project components, the work program and the expected benefits.

8.3.1 The Presentation Meetings Results (2014)

Communication channels were established with various institutions related to the Project development, such as MARN, CNE, SIGET, ETESAL, MINEC, Inter-Institutional Committee for the NG Introduction (CNE) and VMVDU, (March 31 and April 2, 2014) in order to gather their views and any valuable information for the developing process the EIS and general Project development. A) A summary is given in Appendix 8B, as well as the attendance list at the project presentation meetings (dates March 31 and April 2, 2014).

Through those meetings we were able to give a technical Project components explanation to the government institutions involved, and a greater understanding of them in relation to the magnitude and the project complexity , and the benefits that could result was obtained. Also, opinions obtained by the MARN in relation to the guidelines for the environmental form presentation and obtaining reference

terms for the EsIA, some doubts concerning the evaluation times, procedures and steps for obtaining resolved Environmental permission. Also, opinions and recommendations by ETESAL and the CNE in relation to the transmission line were collected.

During the meeting with CEPA and the field visit to the site (Made on April 2, 2014), it was possible to show the land where the Project's location is projected, to the World Bank entities, such as the International Finance Corporation (IFC, With whom it is sought part of the financing for the same development. (See Photos 8.1 and 8.2).

Photo 8.1 – Visiting the Site with Representatives of CEPA, IFC, EDP, and Wärtsilä Representatives

Source: Own Elaboration ECO/DILLON, 2014.

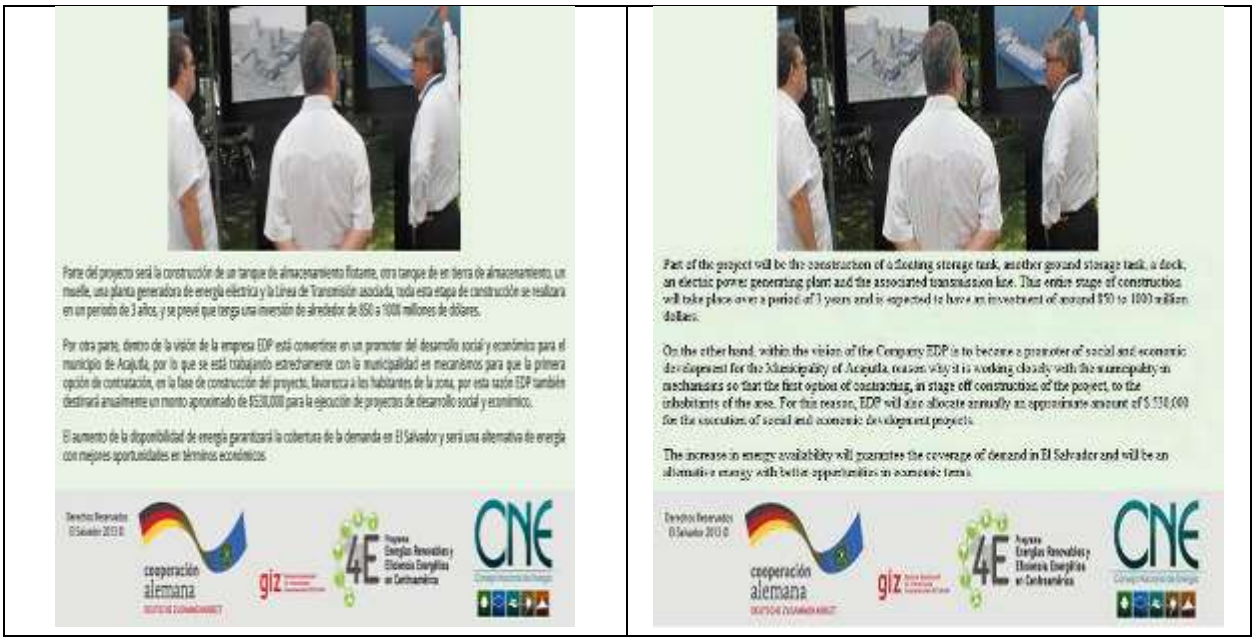
Photo 8.2 – Meeting with ETESAL, MARN CNE Representatives among others

Source: Own Elaboration ECO/DILLON, 2014.

Through other non-documented meetings with MARN and VMVDU, it was also inquired about the pipeline related to the Project, which should be hand in hand with those institutions to create a work dynamic. Interest samples were obtained in the "LNG TO POWER" Project and collaboration desires for the project development.

After some of those presentation meetings, a great interest of different sectors was generated, several publications appeared in relation to the same one, here are some examples, Figures 8.3 to 8.6.

Figure 8.3 – Article of Interest in the Project Posted by CNE



Source: Image taken from CNE official website http://www.cne.gob.sv/

Figure 8.4 – Publications in Newspapers

EL MUNDO .com.sv

Economía

Inicia estudio ambiental para la planta de gas natural licuado

Energía del Pacífico abrirá una oficina en Acajutla en un mes, para poner a disposición la documentación sobre el proyecto.

La sociedad Energía del Pacífico, constituida por las empresas que construirán la primera planta de Gas Natural Licuado (GNL) en el país, anunció ayer el arranque de su estudio de impacto ambiental, previo a la instalación de la estructura.

Compuesta por el asocio Quantum-GLU, Energía del Pacífico ejecutará una inversión de entre $800 y $1,000 millones para la planta, luego de ganar una licitación gubernamental para suministrar 355 megavatios (MW) de energía.

En un campo pagado publicado en un periódico local, la sociedad explicó que el estudio inició con la presentación del Formulario Ambiental al Ministerio de Medio Ambiente y Recursos Naturales (MARN), de tal forma que se identifiquen los impactos y medidas ambientales que minimicen los efectos negativos del proyecto.

EL MUNDO .com.sv

Economía

Environmental study begins for liquefied natural gas plant

Energía del Pacífico will open an office in Acajutla in a month to make available the documentation about the project.

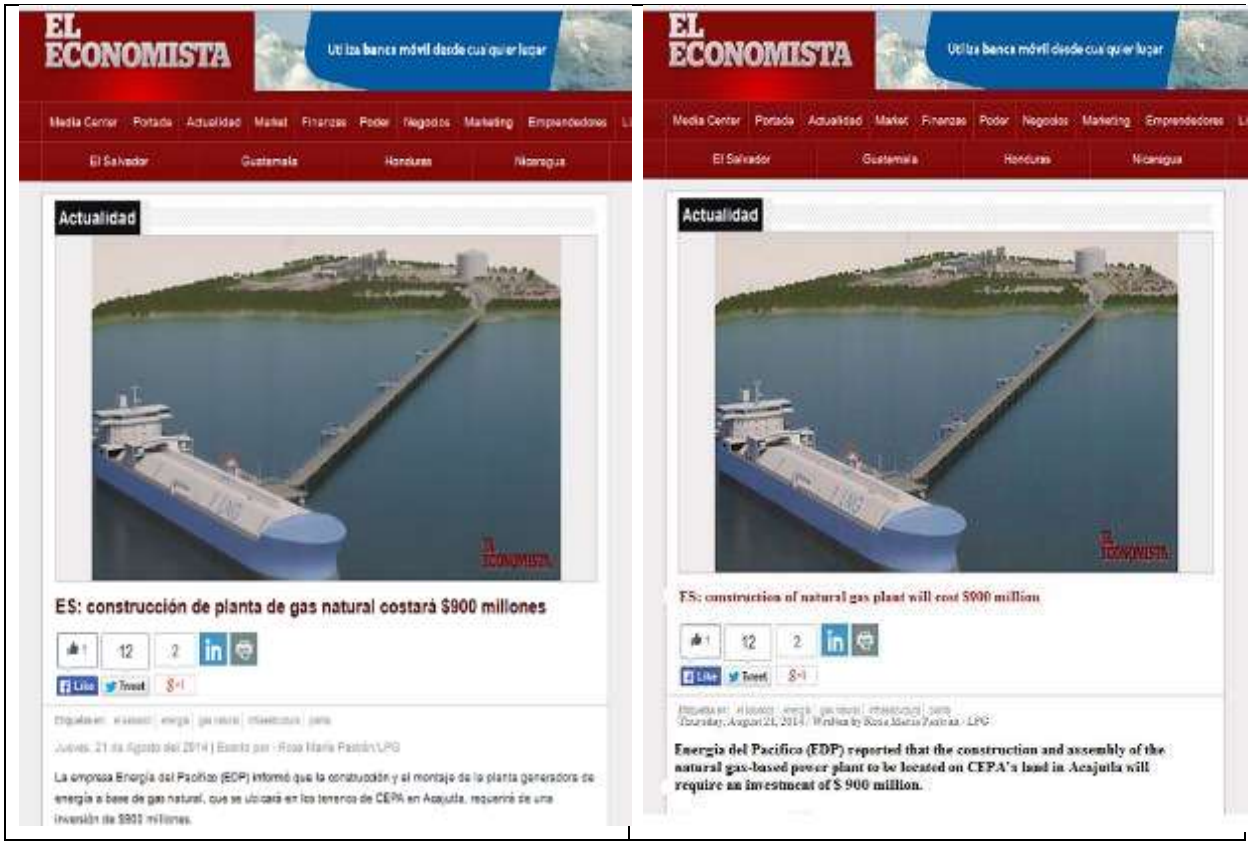
Energía del Pacífico composed by enterprises which will build the first Liquefied Natural Gas (LNG) plant in the country, yesterday announced the start of its environmental impact study, prior to the installation of the structure.

Composed by the associated Quantum-GLU, Pacific Energy will run an investment of between $800 and $1000 million for the plant, after winning a government tender to supply 355 megawatts (MW) of energy.

In a paid publicity space in a local newspaper, the company explained that the study began with the presentation of the Environmental Form to the Ministry of the Environment and Natural Resources (MARN) in such a way as to identify environmental impacts and measures that minimize the negative effects of the Project.

Source: Scanned image of the newspaper Diario El Mundo May14, 2014

Figure 8.5 – Articles of Interest in the Project Published by El Economista Magazine [3]



Source: Image taken from publication on August 21, 2014
on internet: http://www.eleconomista.net

8.3.2 The Natural Gas Seminar Results (2014)

The aim of this event was to expose more detail to the project components as well as to train the guests on the energy generation topic with natural gas. This was held on Wednesday, 16 July 2014, at the Hilton Princess, and using the same, to report on the progress of the project to date, and describe their characteristics as well as components, with the various governmental institutions and some private ones, which were convened through an invitation.

During the same, the EDP technical team (The project Holder) and the company Wärtsilä (Responsible for the technology use's installation), as well as technical consultant team which was responsible for the study preparation, presented the topics listed in the following Table 8.8.

[3] *It must be taken into account that this image is of the project as it was configured in 2014 and has changed.*

Table 8.8 – Topics covered in the seminar on Natural Gas	
1.	The project Importance at the national level. Project Program important dates.
2.	Introduction to natural gas power generation wordl
3.	Benefits of the generation with gas, natural gas reserves in the world.
4.	Location of the project and its elements
5.	Explanation on how the generation plant to be installed will operate, operation principles , main operations.
6.	LNG / NG characteristics brief explanation.
7.	Expected atmospheric emissions
8.	Waste and residues generation
9.	Work structure, team and responsible. the Physical, biological and socio-economic environment main aspects to be analyzed as part of the Environmental Impact Study.

Source: Elaboration of the Consultant, 2014.

Further the agenda developed details during the event and the attendance list are provided in Appendix 8C, which was widely used by various governmental institutions, among others, who showed interest in the Project. Next in Photo 8.3 is an image during the event.

Photo 8.3 – Director of the project giving his presentation

Source: Own Elaboration ECO/DILLON, 2014.

8.3.3 The Official Project's Presentation Event Results (2014)

The event took place on August 20, 2014 and achieved a great call by the different media and the Press, with which it was possible to publicize the project further. It fulfilled its main objective was to publicize the project importance for the country and the Central Region for being the first plants generating electricity from natural gas.

The event report is presented in Appendix 8D. During the event we had the following media :

- La Prensa Gráfica;
- Diario El Mundo;
- Gentevé;
- El Diario de Hoy;
- Revista SUMMA;
- Central América Data;
- Revista El Economista;
- Revista Estrategia & Negocios; y
- TCS.

Likewise, government entities were present, including the Republic Vice President Oscar Ortiz participation, from whom a positive feedback was obtained. The Vice President and Commissioner for Public and Private Investment, Óscar Ortiz, spoke to the commitment about the energy matrix diversification . "*With the start-up of the natural gas plant we will be able to reduce the electric power generation cost in the country and offer a higher quality service, this benefits the industry, makes it more competitive, and the population will have cheaper energy*" the Vice President said. See Figure 8.6.

Figure 8.6 – Example of One of the Publications

EL MUNDO

INVERSIÓN Proyecto implica inversión aproximada de $900 millones

Planta de gas natural iniciará construcción a mediados de 2015

Las obras se desarrollarán en el puerto de Acajutla, Sonsonate. Prevén generar 355 megavatios de energía a partir de gas natural licuado.

La planta de gas natural licuado debe proveer energía desde enero del 2018.

El vicepresidente de la República, Óscar Ortiz, asistió a la empresa Energía del Pacífico.

Source: Scanned image of publication
Diario El Mundo August 2, 2014
(Unable to translate text given the small size of font, it is not clearly legible)

During the event explained the main generating electricity advantages from Natural Gas, and some of the benefits that would imply the Project. Some of the topics discussed include the following:

- The importance for the country to diversify the energy matrix, with the power 355 megawatts generation and its associated energy, will expand the electricity supply installed in El Salvador;

- The new electric generation option introduction relevance, which is being used by many developed countries in the world;
- The increase in the energy availability, guaranteeing the demand coverage in El Salvador, and that being an alternative energy with better opportunities in economic terms, will enable an electricity rates reduction;
- To reduce environmental impact as it is a cleaner fuel;
- EDP's vision to become a social and economic development promoter for the Acajutla municipality; and
- EDP's commitment to the project during the Project duration , ear marking an approximate amount of US $ 530,000 annually for the social and economic development projects execution, for which we will work hand in hand with the Acajutla Municipality and the *Fondo de Inversión Social para el Desarrollo Local* (Social Investment Fund for Local Development) (FISDL).

Below you can see some images taken during the event, Photos 8.4 to 8.6.

Photo 8.4 – The Republic Mr. Vice-President, Mr. Oscar Ortiz Participation

Source: http://www.vicepresidencia.gob.sv/presentacion-de-proyecto-de-gas-natural-acajutla/

Photo 8.5 – Different Institutions and Media Representatives Participation

Source: http://www.vicepresidencia.gob.sv/presentacion-de-proyecto-de-gas-natural-acajutla/

Photo 8.6 – Some Event Guests Image

Source: http://www.vicepresidencia.gob.sv/presentacion-de-proyecto-de-gas-natural-acajutla/

8.4 Annual Activities Description with Local Actors 2014

The work methodology has been designed to inform the social actors about the Project and the Environmental Impact Study for it, as well as to offer opportunities for them to provide their opinions, comments and perceptions of the Project's development. Attention was paid to the different national and international policies, principles, and regulations (described above) related to the public consultation.

The consultation activities carried out by EDP at a later date can be organized within the following 5 phases:

- Phase 1: Initial announcement of the project / identification;
- Phase 2: EIA consultation activities;
- Phase 3: Public consultation of the EsIA draft;
- Phase 4: Presentation of the EsIA and action plans; and
- Phase 5: Communications Plan in construction and operation Phase

A summary of each phases is provided in the following sections. Table 8.9 lists the actors involved in each phase.

Table 8.9 – Summary of Local Actors and Activities per Phase

Actors (Stakeholders)	Activities
City Hall	Meetings with the Mayor's Office different areas representatives and with the Mayor and his council will be carried out during all phases.
Local Communities	Activities such as interviews, assemblies and workshops were carried out during phases 2 and 3. And follow-up will be continues up after the delivery of this document to MARN.
Companies / Associations	Project presentation activities were carried out by correspondence from EDP during phases 2.
Local NGOs and interest groups	Consultation through interviews and workshops during phases 2 and 3. And follow-up will be followed after the entry of this document to MARN
People potentially affected by the project (PAP)	This project is not going to result in the people displacement or affectation to private lands. PAPs include those who own the property, or are involved in economic activities in the project vicinity . Workshop-type meetings were held with affected groups representatives such as fishermen in phase 2 and 3 to inform them of the project and identify their concerns. PAP may also receive information through the local project office and planned public meeting (Phase 3). And follow-up will be followed after the entry of this document to MARN.
Public in general	The project would be inform in the newspapers, web site etc… The project local

Table 8.9 – Summary of Local Actors and Activities per Phase	
Actors (Stakeholders)	**Activities**
	office allows the general public to receive project information, questions and / or express a concern. The available information includes posters and a Project summary. The TdR, the EIA Report (draft and final), and a non-technical summary EIA Report will be made available to the public. The public meeting held in Acajutla the October 18, as part of Phase 3 to present the environmental impact assessment preliminary , and to receive your comments and concerns. And will follow up later at the present document entrance to the MARN.
	Included in the activities of phase 2 and 3. And follow-up will be followed after the entry of this document to MARN.
Cultural groups	No indigenous groups were identified in the Project area.

Source: Own elaboration ECO/DILLON, 2014.

8.4.1 Description of Phase 1: Initial Project Announcement / Identification (2014)

The activities carried out during phase 1 were initiated in March 2014 and included announcements, project introduction materials, stakeholder identification, holding project presentation meetings with government entities and stakeholders, and important points and community concerns documentation. These activities were carried out between March and May, 2014.

8.4.1.1 Announcements Publication

Those publications informed the activities start to develop the Environmental Impact Study for the Project. It was also published about the components of it, and the environmental impacts evaluation process that would be carried out. A different publications compilation made in different media, as well as the material used to inform is presented in Appendix 8E. The newspapers with the highest circulation were selected at the National and Local levels, and the Acajutla festivities local magazine publication.

Below is the publications detail :

- Announcement notifying the start of EIA and consultation activities, two publications made in the national and local newspapers, "El Diario de Hoy" and "La Prensa Gráfica". Date of publication May 13, 2014. See Figure 8.7.
- Announcement notifying the EIA and consultation activities start, published in the Acajutla festivities magazine dates from 6 to 15 June 2014. This magazine has taken advantage because of its popularity during those dates and the reach level that would represent with the local population, since it is distributed gratuitously by the municipality during the local festivities, being able to have access to this all the Acajutla population without any cost, unlike the newspapers. See Figure 8.8.

- Announcement notifying the project's communications office opening, two publications made in the national and local newspapers, "El Diario de Hoy" and "La Prensa Gráfica". Published in July 2014. See Figure 8.9.

Thanks to the announcements published in the different circulation newspapers, it was possible to inform on the first hand the general public at the National and Local level that the Project started with the preparation of the Environmental Impact Study. As a result of these publications, several people communicated to the official e-mail that Energía del Pacífico assigned to their consultations "info@edp.com.sv", most e-mails received during the publications investigated possibilities of employment and participation, but technical questions related to the Project were not received.

Figure 8.7 – Advertisement Notifying Project and Start of EsIA

ENERGÍA DEL PACÍFICO
"LNG to Power Project"
Aviso de Inicio del Estudio de Impacto Ambiental

Source: Scanned image taken from newspaper "El Diario de Hoy", dated May 13, 2014

Figure 8.8 – Announcement Posted in Magazine Fiestas Patronales de Acajutla

ANTECEDENTES

Energía del Pacífico es la empresa formada por los miembros del Asocio que resultó adjudicado en la licitación internacional coordinada por DELSUR en 2013, para el suministro de nueva capacidad eléctrica a ser entregada a siete empresas distribuidoras en el país. Para cumplir este requerimiento, Energía del Pacífico instalará una planta de 380 MW de capacidad en el puerto de Acajutla, departamento de Sonsonate, que utilizará gas natural, el combustible más limpio disponible para la generación de electricidad en plantas térmicas. Este emprendimiento brinda la oportunidad de introducir el gas natural, un combustible limpio, abundante y económico, en la matriz energética de El Salvador.

El inicio de la construcción del proyecto se ha programado para el segundo trimestre de 2015, una vez que se hayan obtenido todos los permisos necesarios, y para la operación comercial del mismo, el primer trimestre de 2018.

El emprendimiento que **Energía del Pacífico** instalará en el puerto de Acajutla consta de:

- Una terminal para la recepción de Gas Natural Licuado (GNL), adecuadamente dimensionada para la recepción de buques tanques y almacenamiento del producto. Los principales componentes de la terminal son:
  - Una unidad de almacenamiento flotante (buque tanque) que permanecerá anclada a un nuevo muelle a construir para el proyecto, cerca del actual muelle del puerto de Acajutla.
  - Un tanque de almacenamiento de GNL en tierra, para complementar el almacenamiento del GNL.
  - Una tubería para transportar el GNL de la unidad flotante a la unidad en tierra, y
  - Una planta de regasificación, para convertir el gas natural licuado a gas natural.
- Una planta de generación eléctrica de una potencia de 380 MW que operará con gas natural como combustible.

Para interconectar el proyecto a la red eléctrica nacional se requerirá de la construcción de una línea de transmisión de alto voltaje (230 kV), la cual está siendo desarrollada en otro proceso de evaluación que a su vez se encuentra interrelacionado con este proyecto.

ESTUDIO DE IMPACTO AMBIENTAL

Energía del Pacífico ha iniciado la evaluación de los posibles impactos ambientales, sociales y de salud que pudiesen producirse por el proyecto, mediante la presentación del Formulario Ambiental al Ministerio de Medio Ambiente y Recursos Naturales (MARN). A través de este proceso de evaluación de impactos ambientales se identificarán los impactos y se propondrán las medidas ambientales para minimizar los efectos negativos y potenciar los impactos positivos del proyecto. El proceso de evaluación ambiental dará como resultado un documento que cumplirá con los requerimientos de la legislación vade El Salvador. Adicionalmente, el documento cumplirá con las políticas ambientales, sociales y estándares del Banco Mundial. Se espera tener terminado el estudio de impacto ambiental (EIA) a finales de este año.

ACTIVIDADES DE CONSULTA CIUDADANA

Energía del Pacífico está comprometido a realizar las consultas pertinentes con las partes interesadas durante todo el proceso del EIA. Un plan de participación de las partes interesadas está en elaboración y el mismo incorporará actividades de consulta con el público, las comunidades, la sociedad civil y las agencias gubernamentales.

Energía del Pacífico instalará, dentro de 30 días, una oficina de consulta en la ciudad de Acajutla en la cual se brindará información sobre el proyecto, incluyendo el plan de participación pública que estará disponible para revisión de los interesados. Los detalles de la ubicación de la oficina y las horas de atención se darán a conocer posteriormente por este mismo medio.

Para obtener más información, pueden ponerse en contacto con el Departamento de Comunicación de Energía del Pacífico, de la siguiente forma:

Atención: Departamento de Comunicaciones de Energía del Pacífico S.A. de C.V.

Teléfono: 7840-9635 Dirección de correo electrónico: info@edp.com.sv

Source: Published in magazine "Fiestas Patronales Acajutla 2014", date June 06 to 15,l 2014.

Figure 8.9 – Advertisement from Communications Office

ENERGÍA DEL PACÍFICO, S.A. DE C.V.

PROYECTO DE GENERACIÓN DE ENERGÍA ELÉCTRICA

Aviso de apertura de oficina de información del Proyecto

Energía del Pacífico, S.A. de C.V., sociedad mercantil constituida por el Asocio ganador de la "Licitación Pública Internacional No. DELSUR-CLP-001-2012" convocada por DELSUR para el suministro de 355 MW de energía eléctrica a partir del 1 de enero de 2018, ha iniciado la evaluación de los posibles impactos ambientales, sociales y de salud que podrían derivarse del Proyecto de Generación de Energía Eléctrica a partir de Gas Natural Licuado (uno de los combustibles más limpios en la actualidad), el cual estará ubicado en el Puerto de Acajutla, departamento de Sonsonate.

En ese sentido, se llevará a cabo un "Programa de participación" que permita identificar los problemas, preocupaciones y oportunidades relacionados con las personas directamente afectadas por el Proyecto, así como con los actores locales involucrados en su desarrollo; por lo tanto y en aras de facilitar los canales de comunicación pertinentes, Energía del Pacífico, S.A. de C.V. ha abierto una Oficina de Información con el propósito que cualquier persona interesada en el tema pueda acercarse a la misma y conocer más acerca del citado Proyecto, así como de los beneficios que éste traerá al país.

Los datos de la oficina de información son los siguientes:
Dirección: Colonia RASA 1, casa #44, en la intersección de Calle Circunvalación y Pasaje Tres, ciudad de Acajutla, departamento de Sonsonate.
Horarios de Atención: De lunes a viernes, de 7:30am a 12m y de 1 a 5pm.

Asimismo, las personas interesadas pueden comunicarse a través de:
Teléfono: (503) 2452-6313.
Correo electrónico: blovato@edp.com.sv

Source: Energía del Pacífico

8.4.1.2 Communication Office Opening

The communications office will be officially opened on July 1, 2014, in the previous section, detailing the announcements published to inform the population of its opening (See Figure 8.9). This communications office was adequately equipped with the necessary material (posters, project summary, trifoliate and project presentations) as well as trained personnel to facilitate the communication channels between Energía del Pacífico, S.A. Of C.V. And anyone interested in the Project.

This office is open to the public in general so that anyone interested to know about the Project or with any doubts or concerns related to it, can get to express about it. Lcda. Brenda Lovato was assigned as the official responsible for this office, having extensive knowledge of the Project and criteria to attend any public consultation and follow up on the visitors concerns. She is also the person responsible for keeping a record of the most common visits and visitors, in Appendix 8F visitors report to the office until September 2014. It is worth mentioning that the communications office will be open to the public throughout the EsIA development and also during the Project construction and operation Phases. (See Photo 8.7)

Photo 8.7 – Communication Office

Source: Consultant's Own Elaboration, 2014.

8.4.1.3 Project's Website

Since July 2014 the project's website has been available, which contains information and updates. On this site, there are sections on the tender process, Project's description, natural gas generalities, environmental impact assessment process, community support and contact information. The the page image published to date is shown in Figure 8.10. The link to the website is http://www.energiadelpacifico.com/.

Figure 8.10 – Image of Project's Website in 2016

Source: website www.energíadelpacifico.com

8.4.1.4 Available Material

Various project materials information forms were prepared and made available to interested parties. To be able to explain the project properly through:

1. The project Summary ;
2. Trifoliate brochure;
3. Posters (in communications office);
4. The original project Model , which was then updated with new elements and changes (Available for assembly, phase 3); and
5. Various Presentations.

The first two are given to actors or people who request them and were distributed in different meetings, presentations, assemblies. The available materials are listed in Appendix 8E (See Photo 8.8).

Photo 8.8 – Model of the Project Presented in 2014[4]

Source: Consultant's Own Elaboration, 2014.

8.4.1.5 Telephone Line / Email

A telephone line and project e-mail were set up and advertised on the project announcements and other stationery. The phone line and website are available so people can and / or ask questions.

8.4.1.6 Presentation Meetings

The presentation meetings were held with government agencies such as the Acajutla Municipality, in an introductory manner and with the informing purpose about the Project to be developed, creating communication channels to obtain valuable information for the same, consult about Procedures related to the EsIA, as well as to determine their interest level. Photo 8.9 presents one of the image meetings.

They also helped in identifying the social actors (stakeholders) that should be taken into account for other consultation activities. Appendix 8G shows a detailed list of all the actors who were identified and contacted in some way or other in the activities in 2014.

Appendix 8H reports on the meetings and interviews conducted.

[4] *This image is from the model of the 2014 project, which has changed.*

Photo 8.9 – Images taken on the May 28 Meeting

Source: Consultant's Own Elaboration, 2014.

8.4.1.7 Stakeholder Control Mechanism

A recording mechanism was established for the r stakeholders. All comments received by telephone, email, correspondence and visits are entered into a control sheet. Depending on the nature of the question also the file is used to track the responses. To date, the majority of consultations have been related to job applications. See Appendix 8F.

8.4.2 Description of Phase 2: EsIA Consultation Activities (2014)

The activities carried out during phase 2 refer to various consultation actions as part of the EsIA development and were initiated in June 2014. During this phase the field work was carried out, qualitative data collection instruments application, previously prepared, such as interviews and workshops was completed. The following describes each activities types that make up this phase:

- **Consultation Preliminary Assembly**: A general assembly was held on June 5, 2014, to consult with different actors identified locally, whose main objective was to inform them about the project execution, obtain perceptions, opinions, suggestions and concerns. Community leaders, local institutions such as the naval force and health unit, local fishermen's cooperatives, municipal authorities, among others, attended this meeting. The attendance list and a report of what happened in said assembly are found in Appendix 8H.

- **Key Informant Interviews**: This activity consisted in interviewing several key informants in the territory. Amon those (community leaders, municipal council, health unit, school centers, churches, fishermen's cooperative), with the similar projects knowing past experience purpose referred to this Study, as well as to know their perceptions for project

"LNG TO POWER" that will be installed in the Acajutla municipality. An interview was conducted by a key informant.

The questions that were developed were open type and focused on collecting qualitative data that will reflect the experiences of those involved. The interview application lasted approximately 40 minutes to 1 hour. (See Appendix 8I).

- **Workshops:**The workshops correspond to meetings with specific smaller groups than those handled in the assembly-type meetings, especially aimed at collecting opinions from communities or groups identified as vulnerable or that could be affected in some way by the project. These included communities close to the project in an approximate 700m radius, women's groups organized by the women's unit, and the two local fishermen's cooperatives ACOOPPAC and ACPPRA (see Appendix **8J**).

Those workshops were held on July 9th, 11th, 17t and 30th, according to the following:

a) Workshops- July 9 and 11, 2014: They had the leader participation and leaders local communities The technique type development was focused on collecting qualitative data on the experiences that the communities have had with the plants and companies in the Acajutla municipality. The workshops lasted approximately 3 hours.

b) Workshop- July 17, 2014: A workshop held with women organized in the Municipal Gender Unit, where activities were carried out with the knowing purpose from the women perspective as the industries that operate in Acajutla, have positively or negatively impacted the municipality and its inhabitants. The workshop lasted approximately 3 hours.

c) Workshop- July 30, 2014: Conducted with the Acajutla two fishermen's cooperatives members participation, ACOOPPAC and ACPPRA. This activity sought to explain in detail the Project components, especially the pier location that could affect its fishing activities. Also doubts were cleared and explained to them

In the workshops, each participant was informed about the components of the "**LNG TO POWER**" project, the objectives, the citizen participation strategy and the activities programming that is considered as an indispensable mechanism to execute.

Subsequently, each community is given a cardboard in which you put the Projects positive and negative impacts already installed in the municipality and in the same way they were asked to put the new project perceptions. The same dynamic is applied with the women participating in the workshop. Finally, the opinions and perceptions were exposed by each one of the people involved.

All communities identified within the influence range mentioned in Table 8.4 were invited, however, not all of them attended the workshops. Table 8.10 defines the dates for each consultation activities carried out during phases 1 and 2, as well as a detail of the actors involved in each one.

Table 8.10 – Consultation Activities Summary with Local Actors (Stakeholders) Conducted During Phases 1 and 2 (2014)	
PARTICIPATING ACTOR (Stakeholder)	**Date**
PRESENTATION MEETINGS	
Acajutla City Council	May 19, 2014
Municipal Council of Acajutla, and CEPA	May 28, 2014
INTERVIEWS	
Proyección social (Social projection)	May 30, 2014
La Playa	June 11, 2014
ADESCO MAR	June 10, 2014
Zona Industrial	June 10, 2014
El Barquito	June 10, 2014
Alcalde municipal (Municipal mayor)	June 10, 2014
Turismo	June 28, 2014
Medio ambiente	June 8, 2014
ACOOPAT	June 10, 2014
Rederos y Langosteros	June 10, 2014
Unidad de salud	June 16, 2014
Seguro Social	June 18, 2014
Cruz Roja de Acajutla (Acajutla Red Cross)	June 18, 2014
AGAPE Acajutla	July 1, 2014
Centro Escolar Comunidad Alvarado	July 8, 2014
Colegio	July 8, 2014
Evangelic Church: Iglesia Santuario del Dios de Elías	July 8, 2014
Catholic Church	August 18 2014
WORKSHOPS	
Communities: Rasa 1, Ciudadela CEPA, Zona Industrial, ADESCO MAR, Barrio La Playa, San Roque, El Barquito.	July 9, 2014
Communities: La Obrera, Lotificación Alvarado, El Obelisco, Barrio Las Peñas, La Rasa 2, Colonias Brisas de Acajutla 1 y 2.	July 11, 2014
Women's organizations and the Municipal Women's Unit	July 17, 2014
Meeting with fishermen's cooperatives ACOOPPAC y ACPPRA	July 30, 2014
PRELIMINARY ASSEMBLY	
Community “La Rasa № 1”	June 5, 2014
Community “La Rasa № 2”	
Community Ciudadela CEPA	
Community “Zona Industrial”	
Community “Bendición de Dios”	

Table 8.10 – Consultation Activities Summary with Local Actors (Stakeholders) Conducted During Phases 1 and 2 (2014)	
PARTICIPATING ACTOR (Stakeholder)	**Date**
ADESCOMAR-Integrated by :	
Barrio La Playa	
Comunidad San Roque	
Comunidad El Barquito	
Comunidad La Obrera	
Lotificación Alvarado	
Comunidad Obelisco	
Barrio Las Peñas	
Colonia “Brisas de Acajutla 1”	
Colonia “Brisas de Acajutla 2”	
Representantes de La Alcaldía Municipal: Unidades de Proyección Social, Turismo, y Medioambiente	
Fuerza Naval	
Unidad de Salud de Acajutla	
ISSS de Acajutla	
AGAPE Sonsonate	
Cruz Roja de Acajutla	
Cooperativa de Pescadores ACOOPPAC	
Cooperativa de Rederos y Langosteros ACPPRA	

Source: Own Elaboration, 2014

8.4.2.1 Social Actors (Stakeholders) Phase 2 Consultation and Participation Results

The Project influence Area Existing Industries General Impacts Identification.

To better understand the main population concerns or concerns, and the environmental baseline current conditions, local stakeholders were consulted about their current and past experiences with companies or industries that have settled in area.

Based on the information provided by the actors involved in the project through information collection techniques such as interviews, workshops and meetings, the negative and positive impacts that according to the respondents could have been generated by the various plants and companies that were installed at some point in the influence project's area.

- **Negative Impacts Perceived by Local Actors (Stakeholders), of Existing Industries in the Influence Area of the Project**

The impacts mentioned below come from the general perceptions of the actors contacted and opinions expressed. In general terms, environmental pollution is a problem that people mention which have been generated by activities performed in various plants that have been installed in the municipality. These are understood as the noise generation, vibrations, dust, smoke, sea pollution and the increase and the diseases generation within the population. In this regard, the City Hall Social Projection Head mentioned in the interview: "*we cause serious environmental problems to the surrounding communities, for example pollution, noise, if you go out at night, the communities start to move to their houses and generate a hostile environment"*[5].

It was found that 18 of the 15 key informants interviewed, mention that environmental pollution is a problem that affects the municipality (see Table 8.11). The workshops, 4 communities were identified as a big impact ( ). In this sense, each negative impacts identified within the environmental pollution and others are described below.

Noise Generation

One of the negative impacts mentioned by the people participating in the qualitative collection information was the noise generation caused by the plants that are close to the communities located in the project influence zone. The work schedules in the plants are diurnal and nocturnal, being the noise provoked in nocturnal hours the one that generates greater displeasure and discomfort in the population because the sound is heard stronger and with greater intensity when comparing the noise during the day.

For this impact, the Industrial Zone Community Directors Board Chairman opinion was obtained. "*The complaints I have about people who live nearby is with respect to engines that buzz too much, there are people whose ears are bothered. We did not take into account all that was going to happen with the people who live there and they did not take us into account to inform us and they did not give us options, the people who live there are very poor and have had to move"*[6]. The Industrial Zone community is within the plants influence area that have already been installed in the Acajutla municipality.

Dust Generation

Another impacts mentioned by the various actors involved in the consultation process was the dust generation emitted by the transport of cargo to and from the plant and the port, which circulates in the

[5] Moisés Bonilla. Responsible for the Social Projection Unit of the Municipal Mayor of Acajutla. Interview with informant Key made on May 30, 2014.

[6] Nelson David. President of the Industrial Zone community, interview conducted on June 10, 2014

various central streets of the municipality. Likewise, the communities in workshops held with community leaders identify this impact. (See Table 8.11)

Smoke Generation

Among the environmental impacts mentioned by the population involved, the smoke emission by the plants stands chimneys, which according to the inhabitants causes and increases inhabitants health problems in the communities near the Project influence area. This impact is supported by the opinion emitted in the interview conducted by the Pastor of an Evangelical Church located in the Alvarado community: "*Some days a black cloud is generated, but this is a gas or chemical that companies emanate and thenan itch in the body can be felt. In addition, this has generated respiratory diseases in the community. This is what usually happens here. Companies do not compensate with anything, they only come and settle"*[7]

Likewise, for a community leader the problem in this area has increased, he mentions in this regard: *"If there have been problems with smoke emanating chimneys and pollution, saying that they have been solved is a lie. These complaints have been sent to the mayor, but no help has been sought"*[8]

Sea Pollution

Another negative impact generated to the environment according to the interviewees is pollution to the sea, relating to cleanliness in ships, whose wastes are deposited in the sea. In addition, this pollution increases when there are oil spills.

According to the Acajutla municipality Red Cross, this situation affects the entire population, due to the diseases increase, mentioned in this regard: *"Here in the village the most serious disease has been bronchitis and kidney failure. Due to ammonia, by 'soya castiga', a bunch of chemicals carried in gasoline, the waste is thrown to a stream by pathway route, this is polluting and what to is left in the water floats, they throw a detergent and sinks ruining the marine fauna"*[9]

In the workshops, 5 communities determine this problem as having a great impact (see Table 8.11).

Vibrations

Another impact according to the inhabitants are the vibrations caused by the different plants located in the Acajutla municipality and that specifically affects the communities close to them. The vibrations cause that the houses have damage in its infrastructure (windows, settling, electrical system-lightbulbs).

[7] Félix Aguirre, Evangelical Church Pastor, Santuario del Dios de Elías, interview on July 8, 2014
[8] Omar Esaú De la O. ADESCO MAR Community Leader, interview on June 10, 2014
[9] Rafael Martínez. Director of the Red Cross of Acajutla, interview on June 18, 2014

Added to this is the discomfort caused in the area inhabitants, especially during night hours when their sensitivity increases.

With regard to the problem, the opinion obtained by the Acajutla Red Cross director was: *"It is serious because it is psychologically annoying, the engines are strong for what the windows, the doors, the walls crack, so even if you are asleep that noise is already there. Where the Colonia IVU is located, La Obrera is felt and it is far away"*[10]

Likewise, this problem was identified by 5 actors involved from the 18 key informants who participated in the interviews. While 4 communities participating in the workshops identified it as having a major impact (+) (See Table 8.12)

Generation and an increase in diseases

Among the negative impacts that the actors involved mentioned in the information gathering process was the generation and diseases increase. Those diseases are related to negative impacts on the environment, such as respiratory diseases, skin allergies and the renal failure diseases increase.

In reviewing Table 8.11, it can be identified that 4 key informants mentioned that the generation and diseases increase is a problem affecting the municipality.

Specifically, a key informant considers that diseases affect vulnerable groups such as children and the elderly, the director of the Centro Escolar Comunidad Alvarado states in the interview: *"dust is affecting us because it causes us cough, it causes allergy in the skin. Many people have flu, cough, and for that reason, they do not come, constantly it causes us much allergy in the skin"*[11].

No local workforce is hired

Another of negative impacts mentioned by the actors involved in the study is that the companies that are located in the municipality require labor, whether unqualified, technical or professional. However, according to the population in the territory, the plants and companies hire employees who do not reside in the area. Therefore, this generates a negative impact because no income is generated within the place families, nor is contributing to the municipality development.

In addition, the population rejects this actions type because according to their opinions the companies that are going to be established in the zone, they commit themselves in meetings with the community and the municipality to hire local workforce, which does not happen.

[10] same.

[11] Israel Enríquez Tapas. Principal Centro Escolar "Comunidad Alvarado", interview on July 8, 2014

The priest of the Catholic Church, identifies why the companies do not hire local labor: "*the local labor has gone down because in the past the contract was made in CEPA and the union did it. Now it is done by a contractor and he is in charge to hire people for either gardening and all that, but there is also a second hand and this searches in other sites and has different interests. Since there were problems with the union, contractors are afraid to hire people from the municipality for what people coming is from outside. The workforce is specialized, and this affects the municipality in growing"* [12]

Affectation to Fishermen

Within the negative impacts identified by the actors involved is the area fishermen affectation. These are associated in two large cooperatives, one of them is the Asociación Cooperativa de Pescadores de Acajutla and fishermen called netters and LANGOSTEROS (lobster catchers).

The impact that the factories cause to those cooperatives are related to the restrictions that the maritime authorities establish. Hence, there is a specific zone where the fishermen can do their work. In this sense, the investment that they make to fish increases because they have to move to other areas in order to be able to fish.

Another negative aspect, according to them, is that ships when performing cleaning on the premises deposit the wastes in the sea and the oil spills that occur, causing pollution in the marine fauna, and therefore they are unable to sell their products.

In this regard, the president of ACOOPPAC states diring the interview: "*It has affected us negatively because of the sea pollution. Now we have to go more than 2 miles away to work. At first, there was no need because we had production on the coast. It's not the fishing boats at all, it's all the companies that have come to Acajutla who have affected because of the toxic that the companies that have come to Acajutla depose them into the sea, and this causes the marine fauna to die"*[13].

From their part, 4 of the 18 key informants interviewed identified this problem (see Table 8.11)

The Municipality Little Support for Social Works

A significant impact for the actors interviewed is related to the little or no support that companies offer to communities and the municipality in general. The social responsibility that manifests itself on the part of the companies is focused in a minimal way to the support sports, some holidays celebration , an access improvement, and a minimum investment in other areas.

According to the community's opinion, although the directives, School Centers and other local

[12] Silvia Estela Henríquez. President of the board of Directors El Barquito, interview on July 8, 2014

[13] Ricardo Napoleón Jovél. President Cooperativa de Pescadores "ACOOPAT", interviw June 10, 2014

institutions take the necessary steps with companies to support some social work, they do not receive a response to solve the problem that is affecting them. According to Table 8.11, communities identified it as a negative impact.
In this regard, the Principal of *"Colegio Católico de Acajutla"* states*: "A negative impact is that they really do not help, well these talking about this school, we have not received help from any company*"[14]

Next, a negative impacts summary table identified by the actors involved in the study is presented. It has been placed at each impact identified in the interviews conducted with an "X". One of the most frequently identified impacts is the little help that the communities and the municipality in general receive from the companies and plants that are installed in the locality. Another impact is environmental pollution in general.

[14] María Elvira Saravia Morales. Principal "Colegio Católico de Acajutla, July 8, 2014

Table 8.11 – Identification of Negative Impacts Perceived by Local Actors (2014)						
TYPE OF ACTOR/STAKEHOLDER	**ENVIRONMENTAL POLLUTION**	**VIBRATIONS**	**GENERATION AND INCREASE OF DISEASES**	**DO NOT HIRE LOCAL LABOR**	**AFFECTATION TO FISHERMEN**	**THERE IS NO SUPPORT TO SOCIAL WORKS OF THE MUNICIPALITY**
ALCALDÍA MUNICIPAL (City Hall)						
MAYOR						
RESPONSIBLE FOR SOCIAL PROJECTION	**X**					
RESPONSIBLE FOR TOURISM	**X**					
RESPONSIBLE FOR THE ENVIRONMENT	**X**	**X**	**X**			
COMMUNITY LEADERS INTERVIEW						
LA PLAYA Community	**X**					
ADESCO MAR	**X**				**X**	
EL BARQUITO Community			**X**	**X**		**X**
ZONA INDUSTRIAL Community	**X**	**X**				
COOPERATIVES OF FISHERMEN						
ACOOPPAC	**X**	**X**		**X**	**X**	**X**
REDEREOS Y LANGOSTEROS (netters and lobster catchers)	**X**	**X**			**X**	**X**
HEALTH CENTERS						
HEALTH UNIT						**X**
SEGURO SOCIAL	**X**					
ACAJUTLA RED CROSS	**X**	**X**			**X**	**X**
AGAPE SONSONATE	**X**		**X**			
EDUCATIONAL CENTERS						

Table 8.11 – Identification of Negative Impacts Perceived by Local Actors (2014)						
TYPE OF ACTOR/STAKEHOLDER	**ENVIRONMENTAL POLLUTION**	**VIBRATIONS**	**GENERATION AND INCREASE OF DISEASES**	**DO NOT HIRE LOCAL LABOR**	**AFFECTATION TO FISHERMEN**	**THERE IS NO SUPPORT TO SOCIAL WORKS OF THE MUNICIPALITY**
CENTRO ESCOLAR "COMUNIDAD ALVARADO"	**X**		**X**			**X**
COLEGIO CATOLICO DE ACAJUTLA	**X**					**X**
CHURCHES						
EVANGELIC CHURCH	**X**			**X**		**X**
CATHOLIC CHURCH	**X**					

Source: Own elaboration based on interviews with stakeholders, 2014.

The following is a impacts summary that are currently affecting communities, according to the people opinions in the workshops. Those results have prioritized based on the stakeholders' opinions involved in the workshops, in this case, the directors' boards members perceptions were obtained. Given the methodology applied in the workshops, it was possible to quantify the negative and positive impacts, according to the experiences and perceptions of the people participating in the workshops.

They have been identified as follows:

- Great Impact (+);
- Medium Impact (+/-); y
- Low Impact (-).

Applies both for negative and positive impacts generated by the companies that are installed in the Acajutla Municipality

The following are the negative impacts results (Table 8.12.)
The impacts that the involved actors mentioned in the workshops were the effects related to the environment, among them bad odor, air pollution, water and noise. Becoming the main problems that the inhabitants face in the communities bordering the plants influence. The average impacts are those that are identified +/-, such as the respiratory diseases generation, air pollution and cracks in houses generated by vibrations. Finally, the minor negative impacts are related to the dust generated by the transport of cargo not to control the night work schedules. (See Appendix 8J).

Table 8.12 – Weighting of Negative Impacts Perceived by Communities (2014)

COMMUNITIES	Environmental pollution	Vibrations	Cracks in households	Allergies on the skin	Respiratory diseases	Recruitment of non-local workforce	Affectation to fishermen	Does not support social works of the municipality	There is no control of working schedules	Smoke pollution	Water pollution	Bad odor	Dust	Air pollution	Noise
BRIZAS DE ACAJUTLA N° 1	+				+						+				
OBELISCO	+	+	+/-	+	+/-					+/-				+	
LA OBRERA		+									+	+			+
RASA N° 1		+									+	+/-		+	+
ADESCO MAR												+/-			+
LA PLAYA	+							+						+/-	
SAN ROQUE	-							+						/-	
COMUNIDAD ALVARADO	+	+				+/-			-				-		+
BENDICIÓN DE DIOS									-		+		-	+	
CIUDADELA CEPA											+			+	

Source: Own elaboration based on results of workshops carried out with boards of directors, 2014.

- **Positive Impacts Perceived by Local Actors, of Existing Industries in the Project Influence Area.**

The positive impacts generated by the plants in the project's area, according to the people interviewed and the workshops are summarized as follows:

Support to Social Works

The positive impacts mentioned by the actors involved is the support that some communities receive in social works such as: holidays celebration, scholarships, some access improvement to the community and in some cases that hiring local employees. It should be mentioned that all the actors involved in the interviews did not identify support for social projects. They consider that it is a positive aspect, but that there is a lot of bureaucracy to respond to requests and most of the time there is no social responsibility with the municipality. There are only specific activities in which they receive some type of support. The 18 actors interviewed, only 6 mentioned this positive impact (See Table 8.13., Similarly, only 1 community participating in the workshops of the 10 that attended identified this positive impact made by the companies that are in the municipality

Employment Opportunities

Another positive aspect that some interviewers mention is the employment generation of employment, plants and companies hire some inhabitants from the communities. However, there is a rejection by most of the people interviewed on the subject, because they consider that there is no social responsibility by companies to hire local labor and, if they are employed, amount of recruitment does not exceed to 10 people. Therefore, they consider that this number is not significant because of the affectation they generate to the municipality and to the nearby communities. This is supported by the fact that only 3 stakeholders interviewed identify this positive impact of the 18 key interviewees interviewed (See Table 8.13). Similarly, in the workshops held with the communities, only 2 of them mentioned it as a positive impact of lower weighting (-) that the companies do for the benefit of the communities, while 6 of the 10 communities do not identify any positive impact for communities (see Tables 8.13 and 8.14).

Table 8.13 – Identification of Positive Impacts Perceived by Local Actors /Stakeholders (2014)		
TYPE OF ACTOR	**Support in social works: introduction of drinking water, improvement of roads, support to sports, scholarships**	**Job opening**
MUNICIPAL MAYOR		
RESPONSIBLE FOR SOCIAL PROJECTION	X	
RESPONSIBLE FOR TOURISM	X	
RESPONSIBLE FOR THE ENVIRONMENT	X	X
COMMUNITY LEADERS INTERVIEW		
COMUNIDAD LA PLAYA		
ADESCO MAR		
COMUNIDAD EL BARQUITO		
COMUNIDAD ZONA INDUSTRIAL	X	
COOPERATIVES OF FISHERMEN		
ACOOPPAC	X	X
REDEREOS Y LANGOSTEROS		
HEALTH CENTERS		
UNIDAD DE SALUD		
SEGURO SOCIAL		
CRUZ ROJA DE ACAJUTLA		
AGAPE SONSONATE		
EDUCATIONAL CENTERS		
CENTRO ESCOLAR “COMUNIDAD ALVARADO”	X	
COLEGIO CATOLICO DE ACAJUTLA		
CHURCHES		
EVANGELIC CHURCH		
CATHOLIC CHURCH		X

Source: Own elaboration based on interviews with stakeholders, 2014.

The impacts identified as positive have been placed with an "X". These refer to the generation of jobs by the plants and companies, which promote higher income to the family group and better access to social services. However, there are a minimum number of people hired who belong to the locality, which does not compensate the social commitment of these companies with the community.

Another positive impact is the support to social works, such as support in celebrations, scholarships to students and improvement of communal infrastructure. Although the interviewed population considers that the companies do not carry out works of social responsibility, because there are very few plants that make some type of investment to improve the living conditions of the population.

These results have also been prioritized based on the opinions of the stakeholders involved in the workshops. In this case, the perceptions of board members were obtained. Below are the results.

Table 8.14 – Weighting of Positive Impacts Perceived by Local Actors /Stakeholders (2014)

COMMUNITIES	Introduction of water and lightning	Employment generation	Social work in schools	RASA provided support to communities	Scholarships and summer school	Non- identified positive impacts
BRIZAS DE ACAJUTLA N° 1	+/-	-				
OBELISCO						X
LA OBRERA		-				
RASA N° 1						X
ADESCO MAR						X
LA PLAYA				+		
SAN ROQUE				+		
COMUNIDAD ALVARADO	+		+		+/-	
BENDICIÓN DE DIOS						X
CIUDADELA CEPA						X

Source: Own elaboration based on results of workshops carried out with boards of directors, 2014.

The positive results that have been identified by the communities are manifested in the community social works carried out by the companies located in Acajutla. Those impacts are at a high (+) and a half (2) level, another positive impact is related to past companies experiences that supported community works (1). Likewise, half of the actors involved did not identify positive impacts generated by plants and companies located in the locality.

8.4.2.2 Negative and Positive Impacts Identification Perceived from the Gender Approach

The negative and positive impacts identified by the interviewees in the plants operating in the Acajutla municipality were also identified by women groups who participated in a workshop, with the considering purpose aspects that from the gender perspective are visualized in these participatory processes. In this sense, positive and negative impacts are described below.

- **Positive Impacts Perceived from the Gender Approach**

Support to communities:

According to the women participating in the workshop, the positive impacts are determined by the relative support that some companies and plants have given to certain communities in the Acajutla municipality. Within these stand out:

- Support for scholarships and sports;
- Building or improving access to communities;
- Drinking Installation water in communities; and
- Electric lighting in communities near the plants

These are considered as the most representative activities in social terms responsibility from the companies and plants in Acajutla. However, they consider that the support received is minimal and the demands made are many.

On the support issue for women did not identify any benefit for this population sector, even when they have made requests for support for various activities that develop in improvements in the women life quality and their families.

All those positive impacts were classified as average positive impacts (+/-). The following Table identifies the impacts mentioned by women, as shown in Table 8.15.

Table 8.15 – Weighting of Positive Impacts Identified by Women (2014)					
GROUPS OF WOMEN	**Support from ALBA PETROLEO in scholarships and sports**	**Construction of streets in the Alvarado community**	**Installation of drinking water**	**Electric lighting in communities adjacent to the companies.**	**Employment Support**
Opinions of women group No. 1	+/-	+/-	+/-	+/-	
Opinions of women group No.2	+/-				+/-

Source: Own elaboration based on results of a workshop with women, 2014.

Table 8.15 shows the average positive impacts (+/-) that women considered to be the most outstanding. For instance, the some companies support with scholarships for students in schools, as well as support for communities, like the streets construction , domestic water introduction, electric lighting and employment support.

8.4.2.3 The Social Actors Opinion Description/Stakeholders on the Project

Based on the information provided by the stakeholders involved in the collecting qualitative data process through meetings and workshops with communities, women and interviews with community leaders, it was systematized to identify positive and negative impacts which are considered to arise with the project implementation and are part of their concerns. These are described below.

- **Project's expected positive impacts by Local Actors/stakeholders**

The project advantages have been established through the population opinion participating in the study, highlighting the social, economic and environmental issues.

Social

In social terms, there is a tendency to consider, on the involved participants part , that the generation of this new project to be installed in Acajutla which will bring social development to the communities. This perception is manifested because according to the actors/stakeholders involved, it is the first time that a company that is about to settle in Acajutla takes into account the area population for suggestions, recommendations and considers to incorporate negative impacts that could be generated and by which could be affected.

In this regard a communal leader stated in an assembly: "*I had never been invited to a meeting and I am pleased that they invited me*"[15].

This perception is manifested in the various community leaders, women and fishermen's cooperatives. Even the Social Promotion Unit of the municipal hall Social Promotion head said: "*What you are doing right now is good, to take into account the population as people are assimilating it with the negative impact they currently have"*[16].

In general, the actors involved in the project see positively assemblies, meetings, workshops, interviews and all of activity kinds in which they are taken into account and listen to opinions and suggestions. This promotes that the population relied on the social responsibility that the company Energías del Pacifico will have with the project execution.

Among the social advantages that could be generated suggested by the population are highlighted:

- **Development Generating sources for youth and communities**: This impact was identified by 5 actors interviewed (See Table 8.16);
- **Technical specialization in the municipality Collaboration in the creation:** Through the technological institute construction to specialize young people who leave high school. 3 key informants participating in the interviews mentioned this positive expectation. (See Table 9);
- **Feedback to the local workforce to see if they are qualified**;
- **Social projects supporting community development**, Support for fishermen's cooperatives, support for communities and educational institutions. 11 informants from the 18 actors involved identified this impact. (See Table N° 9); and
- **Transparent social compensation It:** is expected from the stakeholders that EDP will transparently carry out the programs and projects that will be implemented as part of the company's social responsibility. Considering the needs of each municipality sectors.Table 8.16 summarizes the positive social impacts mentioned by key informants.

[15] Nelson David. President of the Industrial Zone community. Public consultation held on June 5, 2014

[16] Moisés Bonilla, Head of the Social Promotion Unit of the municipal mayor, interview conducted on May 30, 2014

Table 8.16 – Identification of Positive Impacts Expected by Social Actors/Stakeholders, 2014					
TYPE OF ACTOR	**Generation of employment sources for youth and communities**	**Creation of a Technological Institute**	**Training of the local workforce**	**Implementation of social works for communities, schools and the municipality in general**	**Transparent social compensation**
MUNICIPAL CITY HALL					
MUNICIPAL MAYOR	X	X			
RESPONSIBLE FOR SOCIAL PROJECTION				X	
RESPONSIBLE FOR TOURISM			X		
RESPONSIBLE FOR THE ENVIRONMENT				X	
COMMUNITY LEADERS INTERVIEW					
COMUNIDAD LA PLAYA	X	X	X	X	
ADESCO MAR				X	X
COMUNIDAD EL BARQUITO					
COMUNIDAD ZONA INDUSTRIAL				X	
COOPERATIVES OF FISHERMEN					
ACOOPPAC				X	
REDEREOS Y LANGOSTEROS (netters and lobster catchers)					
HEALTH CENTERS					
UNIDAD DE SALUD				X	
SEGURO SOCIAL				X	
CRUZ ROJA DE ACAJUTLA				X	
AGAPE SONSONATE	X				
EDUCATIONAL CENTERS					
CENTRO ESCOLAR “COMUNIDAD ALVARADO”				X	
COLEGIO CATOLICO				X	

Table 8.16 – Identification of Positive Impacts Expected by Social Actors/Stakeholders, 2014					
TYPE OF ACTOR	**Generation of employment sources for youth and communities**	**Creation of a Technological Institute**	**Training of the local workforce**	**Implementation of social works for communities, schools and the municipality in general**	**Transparent social compensation**
DE ACAJUTLA					
CHURCHES					
EVANGELIC CHURCH	X	X			
CATHOLIC CHURCH	X				

Source: Own elaboration based on interviews with stakeholders, 2014.

In the previous Table, the positive social impacts that are expected to be carried out with the project execution stand out, mainly the social works implementation for the communities and the municipality, 11 of the 18 interviewees identified it. Following the employment sources generation for the local population, with 5 convergent opinions.

Economic

In the economic aspect, the population considers that with the installation of the " Energy Generation" project, the job opportunities will be improved for the municipality inhabitants. Especially of the surrounding communities, due to the job offer that is generated, even when The workforce is or is not qualified, although they consider that in the municipality there are professionals capable of developing the activities required by the company in the construction phase and the project operation. In this regard, during the interview with the Evangelical Church Pastor located in the community Alvarado he expressed: "*There are several young people here prepared in high school few have become technicians and they are better prepared. there is good workforce, but it needs to be technified"*[17].

Another positive aspect that is visualized is the economic development that will face the municipality with the investment that will be carried out in the territory. The Acajutla Health Unit Director said during the interview: *"Many people will be hired, even in the lifting of infrastructure, many local people will have jobs so those are great advantages. They will generate dynamism to the local economy, and will generate employment for those who work in the generation of energy and generating taxes to the mayor who indirectly helps us"*[18]

[17] Félix Aguirre. Pastor, Iglesia Santuario del Dios de Elías, interview on July 8, 2014

[18] Carlos Javier Villa Fuerte, Director, Unidad de Salud de Acajutla, interview on June 16, 2014

Within the positive impacts in the economic area that were mentioned in 2014, the following were highlighted:

- Cheaper electricity for the municipality and for the country;
- Take into account young people who are professionally prepared, there is a local workforce that only needs to be technified;
- The employment sources Generation for the municipality inhabitants;
- Income Generation by taxes means that will be paid in the municipal mayor's office; and
- The Municipality Economic development.

Environmental

In the environmental aspect, there is a positive perception that power generation is made with a less process polluting the environment in comparison with other companies that generate energy with liquid fuels. In this case, we obtained the responsible opinion for AGAPE Sonsonate community promoters area . He dimensions this project as something positive: *"The generation of energy in a natural way without creating so much pollution and this would be for a long time, and it seems attractive start to bet on another way to survive without continuing to pollute the environment*"[19]. Moreover, this same perception was identified with the other actors involved in the project, because they consider that the process for the energy generation will be more environmentally friendly.

Among the environmental approach positive impacts , the following stand out:

- Reforestation is expected to occur in the municipality and in areas that the municipality considers relevant;
- Clean electric power generation; and
- New energy generation form.

In the workshops carried out with the communities that are located in the project influence area and with women groups, the same positive impacts were identified that the other stakeholders mentioned about the project execution, being highlighted in detail in the Table 8.17.

Table 8.17 – Identification of Positive Impacts Expected by Communities in 2014[20]

COMMUNITY	POSITIVE IMPACTS
BRISAS DE ACAJUTLA N° 1	- Participation of communities - The municipality natural resources Care - Jobs Generation - Less environmental pollution.

[19] Dra. Morales, Responsible for the area of community promoters of AGAPE Sonsonate, interview on July l 1, 2014

[20] These opinions were expressed en 2014.

Table 8.17 – Identification of Positive Impacts Expected by Communities in 2014[20]	
COMMUNITY	**POSITIVE IMPACTS**
OBELISCO	- Jobs Generation -Lower electricity prices -Helps communities in some projects
LA OBRERA	-Cheaper energy cost -Generation of more jobs -Citizen participation
RASA N° 1	- Jobs Generation -Enhanced investment in energy infrastructure - Cleaner energy Generation
ADESCO MAR	- Less pollution will occur -Employment generation -Help in trade
LA PLAYA	-More development to the municipality -Opportunity in works to the community -Citizen participation - Employment Sources
SAN ROQUE	- Employment Sources -Opportunity in works to the community -Citizen participation
COMUNIDAD ALVARADO	-Generation of taxes for the mayor's office -More investment for the country -Generation of cleaner energy-Social responsability -Generation of jobs for people in the municipality -Less operating hours per day
BENDICIÓN DE DIOS	-Planting trees to respond to deforestation - The generation of employment for citizens - Collaboration with different colonias for the development
CIUDADELA CEPA	-Planting trees to respond to deforestation - The generation of employment for citizens - Collaboration with different colonias for the development
IDENTIFICATION OF POSITIVE IMPACTS BY WOMEN	
OPINIONS OF GROUP N ° 1 OF WOMEN	- To take into account the female sector throughout the project - cheaper energy - Improvement of roads - Less pollution to the environment

Table 8.17 – Identification of Positive Impacts Expected by Communities in 2014[20]	
COMMUNITY	**POSITIVE IMPACTS**
OPINIONS OF GROUP N ° 2 OF WOMEN	- Lower costs in the electrical energy are expected - Take into account the female skilled labor sector - The hiring of personnel based in gender equity - Take into account the ability of women to perform their work in the municipality - The new company hires personnel with good performance although they haven't attended college.

Source: Own elaboration based on workshops with community leaders and women's groups, 2014.

The positive impacts identified by the stakeholders involved in the workshops are related to social aspects such as participation and communities' development and other local actors. This impact was reported by 8 communities of the 10 participants. In economics terms, positive aspects are mentioned such as the employment sources generation for the municipality inhabitants. Within this impact was obtained information from the 10 communities participating in the workshops who mentioned it. Cheapest energy costs at national and municipal level was highlighted by 3 communities from the 10 attendees to the conference. In environmental issues terms, the population expects better activities control to reduce pollution and that the company promotes activities such as planting trees in the municipality which was identified by 4 communities.

As for women, they expect to be considered in hiring and to be trained, because the companies and factories that are established in the municipality have not considered their needs. In the same way, they expect the company to implement appropriate measures to avoid generating more environmental pollution. Economically speaking, that energy is cheaper and as the social aspect, it was said that it is important to promote the communities participation in the process.

- **Negative Impacts that Distress Local Actors/Stakeholders in Relation to the Project**

The population participating in the consultation process has identified the possible negative impacts to be produced by the project, in their opinion. These potential identified impacts are described below.

Affectation to Fishermen

Within the negative impacts identified by the actors involved the impact that the dock creation will generate the area fishermen was mentioned. According to the fishermen, the project construction will increase fuel costs, because they will have to travel more miles to be able to fish in areas suitable for the activity, and some also expressed they are already fishing in the area where the dock's construction is

planned. They mentioned: "*There will be a modification of the exit route from the dock for the fishermen, this entails, the reduction of fishing areas"*[21].

Environmental pollution

Some actors identify environmental pollution in general as a potential impact. Are the municipality Red cross presentative, supported this perception: "*The noise caused, and the smoke generated by the plant, will affect the communities nearby*"[22].

Likewise, 10 actors involved, of the 18 participants in the interviews identified this impact. (See Table N ° 10). To know the impacts in detail, they are described below:

Increase in Air Pollution

One of the negative impacts identified by the actors involved in the project is air pollution. This situation according to people living in the influence area , will increase and will generate other consequences, such as respiratory diseases and allergies in the skin which are currently the most common in the municipality. In this regard a community leader believes that "*All kinds of product contamination from the plant because the community is in the industrial zone, it must be the chemicals that produce bad odor*"[23]. This opinion is supported institutionally by AGAPE, which carries out different actions in the health area with the area communities. "*The environmental impact, the living conditions of the population, because, believe it or not, there are always releases gasses, it has to be seen which gasses, to which levels, and how toxic and harmful can be for the population*"[24]

Vibrations Increase

The vibrations increase becomes another negative impact identified by the involved actors. This perception is related to the activities that the company will carry out in the Project operation phase. At the moment, the vibrations in the communities bordering to factories, like community Alvarado and Industrial Zone, are sensible during the day, increasing in the night working shifts.

Noise increase

The increase in noise is related to the activities carried out by companies and plants. The involved actors perceive that with the project construction there is a noise increase risk , generating auditory problems in the surrounding communities inhabitants. Institutions such as the Acajutla Red Cross perceive this impact. *"The noise caused and the smoke generated by the plant, will affect the communities nearby the*

[21] Ricardo Napoleón Jovél. President, Cooperativa de Pescadores "ACOOPAT", interview on June 10, 2014
[22] Rafael Martínez. Red Cross Director de Acajutla, interview on June 18, 2014
[23] Nelson David. President, Comunidad Zona Industrial. Public consultation held on June 5, 2014
[24] Dra. Morales, Responsible for the area of community promoters of AGAPE Sonsonate, interview on July 1, 2014

Red Cross"[25]*.*

Increase in Marine Water Pollution

The seawater contamination is a problem that could be generated by the waste and sewage discharge in the sea when the cleanings are carried out. In addition, this situation is increased with the possible spills.

The air pollution impacts, increased noise and vibrations were identified by 5 stakeholders who were interviewed. Meanwhile, 6 of the 18 key informants did not identify any negative impacts to be generated by the power plant. (see Table 8.18).

The following Table highlights the potential negative impacts identified by the different actors involved in interviews with key informants.

The impact with greater opinions in this regard is the increase in environmental pollution, 10 of the 18 interviewees identified it. This situation indicates that the environmental pollution issue is a problem that concerns the Acajutla municipality population, due to the plants quantities and companies that are in the locality. Followed by two negative impacts, first the impact increase that the fishing sector will face with the construction of this project, because they will be limited the influence area for fishing. Moreover, the second impact referring to increase noise, dust, and smoke. Both impacts were identified by 5 key informants from the 18 respondents.

The following Table 8.18 shows the negative impacts identified by the actors/stakeholders involved.

[25] Rafael Martínez. Director, Red Cross Acajutla, interview on June 18, 2014

Table 8.18 – Identification of Negative Impacts Concerning Local Actors/Stakeholders in Relation to the Project (2014)								
TYPE OF ACTOR	**Environmental Pollution (Water)**	**Do not give support to the communities**	**Increased noise, dust and smoke**	**Non-recruitment of local workforce**	**Affectation to fishermen**	**Generation of diseases**	**Poor quality control for workers**	**I do not identify negative impacts**
MUNICIPAL CITY HALL								
MUNICIPAL MAYOR								X
RESPONSIBLE FOR SOCIAL PROJECTION, CITY HALL	X	X						
RESPONSIBLE FOR TOURISM, CITY HALL	X							
RESPONSIBLE FOR THE ENVIRONMENT, CITY HALL	X		X					
COMMUNITY LEADERS INTERVIEW								
COMUNIDAD LA PLAYA				X	X			
ADESCO MAR	X				X			
COMUNIDAD EL BARQUITO	X	X			X			
COMUNIDAD ZONA INDUSTRIAL	X		X					
COOPERATIVES OF FISHERMEN								
ACOOPPAC	X				X			
REDEREOS Y LANGOSTEROS	X				X			
HEALTH CENTERS								

Table 8.18 – Identification of Negative Impacts Concerning Local Actors/Stakeholders in Relation to the Project (2014)								
TYPE OF ACTOR	**Environmental Pollution (Water)**	**Do not give support to the communities**	**Increased noise, dust and smoke**	**Non-recruitment of local workforce**	**Affectation to fishermen**	**Generation of diseases**	**Poor quality control for workers**	**I do not identify negative impacts**
UNIDAD DE SALUD								X
SEGURO SOCIAL								X
CRUZ ROJA DE ACAJUTLA			X				X	
AGAPE SONSONATE	X		X	X				
EDUCATIONAL CENTERS								
CENTRO ESCOLAR "COMUNIDAD ALVARADO"								X
COLEGIO CATOLICO DE ACAJUTLA			X					
CHURCHES								
EVANGELIC CHURCH								X
CATHOLIC CHURCH								X

Source: Own elaboration based on interviews with stakeholders, 2014.

Those impacts were also identified in workshops held with community leaders and women's groups. As can be seen in Table 8.19, the negative vibrations impact and noise is mentioned, which were mentioned by 5 communities of the 10 participants in the conference, followed by the air pollution increase that was identified by 4 communities and the contamination/pollution that was perceived by an equal communities number.

For their part, the women participating in the workshops carried out emphasize that the municipality is not prepared in the attention area to emergencies caused by the companies or plants that are installed in the locality. Therefore, they consider that this situation could be increased if the Company does not create alternative care in emergency cases , either of natural cause or generated by operations.

Table 8.19 – Identification of Negative Impacts Concerning Communities in Relation to the "LNG To Power" Project (2014)

COMMUNITY	NEGATIVE IMPACTS
BRISAS DE ACAJUTLA N° 1	-Impact on natural resources - Risks in health -Noise pollution -Destruction of flora and fauna
OBELISCO	-Environmental pollution
LA OBRERA	- More contamination by residual waste - Increased air pollution - More noise and vibration
RASA N° 1	-More contamination by residual waste - Increased air pollution - More noise and vibration
ADESCO MAR	DO NOT IDENTIFY NEGATIVE IMPACTS
LA PLAYA	-Air pollution
SAN ROQUE	-Air pollution
COMUNIDAD ALVARADO	- Vibration and noise -No afforestation program - More pollution
BENDICIÓN DE DIOS	- Communities affected by vibrations - Possible impacts on fishing - Spills in the ocean
CIUDADELA CEPA	- Communities affected by vibrations - Possible impacts on fishing - Spills in the ocean
IDENTIFICATION OF NEGATIVE IMPACTS BY WOMEN	

Table 8.19 – Identification of Negative Impacts Concerning Communities in Relation to the "LNG To Power" Project (2014)	
COMMUNITY	**NEGATIVE IMPACTS**
WOMEN GROUP N ° 1 OPINIONS	- Noise Generation - Risks in health - Not having the capacity to treat an emergency on time and to suffer a catastrophe
WOMEN GROUP N ° 2 OPINIONS	-Environmental pollution - Affectation to artisanal fishermen

Source: Own elaboration based on workshops with community leaders and women's groups, 2014.

8.4.3 Phase 3 Description : Public Consultation for EsIA (2014)

The phase 3 objective is to present to the population the progress on the environmental impact assessment. It is also intended to seek the ideas consensus of all the participants in relation to the critical areas identification, potential environmental and social impacts and proposals for prevention measures, mitigation and compensation to identified impacts. The activities, which were carried out in the draft EIA, are described below. Those activities were adjusted according to the contributions received during phase 2.

a) Presentation to the City Hall and its Council:

On October 13, 2014, the EsIA results were presented to the City Hall, prior to the public assembly. The event was organized and carried out with the consulting firms technical support specialists for the EsIA development, Eco Ingenieros and Dillon Consulting, as well as the EDP team staff; and

b) Public Assembly:

On Saturday, October 18, 2014, an open general public meeting was held at the Acajutla high school facilities. Identified social actors/stakeholders from Acajutla and the general public were invited to present the EsIA draft results . The event was organized and carried out with the technical specialists of the consulting firms technical specialist support for EsIA, Eco Ingenieros and Dillon Consulting, as well as staff from the EDP and Wärtsilä team, and was attended by an observer representative from IFC (World Bank).

The Pre-Consultation Public Assembly was publicized in the following way:

- ***Direct invitation:*** For the Assembly development, local cooperatives, schools, churches, as well as representatives from health unit, Social Security, Red Cross, NGOs, women's organizations

and all the actors who participated in the various previous activities performed for the study were invited; and

- ***Public invitation:*** In the same way, announcements were made in various local media, such as ACAXUAL radio, banners to be placed in the project communication office, municipal mayor's office, parks and places with a population concentration.

In Appendix 8K, the direct invitations made copies , posted posters photographs, publicized radial wedge, event agenda, attendance list, material copies delivered and presentation made during the event, as well as photographs, Interviews videos during the interview.

The public assembly was developed as shown in Table 8.20.

Table 8.20 – Activities of the Assembly 2014
• Reception and guests registration
• Introduction & Purpose for the meeting
• Presentation on the generalities of the Project and Timeline
• Process to obtain environmental permission • Presentation of environmental baseline found in Acajutla • Potential impacts and mitigation measures
• Project's Benefits • Social Porjects • Next Steps (Work Shedules)
• Questions/ Answers. • *(PLEASE WRITE YOUR QUESTION ON THE SHEET GIVEN AT THE BEGINNING AND DELIVER TO ANY OF THE AIDES DURING THE EVENT)*
• Space Open to the Public- Tour to see the model and images of the plant, snack

Source: Own Elaboration, 2014.

As mentioned, this phase consisted of two major activities. First a presentation on the Environmental Impact Study progress to the City Council and, secondly, an Open General Assembly to the general public, where all interested social actors/stakeholders were able to advocate. The following describes the results of each events, together with opinions and concerns expressed during such events.

8.4.3.1 EIA Advances Presentation description meeting to the Acajutla City Hall

Participants openly shared their views, comments, proposals and consultations on the project actions.

Opinions and suggestions were made on the following project aspects:

- What measures will be implemented to solve the problems faced by the fishermen with the project, not being able to fish in the areas destined for such activity;
- It is appropriate to hold briefings with all fishermen, not only with the cooperatives representatives, in order to explain to them the conditions under which the project will be carried out and the solution mechanisms to be implemented so as not to be highly affected;
- Explain to fishermen about the projects to be implemented in the company Energía del Pacífico social responsibility issue and the compensation measures to be implemented as part of the results obtained in the EsIA;
- Train fishermen on the various mechanisms to be implemented as part of the compensation measures for this sector;
- In the meetings that are suggested to be carried out with the fishermen, the city hall aldermen considered relevant that both the Social Investment Fund for Local Development (FISDL) and City Hall shall be present, with the objective of making the pertinent coordination among the institutions;
- As far as the social investment fund is concerned, it is important to work jointly among the public institutions involved, because the procedures in FISDL are characterized by being bureaucratic or complex by all the requirements that are requested for the Projects execution, which will streamline each of the actions to be carried out; and
- The City Council suggests the of the Mayor's office Environmental Unit involvement to follow up on each of the projects that will be carried out.

Some of the responses provided by ECO INGENIEROS regarding the compensation measures referred to fishermen's cooperatives were (Intervention of marine biologist Oscar Molina):
“Information and consultation meetings have been held with cooperatives and independent fishermen, options have been presented on the compensation measures to be implemented under the project, within which can be mentioned:

- Elaboration of project profiles, suggested by fishermen's cooperatives;
- tilapia hatcheries;
- Shrimp farming near the Sensunapán river;
- “Winche” improvement; and
- Restoration of the salted forest (Suggested by Environmental Unit)”.

Answers given by Energía del Pacifico (Mario Ayala):

- "With regard to the projects execution that will be carried out as part of the company social responsibility, the Municipal City Hall is the one that prioritizes in the project profiles pertinent to the population needs and in the case, for the Fisherman cooperatives;
- The Projects execution will not only be carried out through works reflected in infrastructure, but in scholarships, training and others; and
- The various institutions participation in the meetings that will be carried out in the process will be taken into account, for it will have several mechanisms of communication and citizen participation during the various project phases".

Below is a photographic activity record, Photo 8.10.

Photo 8.10 – The Esia in the Mayor's Office Advances Presentation Meeting Images

Source: Own Elaboration, 2014.

In the previous images you can see the Architect Leonora Ferrer, with the consultant technical in charge of the EsIa development, is detailing the progress made. To the right, a wider view of all the attendees.

8.4.3.2 The Public Assembly for the EsIA Progress Presentation Results

The event managed to convene the following local actors/stakeholders:

- City Hall;
- Local Communities;
- Public Health Centers;
- Educational Centers;
- Fire Department;

- National Civil Police;
- Churches;
- Cooperatives of fishermen, netters and lobster catchers; and
- Among other actors involved (See full list of assistance in Appendix 8K).

The participants submitted their comments, doubts and suggestions regarding the preliminary results obtained in the EsIA related to the project. Regarding the Environmental Impact Study, they were explained the identified impacts, as well as the compensation measures established to minimize the damages generated with the project implementation.

Participants openly shared their views, comments, proposals and consultations on the project. Opinions and suggestions were made on the project aspects presented in the Table 8.21.

Table 8.21 – Opinions and Suggestions Delivered During the Assembly in 2014, Sorted by Theme			
N°	**Question or Comment**	**Institution or place coming from**	**Answers provided**
Fishing Sector			
1	What will happen with the artisanal fishermen of the sector, mainly with the Lobster catchers?	Acajutla	It is working with all fishermen productive projects, even talked about the implementing jobs possibility within the plant to be directly affected by the project. Train them in productive projects, lobster and tilapia cultivation. All this is being worked, and the project type to be implemented has not yet been defined. However, that is the objective, not to affect them and if there are some independent fishermen they can approach the social communication office.
2	The Acajutla zone oyster fishers. We have a certain restlessness because we hoped that the project will be constructed in work field that we perform. Since we do not have a cooperative, nor anything because we are independent workers, because we are very few and we work in the place. We are only 5, and we are afraid that we will not be able to work there. Hopefully, they will take us into account for the project development. Excellent for the industry of our city.		
3	We are the oyster fishers, we live there, we need a job to survive, we have problems with this project, we hope it does not affect us. I'm just talking about the oyster fishers		
Social projects			
4	We need a bigger Social Security to give more assistance to the insured people. Also, a closer public hospital for the entire population to give them medical assistance so they do not have to travel to Sonsonate	Col. Los Laureles, calle principal	The projects will not only be annual. They will be implemented in two-three years. They will benefit diverse sectors. For example, if they have needs, any cooperative or community in particular with water or electricity service or any other basic service or park construction or something. They can approach the mayoralty; they are already working on that. The needs can be incorporated in the strategic plan and so will be approved. Energía del Pacifico will be in charge of its programs execution that can also be educational in nature. I understand that the mayor's office already has a
5	Education projects should be for government institutions, as for private institutions, such as the Acajutla school	Col. San Emilio	
6	In case of a serious emergency, how would they help each community?		
7	The project is very good, excellent. In the event of a major emergency, what organization will support Energías del		

Table 8.21 – Opinions and Suggestions Delivered During the Assembly in 2014, Sorted by Theme			
N°	**Question or Comment**	**Institution or place coming from**	**Answers provided**
	Pacífico?		scholarship program, then we can also contribute with this to Ensure that the personnel hired in Acajutla will have the technical academic knowledge to be able to be part of the construction or operation plant phase. Regarding the female sector, of course, they will be taken into account, as long as they take the respective channels, in this case, the mayor's office and the FISDL. As we execute the works that they are going to approve. These benefits are for the following 23 years beginning from 2015.
8	Since we have the mayor at this time, I want to ask what is the possibility to have a bridge that joins El Milagro with Colonia Los Laureles?	Acajutla, col. El Milagro	
9	Is there a strategic plan for the Port of Acajutla?	Cuerpo de Bomberos de El Salvado, Sonsonate	
10	What benefits will we the elderly have?		
11	What is is or will be the social scope for the population?	Barrio Las Peñas y col. El Barquito	
12	Would there be social projects aimed to support schools and the community in general?	Centro escolar “Col. Alvarado”	
13	The establishment of the plant, will it have a direct impact and investment in the communities of the port of Acajutla? Bearing in mind that Acajutla is very poor, even though there are other plants?	Iglesia Bautista “Tabernáculo de Dios con los hombres”	
14	To present the projects, is there some format like Casa de la Cultura where we can present projects? Projects will be infrastructure or intangible culture?	Casa de la Cultura	
15	For approval of projects in the municipality, with the resources of Energía del Pacifico, they only have to be seen by the City Council and FISDL, because they do not include members of the ADESCOS to discuss these projects	ADESCOMAR	
16	All projects are good for our country	Zona Industrial	
17	How education will benefit in the city of Acajutla?	Col. San Emilio	

Table 8.21 – Opinions and Suggestions Delivered During the Assembly in 2014, Sorted by Theme			
N°	**Question or Comment**	**Institution or place coming from**	**Answers provided**
18	The municipality of Acajutla has much to do, such as street repair. There are colonias that need introduction of potable water	Col. Ciudadela CEPA, Acajutla	
19	Projects we need: introduction of drinking water, mini park, communal house, electric lighting	Com. Zona Industrial	
20	What will be the social relationship with the communities surrounding the Project?	Barrio La Playa, comisión comunal de Protección Civil	
21	Seeing the future, after the 20 years of the contract won by Energías del Pacífico, the benefits that have been raised today, will continue or will end then?		
22	What benefits does Energías del Pacífico offer when the plant is in operations in the communities of Acajutla	ADESCO MAR	
Cost of electric power			
23	Energy is one of the most expensive things we have. Will cost lower with new power generation plant?	ADESCO MAR	The entity that sets the prices is the SIGET. It does not depend on EDP. However, as the government entities say, a lower energy cost is expected, but as I explained, it does not depend on EDP.The energy will be delivered to the national network, they will be in charge of delivering them throughout El Salvador, it is expected that the costs will be reduced. As one of the benefits, natural gas is cheaper than the rest of the fuels that exist in the market. It is expected that the cost of generation will be cheaper and this price will be translated into invoices. One of the objectives of the project is the underselling of energy.
24	The use of natural gas will influence the rate of electric power?		
25	Is it projected how much will be the percentage of decrease in the electric bill?	Barrio La Playa, comisión comunal de Protección Civil	
	Operation of the Power Plant		
26	When does the project start?	Col. El milagro	
27	In what part of the world does this type of plant works? What have the pro's and con's been?	Col. Los laureles	

Table 8.21 – Opinions and Suggestions Delivered During the Assembly in 2014, Sorted by Theme			
N°	**Question or Comment**	**Institution or place coming from**	**Answers provided**
28	For when it is projected the starting the construction of the plant? Will green areas be reforested near the industrial zone?	Comunidad Alvarado	
Mitigation and risks			
29	If our homes end up damaging who will be responsible? What is the work and safety plan for the workers, and what benefits does the company offer?	Brisas de Acajutla	Energia del Pacifico is interested in safeguarding its employees, it will install a plan against accidents and the handling of the same, both in the construction stage as in the operation stage. Safety plan. We, independently of the internal manuals that we might have for our operation, there are other manuals that do not depend on us, I think that is already the responsibility of CEPA. The communication office of the project is located. With regard to the damages that the project could cause to housing, compensation will be given if that is the case. We are also working done and meetings have been held with the fire brigades for any situation that can be generated; which we hope will not happen due to all the safety measures that will be implemented in the plant. Plant requirements have been investigated to ensure that all safety mechanisms are in place for any emergency. This study is the one in process, but if it is been taking into account all the international requirements that apply for this type of projects. The study is being carried out to ensure that there are the
30	If our homes end up damaging who will be responsible? What is the work and safety plan that they have for the workers and what benefits does the company offer?	Col. San Julián	
31	What will they do to minimize noise in neighboring communities and how will they ensure that this will not have an environmental impact in the future? What would happen on our shores?	ACOOPPAC- Acajutla	
32	The communities close to the project, in case of deterioration in their homes, Energías del Pacífico will act in solving their problems?	Col. Brisas de Acajutla	
33	We need a fire station to serve communities at all times, as well as factories	Com. Zona Industrial	
34	Besides planting 10 trees per tree chopped off, many trees would be planted? Regardless of how many trees are cut and according to the capacity of the land. Trees will only be planted or would be given protection and care necessary until they root?	Bomberos de Sonsonate	

Table 8.21 – Opinions and Suggestions Delivered During the Assembly in 2014, Sorted by Theme			
N°	**Question or Comment**	**Institution or place coming from**	**Answers provided**
35	If in the future if a worker or citizen will develop a disease, what would you do to help?	Col. El barquito	minor impacts possible within the communities. If a natural event occurs, that is out of the company's activities; of course we have a liability policy with third parties for such events. We will compensate the people who result affected. The measures that have been taken to measure the effects of noise, are the installation of silencers of our equipment. The design of the plant also considered putting the engines, which are the ones that produce more noise, in the southern area of the ground, farther away as possible from households. By doing this, it has been achieved that the levels of annoying noises do not enter the housing zone, but to remain in the industrial area. In relation to the trees we are required to plant and care for the trees, it has to be properly maintained and required by the Ministry of the Environment. A plan of planting will be implemented, in case someone wants to plant trees.
36	In case of fire, the chain reaction with other companies is considered? Will they have a fire system, and fire trucks?	Col. Rasa	
37	How to control whether the methods designed for development and construction will be as presented? For example if the trucks do not pass through the city	Ministerio católico de comunicaciones y evangelización	
38	In case of a natural disaster, which preventive measures are to be taken so that the project and workers are not affected?		
Natural gas			
39	Which home appliances can be used with natural gas, and how is it going to be sold?		Natural gas is found in deposits in the earth. It is associated with the same oil deposits. It is composed mainly of methane gas. The benefits are related in that it is a cleaner gas, equipment gets less dirty, lasts longer, less emission to the atmosphere are generated. It does not have particles that
40	Will natural gas be exported, or will it be exploited in the country in the future?		

Table 8.21 – Opinions and Suggestions Delivered During the Assembly in 2014, Sorted by Theme			
N°	**Question or Comment**	**Institution or place coming from**	**Answers provided**
41	What kind of material is natural gas?	Col. El Milagro	generate smoke, it is economic, and it can be transported compressed or frozen. It can be stored in large quantities on ships, so that helps to lower its price for the operation and this material has been used all around the world. In other countries, it is not only used as a generator of energy, but it is also used in stoves, in heating as heaters.
EMPLOYMENT			
42	We want women to be given the opportunity to work, if we can work. We want to work to get the family going		Within the job opportunities, everyone can participate and approach our office to be taken into account based on the profiles required by the project. Opportunities are open to people of all ages, the most important thing is to know the skills of each candidates for the positions they open. The contracting process will be communicated, as well as the requirements and the conditions so that they can apply to those opportunities and properly present the information required. The operation is expected to start on January 1, 2018, the contracting phase for construction will be carried out the other year. The operation phase, this will be in the year 2018. [26] No hiring percentages are being handled for this municipality
43	From what has been heard so far this project will be an employment opportunity only for the municipality of Acajutla. What percentage of employment opportunity will exist for the other municipalities, in this case Sonsonate specifically?	Sonsonate Centro	
44	What types of workers will you have on board the ship anchored at the pier?	Col. Los Laureles, calle principal	
45	Would you give job opportunities to young people who have not had experience in any company?	Col. San Julián	
46	After three years, how many people will be left with a fixed position or all of them?		
47	Would there be opportunities for people over 45? Open positions.		
48	To work inside the plant, do you require some type of	Col. Linda Vista,	

[26] This starting date was expected when the assembly was held.

Table 8.21 – Opinions and Suggestions Delivered During the Assembly in 2014, Sorted by Theme			
N°	**Question or Comment**	**Institution or place coming from**	**Answers provided**
	experience?	Acajutla	or another, however, it will be prioritized in the inhabitants of the area and contribute to the economic development of the municipality. The jobs for young people, of course they can have an opportunity, but you have to take into account the requirements of law to be hired according to the needs of the project. For example, staff will be hired for earthworks. There will be hiring for execution phase and operation. It is important to mention that, as far as possible, academic training programs will be included and some agreements can be made for projects aimed at young people in order to prepare them to become part of the operation. The professions, we will have an administrative area and also a technical part, where Electrical, mechanical, and civil, Engineers will be needed as well as technicians in these areas. As well as any other profession related, and also administrative staff in charge of human resources, accounting, etc; but, those are needs that we are going to let them know in due course. Possible jobs will be during the project construction phase, the operation phase will start in January 2018. Then, the positions required will be called, and will be taken into account the Acajutla municipality residents: Always prioritizing the people needs in the locality. We give you our commitment that this situation will be tried the best way, and we will try that working conditions are the best.
49	Would there be opportunities for people who own a metal structures workshop, but who do not have a tax credit to work?	Col. Alvarado	
50	How will the hiring process be to be able to work in the construction of the project?	Nahuizalco, Sonsonate	
51	The plant should have more than 60% of the permanent jobs, only this would raise the Acajutla economic.	Col. Acaxual	
52	Provide us with contractors and bidders who do not profit from our sweat, work and family support		
53	How are they going to verify that the contractors will fulfill in hiring people of the zone? And what support will they give to churches?	Iglesia Santuario del Dios de Elías	
54	How much will the salary of the workers be?	Barrio los coquitos, Acajutla	
55	What would be the resume presentation period? Will there be working opportunities for people whose ages are over 30?	Colegio Liceo de Acajutla	
56	I think everything is excellent, would you hire regardless of age?		
57	I hope they give employment to all the Acajutla .The unemployed. Let them be fair wages, not like those of private enterprise, which are very low		
58	Anyone applying for a job will have it?		
59	In addition to the 60 permanent jobs, they will have more temporary jobs during the generator's operations?	Izalco, Sonsonate	

Table 8.21 – Opinions and Suggestions Delivered During the Assembly in 2014, Sorted by Theme			
N°	**Question or Comment**	**Institution or place coming from**	**Answers provided**
60	The work benefits will be fixed or temporary positions?	Col. Las Tablas, Acajutla	
61	When will the project start and when will employees be hired?	Col. Ciudadela CEPA	
62	Work will be carried on both the plant and the pier? What is needed to get the job?	Col. Nueva Acajutla	
63	People residing outside the Acajutla city , but from the same municipality,will be given the opportunity to work?	Punta Remedio, Los Cóbanos	
64	I would like to know if they will give opportunity to young people from ages from15 to 17 years to work in this project	Colegio Liceo de Acajutla	
65	When will the project start and when will they hire employees?	Comunidad el Obelisco	
66	What professions are necessary to work in Energías del Pacífico?	Colegio Liceo de Acajutla	
67	Will you be flexible for the people who are working in the local generators? Noting that many people are prepared, even if they have not worked in this area	Sonsonate	
68	How will the female sector benefit? Wil fixed positions be provided?		

Source: Own elaboration, 2014.

8.4.3.3 Additional Comments on the Project

Some of the comments made by the people participating in the public consultation, regarding the implementation of the power plant, are related to the following opinions

The Acajutla Municipality the Col. El Milagro Inhabitants considered this:

- We expect everything they offer, they comply it. As we have companies experience companies that have come to do their projects, when they are already established, they forget what they have promised. I hope it's true what they promise;
- The project is excellent because it allows development for our country, both for Acajutla and for the communities. The project is excellent.

The Industrial Zone Community leader expressed:

- The Industrial Zone community president, I congratulate Energías del Pacífico for taking into account all communities of our Acajutla, thanks for the support

The participants also expressed:

- Election contests will not affect the project;
- Watch this, see priorities, as a company. We are all important; despite on how much knowledge we have. We are all worth the same - the first as the last. Do not politicize the project.

8.4.3.4 Development of the "OPEN HOUSE" or OPEN SPACE for Participation

After the question / answer section, as part of the methodology the "Open House" was carried out, in which the attendees could circulate through the models that presented the engineering of the project, and also to appreciate in greater detail all the visual material exposed through informative posters. During this activity, we could answer doubts or comments that would have remained still on the part of the attendees, in a more personalized way. In photos 8.11 and 8.12, images of the event are provided.

Photo 8.11 – Images Taken During the Development of the "Open House or Open Space"

Source: Own elaboration, 2014.

Photo 8.12 – View of part of the material shown during the Open Space

Source: Own Elaboration, 2014.

During the development of this space, the technical teams of Eco Ingenieros, Dillon, EDP and Wärtsilä were always attentive to clarify any type of doubt at the immediate time.

Some of the questions and comments that emerged during this space were the following:

How much will be the distance of the pipe with the fishing zone and the residential area? What happens is that I have been requesting an environmental permit to the Ministry for the cultivation of oysters since some time, and I would like to know how it will affect me?
It is approximately 500 meters away from the residential area where the ship is located. The dock is 1.25 kilometers.

The area that will be for safety, will be delimited by *bollas*? Because if they do not signal properly people do not understand?
So far, relevant risk studies and risk mitigation are being carried out, the most adequate way of signaling is being sought, in fact the MPA has to approve all those mechanisms and what is going to be proposed for the subject.

Fishermen would have to give a longer spin to fish?
Yes, we have done the relevant studies and are approximately 40 meters more than those they travel, they do not go straight, but in turn.[27]

[27] The distance presented is a result of the analysis of 2014, which has varied with the project changes.

Are plans being drawn up at this time, based on local and international safety standards?
The advantage of this type of project is that it has chimneys, which are high, and the gas does not stay down, but what is hot makes it go up, that is the advantage that it does not cause damage to the people, that is what is being sought, crude oil is more volatile.

Where will be the entrance for the personnel hired?
3 entries will be enabled which are displayed on the model.

A refinery project that was installed in Acajutla carried hydrosulfide; What it did was burn it, was a sub product of the generation, this same thing will happen with this project?
There is a part where there will be a flame that burns any kind of leak, there it burns and no problem occurs.

When implementing the project we will lose our source of work, we are independent oyster catchers and with the construction of the dock we will be affected, what can we do for you to support us? We have a social communication office, you can approach and provide your data, we have a marine biologist who is monitoring the fishermen's cooperatives.

Where do trucks come in?
We only have access by two places, the heavy traffic of trucks only we will enter by the October street 24. The third entrance is by the boulevard. For regasification we have two entries, for the generation of energy we have only one.[28]

[28] The modified project will have different accesses.

8.4.3.5 Final Considerations of the Public Consultation Event 2014

In general, the event was developed normally, for what the following can be commented:

- The people attending the event participated openly in the activity, expressing their opinions and comments on the project, which enriches the process for elaboration of the Environmental Impact Study;
- In a positive way, actors who were part of citizen participation process attended it. This time, the interest of communal leaders, churches, schools, fire brigades, fishermen's cooperatives, among others, was reaffirmed on the activities that will be carried out when the power generation project in the Acajutla Port is executed;
- Population assistance was massive, with the participation of people residing outside the area of influence of the project (Acajutla), coming from the center of Sonsonate, Izalco and Nahuizalco, which becomes a sample of the interest that the Population has on the project implementation;
- The population perceives in a positive way the social responsibility that EDP develops and the sources of employment that are generated in the construction and execution phase of the project, mainly because it will be prioritized in the people living in the zone of influence of the project (Acajutla) ;
- A total of 128 people were among the 22 women attending the event and 106 men. The women as a vulnerable group consulted in the citizen participation process, again expressed the interest of being part of the hiring employees process that will require the project, in addition, to request the support of EDP for the execution of social projects and benefits ;
- The social projects implementation, as part of EDP's social responsibility, obtained positive opinions by the municipality various sectors, requesting support for the implementation of activities for the communities, schools, churches, health centers,benefits among others.

A photographic record of the activity development is given in Pictures 8.13 to 8.15, in Appendix 8K, there are more images of the event below.

Photo 8.13 – Images of Event Registration by the Mayor and Other Participants

Source: Own elaboration, 2014.

Photo 8.14 – the Presentation development Images by the Architect Leonora Ferrer

Source: Own elaboration, 2014.

The material exhibited during the event was treated as being the most friendly to the public, trying to explain in a clear and practical way those issues that could be difficult to understand by their technicalities. The expositor uses everyday examples to describe in the most understandable way, some of the possible impacts and mitigation measures that are part of the Study.

In Photo 8.15, the Mayor of Acajutla (Darío Guadrón), the Project Executive Director (Alejandro Alle), other members of the EDP team, and the technical team members, can be seen on the left, discussing the EsIA progress to date.

Photo 8.15 – Images from different moments during the development of the event

Source: Own Elaboration, 2014.

8.5 Description of the Consultation Activities 2015 and 2016, Participation on Advances and Changes on the Project

Between the years 2015 and 2016, a number of modifications were made to various changes within the project, which required the reactivation of the citizen participation process, in order to keep the key national and local stakeholders informed to ensure an optimal project development. During the modifications process, participation activities were also carried out with institutional actors with whom the changes were lobbied in order to obtain some feedback.

Among the activities specifically aimed at reactivating the population, several meetings were held, mainly in relation to the risks identification, with key stakeholder groups such as Ministry of Environment and Natural Resources, Ministry of Economy, CEPA, Maritime Port Authority, and other institutions. Further details of those meetings are presented in Chapter 9.

Meetings were also held with the new Acajutla municipal council, which came to govern in 2015 and interest groups such as the fishing sector of Acajutla. Likewise, the last meeting was a preliminary citizen consultation, with an open participation event in the municipality of Acajutla.

The Energia del Pacifico Office was open during this time, receiving visits from people interested in starting the project and job opportunities, mainly. See list of visitors 2015, in Appendix 8L.

8.5.1 Update Meeting with Municipal Mayor and Council (2016)

A project updating meeting was held at the premises of the Acajutla City Hall, Sonsonate department , on Wednesday, October 19, 2016. The meeting was attended by the new Municipal Mayor, Mr. Hugo Arriola, and the Members of the current Municipal Council, who began their work recently. During this meeting the components of the Project were explained and informative material was given to the attendees.

8.5.1.1 Objetives

- Update local government actors on the project progress and changes in the components of the "LNG TO POWER - Energia del Pacifico" project. And the modifications, which have been generated since the last meeting held in 2014, in order to optimize its design and to achieve a better integration of its elements with the environment; as well as the development of the Environmental Impact Study for the Project, and the citizen participation component of the Project.

- Obtain opinions, suggestions and recommendations from the local government stakeholders, with the purpose of identifying environmental and social aspects to be considered throughout the process of developing the EsIA and implementation of the Project.

8.5.1.2 Participants

In Appendix 8M, a copy of the attendance list is provided to the event, participants were:

- The Mayor Acajutla municipality , aldermen and municipality councilors.
- Representative of the Project holder.
- Representatives of the consulting firm for the EsIA elaboration.

8.5.1.3 Meeting's Methodology

As part of the applied methodology, a visual presentation prepared in Power Point containing a complete Project description Appendix 8N was carried out, and a brochure with the informative summary of the Project was also given to attendees, see Appendix 8O. During the activity, there was an update on the project progress and the changes brought about, so that the local actors acquire a global vision. In addition, the main activities to be carried out during the EsIA.

In general, the participants presented their comments, doubts, suggestions and different situations that they considered opportune to clarify with respect to the project.
The Assembly agenda was developed in the following order of activities:

a) Roll call.
b) Welcome and presentation of Energía del Pacífico and the consultant.

c) Purpose of the meeting.
d) Material project and Delivery Presentation (Summary sheet of the project).
e) Snack
f) Open space of participation for questions, comments, concerns etc.
g) Appreciation for assitance.

8.5.1.4 Results of the Update Meeting with the Acajutla Mayor

Thanks to this meeting they were able to establish the bases of collaboration with the mayor, to start the consultation activities rest and citizen participation destined to make known the advances and the project changes.

The Municipal Government representatives, participated in the activity, exposing some comments, proposals and consultations on the actions that the project. The opinions majority were addressed to know how will be the functioning way of the gas plant.

At the beginning of the presentation Energy of the Pacific made a brief introduction on the importance of that the Mayor was aware of the substantial changes that were realized in the project.

They were also explained that a public consultation had previously been carried out and in view of the modifications made to the project. The need arises to know the municipal council opinions and the population in general.

The generalities of the project, the need to build the plant, natural gas advantages, location, permitting process, benefits, among other topics were retaken.

Among the opinions expressed by the actors, the following stand out:

<u>-Councilor Saúl Hernández</u>

- He made the comment "the tanks ashore are safer, they must have the necessary security because there is a fishing pier in that area, besides the security measures near the ship, special care must be taken since the human being is curious And there is the possibility that they want to go and investigate that there is in that place, producing a misfortune"
- He added that the engine of the boat should not only be turned on in an emergency, but 2 or 3 times a week.

-Councilor José Joaquín Moreira

- He referred to another company producing energy with which they have problems with the vibrations emanated by this plant: "The problem in Acajutla with power plants are the vibrations, which affect the dwellers"

-Councilor Saúl Hernández

- Again consulted on the tanks safety in the sea..

-Councilor José Luis Ortiz:

- What is the vessels dynamics, which will be perennial and how often they arrive.

- Councilor Saúl Hernández:

- Within the cargo handling there is a dangerous numbering, which number has the cargo to be handled?
- What will be the change impact in temperature that the water will have?

- Finally, the representatives of the consultant and Energía del Pacífico concluded:

- Responding to some of the concerns previously expressed, the representatives of the consulting firm and Energía del Pacífico regarding the plant operation and the safety measures taken into account both in the construction and in the project operation, in this sense, it was commented:

"In relation to the ships maintenance these will be operated by an international company specialized in the handling of this type of boats"

It was explained, in relation to the vibrations emanated by other power generating plants that the machinery that is currently used has a much more modern technology, which will be moderating the noise, in addition the chimneys will be located on a platform so not will generate this low pressure noise that are the ones that cause the vibrations, therefore the noise will not be increased.

Regarding the issue that the tanks are located inside the sea, it was explained that for security reasons they will be installed inside the sea since the country is very prone to earthquakes and this way it is being prevented that a disaster happens on the ground. It was explained that the large vessel is semi-permanent so it will not move until there is a natural event that requires it to withdraw into the sea; Also, the project has a small tank (boat) so that when it is necessary to move the big boat, the small one can produce natural gas for up to more than a week.

In relation to the hazardous materials is classified into 2 toxic groups and flammability, because gas is flammable and has the same danger of propane gas the only difference is that propane gas remains in the air and natural gas dissipates rapidly in the air.

It can drop to 5oC degrees depending on how much sea water is used to transfer heat to each unit of gas mass, for the few degrees that the water goes down it ends up producing little impact. On this subject the marine biologist in charge of the project impact investigation in the area mentioned that it did not cause any impact on fish and that the most sensitive are corals but in this area there are no corals.

After answering all the questions, Eng. Alejandro Alle, representative Energy of the Pacific representative, mentioned about the aid in social projects, proposing the creation of a training center for children and young people where they taught computing, English and values.
Councilor Wilber Mena proposed the favoring of students with scholarships since in the municipality there is already a type of training center called a center of outreach to prevent violence, which has the assistance of around 100 and 200 children. (See photo 8.16)

Photo 8.16 – Images of the Guests of the Mayor's Office of Acajutla

Source: Own Elaboration, October 2016.

The images above, show the attendees to the meeting, including in green at his desk, Mr. Mayor Hugo Arriola, surrounded by members of his council, among other representatives of the Acajutla Mayor's Office.

In Photos 8.17, Leonora Ferrer, and Alejandro Alle, representing the project's holder, are shown, imparting various moments of the presentation made to the Mayor and members of the Acajutla municipal council.

Photo 8.17 – Images of the Presentation Given by Leonora Ferrer from the Consultant, and Eng. Alejando Alle from EDP

Source: Own Elaboration, October 2016.

In Photo 8.18, on the left, we can appreciate Lic. Oscar Molina, consultant biologist, responsible for Marine Biology, explaining the possible temporal effects on marine species.

Photo 8.18 – Images of the Intervention of Some Guests During the Question and Answer OpenSpace

Source: Own Elaboration,October 2016.

In the images of the Photo 8.19 are presented images of some guests during the event.

Photo 8.19 – Images of the Intervention of Some Guests During the Question and Answer Open Space

Source: Own Elaboration,October 2016.

8.5.2 Update Meeting with Fisheries Sector (2016)

A meeting was held specifically with representatives of the Acajutla fishing sector, this one took place in the Restaurant Acajutla facilities, Sonsonate Department, on October, Tuesday 25 of 2016. This meeting counted with the cooperatives ACOOPPA representatives participation , ACPRA, a group of Tuberos, a group of oystercatchers, ACOOPESCA and Cooperativa Tiburoneros. It is important to mention that staff of the shark cooperative had not participated in previous meetings. The fishermen and cooperatives were summoned by direct invitation. During this meeting the components of the Project were resumed and informative material was given to the attendees.

8.5.2.1 Objetives

- Inform the fishermen, tuberos and oystercatchers of the area, or other relevant groups, about the project progress on LNG TO POWER" project components". And the changes that have been generated since the last participatory meeting held in 2014, in order to optimize its design and to achieve a better integration of its elements with the environment. Also, about the Environmental Impact Study development for the Project, and the citizen participation component of the Project.

- Update the members cooperatives lists and the different groups of fishermen identified, to record all the changes that have occurred from 2015 to date.

- Obtain opinions, suggestions and recommendations from this group, with the purpose of identifying environmental and social aspects to be considered throughout the elaboration process of the EsIAS and the Project execution.

8.5.2.2 Participants

In Appendix 8P, a copy of the attendance list to the meeting is provided. Within the attendees were the following:

- Representatives from Cooperativa ACOOPPAC;
- Representatives from Cooperativa ACPRA;
- Representatives from a group of Tuberos;
- Representatives from a group of oyster-catchers;
- Representatives from Cooperativa ACOOPESCA;
- Representatives from Cooperativa APECTAMAR;
- Project holder's representative;
- Representatives of the consulting firm for the EsIA development.

8.5.2.3 Methodology of the Meeting

As part of the applied methodology, a visual presentation prepared in Power Point was shown containing a complete description of the changes and Project advances, likewise, the attendees were given the brochure containing the informative summary of the Project. During the activity they were updated the project progress since the last consultation activity carried out at the end of 2014, and the changes incorporated into the project, in order that the fishermen of the area acquire a global vision. In addition, the main activities to be carried out during the EsIA development process were announced. In general, the participants exposed their comments, doubts, suggestions and different situations that they considered appropriate to clarify with regard to the project. (See Photo 8.20)

The Assembly agenda was developed in the following activities order :

h) Roll call.
i) Welcome and presentation from Energía del Pacífico and the consultant.
j) Purpose of the meeting.
k) The material project and Delivery presentation (Summary sheet of the project).
l) Breakfast
m) Open space of participation for questions, comments, concerns etc.
n) Appreciation for assistance.

8.5.2.4 The update Meeting Results with the Acajutla fishing sector

Due to this meeting , the mayor's office colaboration has been seted up in order to give all the consulting activities and habitants participation.

The representatives of the Municipal Mayoralty representatives took part of the activity, exposing some comments, about offers and consultations related to the project. The major opinions emitted were directed to know how will work the plant.

At beginning of the presentation a brief introduction has been emitted in relation at the meeting group, since it is the unique group that has been taken into account to ibe informed about e substantial changes that should be realize in the project.

They were also explained that a public consultation had been carried out in 2014 and in view of the modifications that were made to the project, the need arises to know the opinions of the municipal council and the population in general.

The generalities of the project, the need to build the plant, natural gas advantages, location, permitting process, benefits, among other topics were retaken.

Among the opinions expressed by the actors, the following stand out:

-Mr. Raúl Escobar, representative fomr the group of tuberos

- Asked how is transformed into gas the liquid of natural gas and if the tank carries the liquid and if it is tranformed inthe plant. He asked if those pipes will be like those found at the entrance of Acajutla, such as those of the Cenergica company.
- He then consulted if there will be a platform as the basis of infrastructure.
- He made the comment "The plant will be similar to the platforms that are in Mexico, which extract the liquid”

Mr. Oscar Orlando Cortéz representative from ACOOPPAC

- He thanked the company for having been taken into account and for the benefits that this project will bring to the municipality of Acajutla. He suggested that it would have been better if Energia del Pacifico had taken into account cooperatives without including the City Hall in the programs of benefit to the community, since they are not heard in their needs by the Mayor. He asked to be explained a little about the improvements that will be made to cooperatives.

Mr. José Antonio Cordero representative from ACPPRA

- consulted "the Architect was talking about a platform where water is collected from the sea to cool the engines, how much will water warm up, and so on for the regasification process how much would it be cooled?”
- He added that with the change in water temperature and sea currents, even if there are fish aggregators, fish will leave.

Mr. José Bonilla Trigueros representative from ACOOPESCA

Commented: “The machines and every plant work with oil. That water is going through a cooling process, in this case, what is going to be done with hot water and oil waste?

Mr. Rafael Antonio Contreras representative from APECTAMAR

- He made the comment that they had not attended the previous meeting, and they were put to order and availability to collaborate with the company Energía del Pacifico.

Finally, the representatives from the consultant and Energía del Pacífico concluded:
Responding to some of the concerns previously expressed, the representatives from the consultant and Energía del Pacífico regarding the operation of the plant and the compensation measures in which they will be taken into account was commented:

-Regarding the platform, it was explained that there will be no dock, that this is one of the changes that have been made. Only at the construction phase, there will be a dock. And the difference with Mexico is that those platforms are at hight, but here it goes on the sediment.

-Regarding that the aid is channeled through the mayor's office is not a decision of Energia del Pacifico,because this is already given, already is obliged, it is a legal commitment, since it is a project that was won by tender. However, since the previous meeting it has been taken into account the several needs that you have, the environmental management is different to the projects that will be done together with the Mayor and within the measures of compensation there is a component for your sector, the winche, "desasolvamiento" of the old dock, fish aggregators.

-It was clarified that the water that will be used to cool engines, it will come out 5oC warmer, and the water to heat the gas to regasify will come out 5° colder, staying under the standard. As for regasification it was added that this is required because the gas is received in the liquid state at a temperature of less than zero degrees so it needs to be converted into gas.

- On the change of the water temperature the representative from Energia del Pacifico was told that there is already a complete study on this subject and thanks to the tropical temperatures of those waters , the affectation of the water will not have a negative impact since a few meters already will have the normal temperature. Also, Oscar Molina, a specialist in marine biology, added: In approximately 100 meters the water has been homogenized and the FAD (Fish Aggregation Devices) proposed will be located at around 2 kilometers away.

- About oil wastes, it was clarified that in this case there is no contact with the fuel and that the water has no direct contact, so that the water as it enters will come out with the same characteristics but a little cooler, but not there is no contact with any lubricant or fuel.

-It was clarified with some of the representatives from the cooperatives that recently showed interest in the project that at the time it is considered that they will not be affected with the project, for what they did not attend the previous events. However, they were reminded that the public consultation held at

the Institute of Acajutla in 2014 was open to the public and the entire population of the municipality was invited.

As can be seen in Photo 8.20, there was a good call to the meeting, which was attended by at least one representative from each interest group. (See photo)

Photo 8.20 – Images of the Start of the Event and Roll Call

Source: Own Elaboration,October 2016.

As shown in Photos 8.21 and 8.22, several moments of the presentation given by the Architect Lisbia Teresa Jarquín, on behalf of the consulting company.

Photo 8.21 – Images of the Activity in Full Development of the Presentation

Source: Own elaboration, Octuber 2016.

In Photo 8.22, on the left, Mr. Oscar Orlando Cortéz representative from ACOOPPAC, commenting on the project changes. To the right another representative from ACOOPAC, grateful that their opinions were taken into account.

Photo 8.22 – Images of the Intervention of Some Guests During the Space of Questions and Answers of the Meeting with Fishing Sector

Source: Own elaboration, October 2016.

In Photo 8.23, Mr. José Antonio Cordero, representative of ACPPRA, expressed his concerns.

Photo 8.23 – Images of the Intervention of Some Guests During the Open Space for Questions and Answers during the Meeting with the Fishing Sector

Sourc: Own Elaboration, October 2016.

Finally, Photos 8.24 - correspond to the response phase, as some clarifications were received on specific topics of interest to participants in the fishing sector, such as possible changes in temperature in seawater close to the FSRU, and possible involvement to the marine flora and fauna. Consultations that were received by Eng. Javier Mina, representative of EDP, and Lic. Oscar Molina, consultant responsible for marine biota, by the consulting company.

Photo 8.24 – The Intervention Images of the Consultant and EDP, During the Question and Answer Space of the Meeting with the Fishing Sector

Source: Own Elaboration, October 2016.

With this, the 2016 participation event was closed, with the participation of the Acajutla fishing sector.

8.5.3 Second General Information Assembly (2016)

As a conclusion of the Participation activities with the social actors 2015 and 2016, an extraordinary participation event was held that took place on Saturday, November 5, 2016. Through it, it was informed of the advances and modifications to the project, Corresponding to the foregoing Environmental Impact Study. This event was an open invitation, and through it, it was sought at the same time, to have the participation of the main local actors /stakeholders of the Acajutla municipality , as well as some of relevance at the national level.

8.5.3.1 Objetives

- Inform the population of Acajutla in general, and key stakeholders of the locality, about the Project progress between the years 2015 and 2016, as well as show them the changes made in the final design.
- Obtain opinions, suggestions and recommendations from the Acajutla population, so that they can be incorporated into the project development.
- Identify environmental and social aspects that are most interest in the Acajutla population, to consider in the final process of elaboration of the EsIA and execution of the Project.
- To resolve doubts or actors concerns regarding the development of the project.

8.5.3.2 Call

To ensure that the activity was a success, many activities have been carried out in the weeks leading up to the event, such as banners placement in greater areas affluence of the municipality, banners and flyers at key points of the Acajutla city, radial advertisement, invitations to key groups and actors. Each activities call is detailed:

a) **Informative Banners:** A total of 6 banners were placed, approximately 10 days before the event, located in strategic points of the Acajutla municipality. Among these, in front of EDP Offices, in front of the park administered synthetic court by the Mayor, entrance to Health Unit of Acajutla, Acajutla City Hall, Despensa Familiar supermarket and in front of Acajutla Botanical Park. The following photos 8.25 to 8.30 show the banners and their contents.

Photo 8.25 – Banner Located in front the Energía del Pacífico Offices

Source:Own Elaboration, October 2016.

Photo 8.26 – Banner placed at the Health Unit of Acajutla

Source: Own Elaboration, October 2016.

Photo 8.27 – Banner placed in front of the synthetic court in Colonia Brisas, Acajutla

Source: Own Elaboration, October 2016.

Photo 8.28 – Banner placed infront Botanic Park, Acajutla

Source: Own Elaboration, October 2016.

Photo 8.29 – Banner placed in the proximity to the City Hall of Acajutla

Source:Own Elaboration, October 2016.

Photo 8.30 – Banner placed in front of the Casa Comunal de Barrio El Campamento

Source: Own Elaboration, October 2016.

b) Flyers: As part of the activities to convene the population of Acajutla, informative flyers were given, in which the invitation to the Assembly was made, indicating the details of the event (see Figure 8.11). Flyers were handed out during 3 days (October 28 and 29, November 4) in areas of great population influx, such as the entrance of the Despensa Familiar, and along the Acajutla market, a total of 1,000 flyers were distributed . Below are some pictures of the activity. (See Photo 8.32 and 8.33)

Figure 8.11 – Flyers Detail

Source: Energía del Pacífico, October 2016.

Photo 8.31 – Images of the Flyers Activity at the Entrance of the Despensa Familiar

Source: Own elaboration,October 2016.

Photo 8.32 – Flyers activity

Source: Own Elaboration,October 2016.

c) Radial spot: An announcement was made on radio, using a radio spot that was being broadcast on Acaxual radio, from Monday October 31 to Saturday, November 5. The text of the radial spot is as follows:

*''**ENERGÍA DEL PACIFICO Ltda. de C.V.” :***

Invites the population of Acajutla to the "Second General Informative Assembly", on the progress of the electric power generation project, which is being developed in the said municipality. The objective is to present an update of project progress and changes made. The assembly will be held:

Date:** Saturday, November 5th**, 2016

***Time:** 9:00a.m.*

***Place:** Liceo de Acajutla*

***Energía Del Pacifico** Ltda. de C.V., Restate the importance of their participation in this Second General Informative Assembly, all opinions will be considered and analyzed as part of the environmental and social assessment process.*

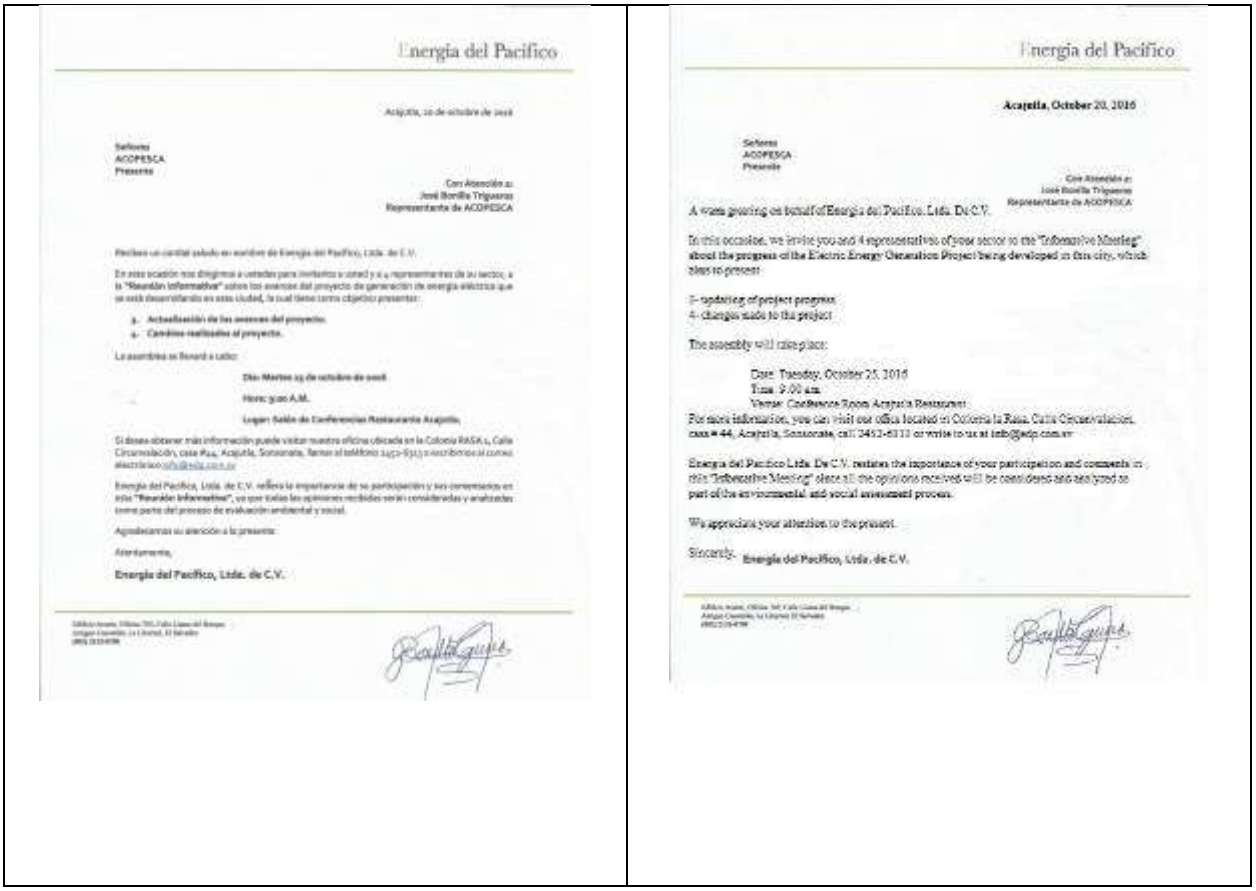
For more information, please contact: 2452-6313

Energía del Pacífico, Cleaner Energy for our future”

d) Dirrect invitation: Formal invitations were issued, which were delivered in person, to key stakeholders of special interest, such as community leaders, local church leaders, fishermen's cooperative managers, government and nongovernmental institutions managers, to diffuse the

invitation within their communities. An example of the invitation delivered is shown in Figure 8.12.

Figure 8.12 – Sample Invitation Delivered



Energía del Pacífico

Señores
ACOPESCA
Presente

Con Atención a:
José Bonilla Trigueros
Representante de ACOPESCA

Energía del Pacífico

Acajutla, October 20, 2016

Señores
ACOPESCA
Presente

Con Atención a:
José Bonilla Trigueros
Representante de ACOPESCA

A warm greeting on behalf of Energía del Pacífico, Ltda. De C.V.

In this occasion, we invite you and 4 representatives of your sector to the "Informative Meeting" about the progress of the Electric Energy Generation Project being developed in this city, which aims to present:

3- updating of project progress
4- changes made to the project

The assembly will take place:

Date: Tuesday, October 25, 2016
Time: 9:00 a.m.
Venue: Conference Room Acajutla Restaurant

For more information, you can visit our office located in Colonia la Rasa, Calle Circunvalacion, casa # 44, Acajutla, Sonsonate, call: 2462-6313 or write to us at info@edp.com.sv

Energía del Pacífico Ltda. De C.V. realizes the importance of your participation and comments in this "Informative Meeting" since all the opinions received will be considered and analyzed as part of the environmental and social assessment process.

We appreciate your attention to the present.

Sincerely, Energía del Pacífico, Ltda. de C.V.

Among these, invitations were given to members of communities, Municipal Hall, health unit, ISSSS, schools, red cross, firefighters, naval force and cooperatives. Table 8.22 summarizes the list of actors/stakeholders who received this type of direct invitation, as well as in Appendix 8Q, a reception record for such invitations is provided.

Table 8.22 – List of Actors/Stakeholders that Received Direct Invitation (2016)

Nº	ENTITY	NAME	POSITION
	COMMUNITIES		
1	**BARRIO LA PLAYA**	Marlene Canjura	
2		Celia Hernández	President
3		Víctor Hernán Quijada	
4	**ACAXUAL**	María de Jesús Gáleas	
5	**LOS MORRITOS**	Ana Cecilia Guillén de Molina	President

Table 8.22 – List of Actors/Stakeholders that Received Direct Invitation (2016)			
Nº	**ENTITY**	**NAME**	**POSITION**
6	**LA REINA**	Omar Esaú De la O	
7	**COMUNIDAD ZONA INDUSTRIAL**	Nelson David Alvarado Rivera	President
8	**COMUNIDAD EL BARQUITO**	Silvia Estela Henríquez	President
9	**BARRIO LAS PEÑAS**	David Bautista	
10	**CIUDADELA CEPA**	Guillermo Cordero	
11		Will Antonio Navarro	President and Leaders
12		Romeo Alonso Argueta	
13	**COMUNIDAD LA OBRERA**	Jorge Orellana	President
14	**LOTIFICACION ALVARADO**	Boanerges Almendariz	President
15		Lorena Antonia Flores de Lara	
16	**COMUNIDAD LA RAZA 1**	Karla Mejía de Estrada	
17		Susana Beatríz de Martínez	President and Leaders
18		Yolanda Isabel Ávalos	
19		Juan Carlos Mejía	
20	**COMUNIDAD LA RAZA 2**	Milton Guillén	President
21		Francisco Calzadilla	Vicepresident
22	**COLONIA BRISAS DE ACAJUTLA 1**	Evelyn Carolina Rodríguez de Mendoza	
23		Carolina de Mendoza	President and Leaders
24		Susana Jeannette Ruíz	
25	**COLONIA BRISAS DE ACAJUTLA 2**	Margot Soriano	President
26	**COMUNIDAD OBELISCO**	Maura Guevara	
27		Yaneth Saraí Portillo	President and Leaders
28		María Luisa Cerna	
29	**COMUNIDAD OBELISCO**	Yesenia Carolina Zelaya	
30	**COMUNIDAD SAN ROQUE**	Reina Rodríguez	President and Leaders
31		Ana Ruth Flores de R.	
ACAJUTLA CITY HALL			
32	**MUNICIPAL MAYOR**	Hugo Arriola	Mayor
33	**TOURISM AREA**	Carlos Antonio Tobar	Head of Unit
34	**SOCIAL PROJECTION AREA**	Moises Bonilla	Head of Unit
35	**ENVIRONMENT AREA**	Walter Montoya	Head of Unit
ACAJUTLA PUBLIC HEALTH INSTITUTIONS			
36	**HEALTH UNIT**	Iris Godoy	Director

Table 8.22 – List of Actors/Stakeholders that Received Direct Invitation (2016)			
Nº	**ENTITY**	**NAME**	**POSITION**
37		Edgar Leonel Gúzman	Coordinator Environmental sanitation
38	**SEGURO SOCIAL**	Walter Martínez	Director
39	**AGAPE ACAJUTLA**	Dra. Marta Morales	Director
40		Dr. Pérez	Coordinador de Promotores
41	**RED CROSS**	Rafael Martínez	Responsible for local promoters
ACAJUTLA SAFETY INSTITUTIONS			
42	**NAVAL FORCE**	José Edid Cortéz	Captain of the Port of Acajutla
43	**PNC**	Sub Inspector Gusstavo Neftalí Pérez	Head of Delegation
44	**SONSONATE FIREFIGHTERS**	Alfonso Rivas González	Lieutenant
45		Damián Villacorta	Lieutenant
46		Luis Arturo Diego	Corporal
ACAJUTLA FISHERMEN'S COOPERATIVE			
47	**ACOOPPAC**	Oscar Orlando Cortéz	President
48	**ACPRA**	José Antonio Cordero	President
49	**ACOOPESCA**	José Bonilla Trigueros	President
50	**APECTAMAR**	Rafael Antonio Contreras	Representative
51	**Grupo de Ostreros**	Oscar Armando García	Representative
52	**Grupo de Tuberos**	Raúl Escobar	Representative
ACAJUTLA EDUCATIONAL CENTERS			
53	**CENTRO ESCOLAR COMUNIDAD ALVARADO**	Israel Enrique Tapas	Principal
54	**COLEGIO CATOLICO DE ACAJUTLA**	Ana Isabel Salazar	Principal
CHURCHES IN ACAJUTLA			
55	**EVANGELIC CHURCH: IGLESIA SANTUARIO DEL DIOS DE ELIAS**	Felix Aguirre	Pastor
56	**CATHOLIC CHURCH: SAN FRANCISCO DE ASIS**	Napoleón García	Priest
WOMEN ORGANIZATIONS			
57	**RED DE MUJERES DE ACAJUTLA**	Maritza Elizabeth Hernández	Member
58		Vilma Noemí Santos	Gender Unit
59		María Maura Castro	Member
60		Daysi Beatríz Espinoza	Member
61		Delsy Noemy Ramírez	Member

8.5.3.3 Participants

The event of the Second General Informative Assembly was held with a very good participants influx, 98 registered people, and the population various sectors presence presence. In Appendix 8R, Assistance list copy to the event. It should be noted that the event was a success, with the differente social actors/Stakeholders participation, and the presence of all communities close to the project, and even more distant ones that showed an interest in the activity

The main sectors involved are detailed below.:

- Representatives of the municipality.
- Project holder's representative ""LNG TO POWER"
- Representatives of the consulting firm for the EsIA elaboration.
- Representatives from various communities in the municipality of Acajutla, especially those close to the project, among others who demonstrated their interest in the project.
- Representatives of the different local fishermen groups.
- Representatives of Local and National Institutions.
- Representatives of Non-Governmental Organizations.
- Representatives of Educational Institutions.
- Representatives of Workers' Organizations (Unions).

Table 8.23 summarizes the participating actors/stakeholders and details the participants of each major group.

Table 8.23 – Actors/Stakeholders Participating in the Second General Informative Assembly (2016)

Type of Actor	NAME OF Organization or Institution
Project Holder	Energía del Pacífico y Grupo Invenergy
Project Consultants	Eco Ingenieros – Dillon Consulting
City Hall of Acajutla	Environment Unit
Communities	Caserío Metalío
	Urb. Brisas de Acajutla
	Col. San Julián
	Acaxual Nº 3
	Acaxual Nº 4
	ADESCOMAR
	RASA 1
	Colonia Nueva Acajutla
	Colonia San Roque
	Colonia Alvarado
	Colonia IVO
	Colonia Santa Águeda

Table 8.23 – Actors/Stakeholders Participating in the Second General Informative Assembly (2016)	
Type of Actor	**NAME OF Organization or Institution**
	Barrio La Playa
	Barrio Atarrayas
	Barrio Las Peñas
	Colonia El Milagro
	Comunidad El Obelisco
	Cantón Punta Remedios
	Barrio Atarrayas
	Colonia La Coquera
	Ciudad de Sonsonate
	Ciudadela CEPA
	Colonia El Barquito
	Colonia El Milagro
	Colonia Caracol
	Nahuizalco Barrio Trinidad
Communities	Lotificación Canales
	Los Laureles
	Barrio El Campamento
	Comunidad 12 de Octubre
	Colonia Obrera
	Cantón Kilo 5
Fishing Sector	Asociación Cooperativa Rederos de Acajutla (ACPPRA)
	Asociación Cooperativa de Producción Pesquera del Puerto de Acajutla (ACOOPAC)
	Asociación Cooperativa de Producción Pesquera "Tiburoneros de alta Mar" (APECTAMAR)
	Asociación Cooperativa de Producción Agropecuaria Y Pesquera Camaroneros De Acajutla (ACOOPESCA)
	Tuberos de Puerto de Acajutla
	Ostreros de Puerto de Acajutla
Workers' Organizations	Sindicato de Trabajadores del Sector Eléctrico (STSEL)
Government Institutions	Unidad Comunitaria de Salud Familiar (UCSF)
	Ministerio de Medio Ambiente y Recursos Naturales (MARN)
	Dirección de Protección Civil
Educational institutions	Liceo de Acajutla,
	Universidad de El Salvador (UES)
NGO's	Asociación Agape de El Salvador
	Movimiento Cultural Atonal
	Club Deportivo Acajutla Volley

Source: Own Elaboration, November 2016.

8.5.3.4 Methodology of the Meeting

Part of the applied methodology, a visual presentation prepared in Power Point containing a complete Project description Appendix 8N was carried out. A brochure with the information summary of the Project was also given to attendees, see Appendix 80. During the activity, updates on the project progress and the changes were brought about, so that the local actors/stakeholders acquire a global vision. In addition, the main activities to be carried out during the EsIA development process were announced.

In general, the participants presented their comments, doubts, suggestions and different situations that they considered opportune to clarify with respect to the project.

The public assembly was developed as presented in Table 8.24.

Table 8.24 – Activities of the Assembly (2016)
• Welcome and guests registration.
• Introduction and meeting Purpose.
• Presentation on progress and generalities of the Project and timeline
• Process to obtain environmental permission • Changes in the project • Potential impacts and mitigation measures
• Project's Benefits
• Questions, Answers. • (PLEASE WRITE YOUR QUESTION ON THE SHEET GIVEN AT THE BEGINING AND DELIVER TO ANY OF THE AIDES DURING THE EVENT)
• Public Comments Open Space
• "Open House" space - tour around model and images of the plant and snack

Source: Own Elaboration, November 2016.

8.5.3.5 Results on the Informative Assembly

Thanks to this meeting, we were able to establish the collaboration bases with the mayor, to start the consultation activities and citizen participation aimed to publicize the advances and project changes.

The participants submitted their comments, doubts and suggestions regarding the preliminary results obtained in the Esia related to the project. Regarding the Environmental Impact Study, they were explained the identified impacts, as well as the compensation measures established to minimize the damages generated with the project implementation.

Participants openly shared their views, comments, proposals and consultations on the project actions.

Opinions and suggestions were made on the aspects related to the project described in Table 8.25.

Table 8.25 – Opinions and Suggestions Delivered During the Assembly, Sorted by Theme (2016)			
N°	**Question or Comment**	**Institution or place of visit**	**Answers provided**
Social projects			
1	Within the social assistance, EDP has projected as far as the education and cultural development of the zone?	Movimiento Cultural Atonal	It is necessary to make the difference between environmental remediation as its name says it is for the environment based on the studies carried out and that study will tell us what remediation and social investment are works to which it is committed to the environment. During the project life. in this case, the amount is $ 532,000.00 per year. This amount will be used for the works execution that will be determined by the Mayor and the FISDL and will be channeled by the competent authorities. At the end of the environmental impact studies will begin with environmental compensation measures such as the delivery of equipment for the tuberos, which will be before the work begins at sea that is likely to affect fishermen. There are three support areas for fishermen: fishing equipment and training, winch installation at the craft pier and creation of artificial reefs, projects related to drinking water, sewage, cultural projects can be requested as a petition to the Mayor as part of the annual social projects. With regard to wetlands or water bodies, there are
2	Why community leaders are not taken into account for projects consultation that the community needs?	Bo. La Playa	
3	Will the project support wetland recovery?	Comisión Comunal de Protección Civil, Bo. La Playa	
4	A stationary engine was requested as a cooperative, when will it be delivered?	ACOOPPAC de R.L.	
5	What are the benefits for ACOOPPAC?	ACOOPPAC de R.L.	
6	The projects that have been selected this year to be performed in Col. Los Morritos, when do they start?	ADESCOMAR	
7	Will the most vulnerable and under-resourced communities be taken into account?	Bo. Las Atarrayas	
8	What possibilities are there for the project to give working possibilities to cooperatives?	ACOOPPAC	
9	What is the maximum fund of the Project?	APECTAMAR de R.L.	
10	Clean water project is needed for the inhabitants of the industrial zone	Zona industrial	
11	Have you considered what percentage of work opportunites will be given to the people originating from Acajutla?	Sindicato de Trabajadores del Sector Eléctrico	
12	Will there be any recreational project for the population of	Sindicato de	

Table 8.25 – Opinions and Suggestions Delivered During the Assembly, Sorted by Theme (2016)			
N°	**Question or Comment**	**Institution or place of visit**	**Answers provided**
	Acajutla?	Trabajadores del Sector Eléctrico	compensation measures in these areas, we have revegetation projects in areas with water bodies; In addition, it can be evaluated in the future as part of social projects. At the end of the environmental impact studies will begin with environmental compensation measures such as the delivery of equipment for the tuberos, which will be before the work begins at sea that is the one that can affect the fishermen. There are three support for fishermen: fishing equipment and training, installation of a winch at the artisanal dock and creation of artificial reefs In relation to dredging of the dock, one has to determine if this is within the social work, dredging needs environmental permits, it is recommended to prepare the request as a social project
13	What will be the aid for the oystercatcher sector?	Representante del grupo de ostreros	
14	Can you provide a reef for better fishing?	Asoc. De Tuberos	
15	Can you help us with sunken ships that will serve as nurseries?	Asoc. De Tuberos	
16	When will you deliver the fishing equipment for the tuberos?	Bo. La Coquera	
17	What possibilities are there to drain the artisanal dock?	ACOOPPAC de R.L.	
Environmental			
18	An environmental impact study will be carried out in the area where the floating storage unit is?	UES/ Maestría en Gestión Ambiental	The environmental remediation as its name says are measures for the environment based on the studies carried out and it will tell us what are the remedies that must be fulfilled according to the law. The extensive studies carried out in the area in relation to the water temperature and the increase of this temperature do not affect the fauna, with the temperature decrease the fauna tend to improve because they like colder water better.
19	What will happen to the fishermen to whom the project is left in their path?	Col. San Julián	
20	What impact will it have on the fisheries sector?	Bo. La Playa	
21	What security measures will there be after the end of the project?	Caserío Santa Agueda	
22	When natural gas is mentioned, it refers to methane, is it the	UES/ Maestría en	

Table 8.25 – Opinions and Suggestions Delivered During the Assembly, Sorted by Theme (2016)			
N°	**Question or Comment**	**Institution or place of visit**	**Answers provided**
	project to generate natural gas in El Salvador?	Gestión Ambiental	With the obtaining of natural gas, there is no gas in the country. There would be no international conflicts and no international waters touched. In relation to the environmental impact the energy obtaining by means of natural gas is also known as clean energy since compared to other plants, the pollution is minimal. With the risks in the case of disasters, all types of measures have been considered which do not affect CEPA or the population of Acajutla. We are working with national and international safety measures which also require the maintenance of international safety measures which will provide financing for the project construction. It should be mentioned that risks associated with gas management will always be there due to its flammability, but it has been determined that there is no significant risk for the population of Acajutla The exact number of trees that will be cut down by the construction of the plant is not available. What can be guaranteed is that they are inside CEPA lands which only have scattered trees and bushes there is no forest as such. Noise will provoke the fauna of the place because the plant is
23	Will this plant affect CEPA employees?	Comunidad Obelisco	
24	In the design of the plant were there considered risks in relation to disasters, for example earthquakes, tsunamis, leaks, explosions, spills, attacks, etc.?	UES/ Maestría en Gestión Ambiental	
25	The temperatures of the underground pipes, how does it affect the fauna and flora of the place?	UES/ Maestría en Gestión Ambiental	
26	Do you count with the system of "Assessment and Environmental and Social Management", and elements required by the standard IFC?	UES/ Maestría en Gestión Ambiental	
27	Do you count with micro fauna studies affected by the temperature of the water that will be used for cooling, what would be the measure to implement to compensate the mortality of the micro fauna?	UES/ Maestría en Gestión Ambiental	
28	Have you already calculated the vibration level of the engines, since you have high levels of vibration with motors from other plants and are perceived in our homes?	Col. Rasa 1	
29	Damages have been quantified by the various environmental factors. They mentioned 10 trees for each tree cut, how many trees will be affected?	UES/ Maestría en Gestión Ambiental	
30	What are the risks associated with the environment?	Col. Rasa	
31	How to control if the methods thought for the development and construction will be as they have been presented,	UES/ Maestría en Gestión Ambiental	

Table 8.25 – Opinions and Suggestions Delivered During the Assembly, Sorted by Theme (2016)			
N°	**Question or Comment**	**Institution or place of visit**	**Answers provided**
	example if the trucks did not pass through the city?		located in industrial location lands around the plant, there is already an industrial noise. Regarding the noise level, the engines that will be in the plant are new technology, reason why will not generate the levels of noise present in other plants.
32	Will it affect the environment?	Bo. El Campamento	
Project's Schedule			
33	When does the project start?	Bo. La Playa	According to our schedule the civil work will begin as established at the end of 2017 beginning of 2018 taking advantage of the year dry season and continue until 2019, by the end of 2019 will begin with the plant tests. The time that the project will work is established in the contract that for 20 years, but will continue to work for longer as well as other companies established in the country. At the moment it is in the phase of obtaining environmental permits, in fact this assembly of citizen participation is part of environmental impact study.
34	How long will the project work?	Kilo 5, Acajutla	
35	Do you already have the environmental permits?	Col. Obrera	
Employment			
36	What possibilities there are to take into account the new marines with all core courses?	Com. Santa Agueda	With regard to the requirements for each positions, it will be published in the course depending on the area in which they
37	Will the people who presented their personal curriculum be	Col. Acaxual 1	

Table 8.25 – Opinions and Suggestions Delivered During the Assembly, Sorted by Theme (2016)			
N°	**Question or Comment**	**Institution or place of visit**	**Answers provided**
	given the opportunity to work at the plant?		needed. Regarding discrimination, there will be discrimination by for sex, race, age. The number of fixed positions will be ready when the plant is in operation, but will be approximately 10060 people Within the limitations to apply, the only ones that will be are those established by the Labor Code. As the curricula delivery, all the people who have already submitted one or sent via email will be taken into account the selection process if requirements are met. It is recommended to send it as soon as possible either in our offices or even today, yet it is not the most appropriate time. The qualified workforce will be welcomed and there will be an opportunity for employment for all those who want to apply and have the skills to do so: There will be positions that, due to the technicality of their position, will require experience which will be evaluated in the selection process, but there will be no discrimination. Wages still can not be announced at the moment, but will be
38	As a student of electrical energy, soon to complete my studies, is there a probability of employment within the company?	Col. Ciudadela CEPA	
39	Can we leave the curriculum today?	Barrio La Playa	
40	In case of security delegates who will be part of the working group, what would be the monthly salary be?	Col. Acaxual 3	
41	The staff that will work in the construction will be people from Acajutla?	Col. Obrera	
42	What possibilities are there to apply to future jobs the inhabitants of the municipality who do not have experience?	Col. San Julian, Acajutla	
43	Is there a problem for sending the curriculum via e-mail, what is the process to apply?	Col. San Julian, Acajutla	
44	Will there be age limit to work, will there be age discrimination?	Col. Acaxual 1	
45	Will there be jobs for the youth of the communities?	Bo. La Playa	
46	What are the documentary requirements to obtain an employment opportunity?	Bo. La Playa	
47	Will you give chance to the people from Acajutla?	Col. El Milagro, Acajutla	
48	What will be the number of fixed positions that will be generated?	Caserío Comendari	
49	For job placement, will there be job fairs?	Acajutla Centro	
50	How will the hiring method be, will it be direct with the	Bo. Las Peñas	

Table 8.25 – Opinions and Suggestions Delivered During the Assembly, Sorted by Theme (2016)			
N°	**Question or Comment**	**Institution or place of visit**	**Answers provided**
	company or will there be other contracting companies?		competitive and will be in line with the position.
51	Will there be employment opportunities for transporters?	Ciudadela CEPA	Yes, it will be EDP the company that hires, and there will also be an outsourcing, but it has been discussed with them so that the priority is the local workforce depending on the needs of the project and if they meet the skills will have the opportunity.
52	EDP is committed to remunerate with a fair wage for the people that contracted to construct the plant, the salary must be according to our national reality?	ADESCOMAR	
53	Will there be opportunity for knowledgeable people in floatings?	Col. Acaxual	
54	At the construction phase will there be life insurance for employees?	Com. Santa Agueda	
Energy			
55	The energy of the natural gas plant has something to do with the common energy consumption of the community? Will it be the same cost or will it be less?	Comunidad Obelisco	Regarding the reduction or electric energy subsidy in households is not EDP the rates coordinators, but the Electricity and Communications General Super intensity which is the electricity sector that sets rates.
56	Have they considered any subsidy in the electricity bill for the homes of the Acajutla municipality ?	Col. Caracol	

8.5.3.6 Development of Additional Comments on the project

After responding to the written questions block, the people participating in the public consultation made comments openly to the public, regarding the implementation of the power plant. During this space, the following opinions were expressed:

Mr. Erick Osman Mazariego, fisherman, Com. El Barquito from the municipality of Acajutla consulted on the following:

- How is it going to mitigate the problems that will occur in the sector that work for and live ?
- How should we do in order that, together, the impact is minimum and so that the aid is according to the people needs of the people?
- How will they do with the engines vibrations, to not be felt in the houses?.
- There is a study on the "sedimentation", since you said that the marine currents go from south to north but we fishermen know that the currents go from north to south.
- Fight for the artisanal pier sedimentation.
-

Energía del Pacifico answered:
"Regarding the vibrations, the machines will be new, so you will not have problems with this, as you have with other companies".

Regarding "sedimentation" "if the sedimentation pier is not part of the compensatory measures to be carried out by EDP, and is considered as a social benefit for the community, the request will have to be channeled through the municipality, but they can be advised on how environmental permits can be obtained to carry out the sedimentation.

Lic. Sofía Guadalupe Paniagua, UES Master in Environmental Management, asked:

- Where will the liquefied gas come from, what will be the via of transportation, what leak risks could occur and what is the possibility that El Salvador will be in international litigation for some leak.
- Why is the methane gas produced by the country's organic solid waste not used?

Energía del Pacífico answered:
The origin of the natural gas will be through a supplier, on this issue there was a coordinated tender with SIGET where 20 international companies participated which wanted to provide gas to the project, the winning company was SHELL, which is a company with a worldwide trajectory level. The country of origin may vary.

Regarding methane production, this is a matter of commercial scale since what the country produces is about 6 to 9 megas and in this plant we need to produce an approximate of 380 megawatts.

Mr. Boanerges Almendariz, representative from Comunidad Alvarado:

- "Undoubtedly, this is a mega project and although all the measures are taken there is always damage and a risk around it, my question is: How will Acajutla compensate, in relation to the environment since there are always damages?.
- A 380-mega plant is huge, they talk about social responsibility of a little more than half a million dollars, which the profits percentage is what they allocate to social responsibility, since I feel that the amount they will give is too low for the existing needs.
- With the way how the projects of the community will be channeled, I consider that using the City Hall and the FISDL is to extend the bureaucracy. I can think of an idea that has already worked with other companies that appointed a Engineer to serve as a mediator between the company and us in which they didn't have access to the funds. The company was in charge of everything, because if the funds reach the City Hall, they can take another direction, it is not a question of giving us a blank check but to be audited and controlled by you.

Energía del Pacífico replied:

It is not that a blank check is going to be delivered to the City Hall or the FISDL, but EDP always manages the work executed by companies, contracted by EDP to comply with the request.
EDP does not choose the way in which this aid is carried out. Conditions that are already given through the tender. Likewise, within the rules of the tender, it is established that $ 1,500.00 per year must be delivered for each contracted megawatt.

Mr. Domerci Juarez representative from Comunidad Alvarado, commented:

- The industrial workforce of Acajutla is highly trained. We have made most industrial constructions. The Acajutla labor has to be included in this project.
- I consider that there has been no consultation with the population because they are going to establish new engines, but in 20 years they will be generating noise and you cannot hide that reality.
- In relation to the taxes payment there are companies that pay large amounts to other municipalities not where the projects are located since they pay them according to where their main offices are located and it is not fair that Acajutla is contaminated, and the taxes goes to other municipalities, that is the economic resource migrate to other municipalities.

Energía del Pacifico answered:

"There are certain things that cannot be changed, for example the place where municipal taxes are paid, those are the laws and must be fulfilled."
"The last word on which will be the works of social investments is up to the City Hall"

"With the generation of noise, the foundations where the engines will be, are much better than those occupied by other companies, so dampen vibrations, are guaranteed that even in 20 years, will not have the vibrations felt now".

Mr. Hilton Aguilar, commented

- "Communal leaders ask about the benefits because a few months ago the City Hall took over an assembly where 10 communities were invited. The event was attended only by 4 communities, at that meeting they were given a list of projects that were going to be executed in the 2017, and requested the signature and seal of the communities so that EDP carried out the projects like the lighting of the Obelisco up to the naval force among others."

He thanked EDP for being the only ones to carry out this type of citizen participation event.

Energía del Pacifico answered:
"It is unknown about that event. By no means EDP is being told about such projects, it is not necessary to send a letter signed by EDP, since it is the City Hall proposes the projects".

Photo 8.33 – Images of development of additional comments during the event

Source: Own Elaboration, Eco Ingeneiros, November 2016.

Photo 8.34 – Images of development of additional comments during the event

Source: Own Elaboration, Eco Ingeneiros, November 2016.

8.5.3.7 Development of the "Open House" or Open Space

After the question / answer section, as part of the methodology the "Open House" was carried out, which the attendees could circulate through the models that presented the engineering of the project, and also to appreciate in greater detail all the visual material Exposed through informative posters. During this activity, doubts or comments that would have remained on the part of the attendees could be answered in a more personalized way.

Photo 8.35 – Images taken during the development of "Open House or Open Space"

Source: Own Elaboration, Eco Ingeneiros, November 2016

Photo 8.36 – The Material part view displayed during the event

Source: Own Elaboration, Eco Ingeneiros, November 2016.

During the development of this space, the both consultant technical teams and EDP were very attentive to clarify any doubt at immediate time.

8.5.3.8 Final Considerations on the Pubic Consultation Event

In general, the event developed normally, some additional comments are provided:

- The people attending the event participated openly in the activity, expressing their opinions and comments on the project, which enriched the Environmental Impact Study elaboration process.

- In a positive way, actors/stakeholders who were part of the citizen participation process that has been taking place since 2014 to date attended it. On this occasion, the interest of community leaders, schools, fishermen's cooperatives, among others, was reaffirmed in order to run the power generation project in the Port of Acajutla.

- Population's assistance was very extensive, with the people participation residing outside the area of the project influence (Acajutla), even coming from the Sonsonate center which becomes a sample of the interest that the population has over the implementation of the project.

- The population perceives in a positive way the social responsibility that EDP develops and the sources of employment that are generated in thestage of construction phase and Project execution, mainly because they see that the benefits will be prioritized to the inhabitants in the zone of influence (Acajutla).

- There were a total of 88 people, including 16 women attending the event and 72 men. The participation of men was greater, since most community leaders and representatives of the interested groups are men. In any case, women as a vulnerable group consulted in the process of citizen participation expressing similar interests as men. That is, about being part of the hiring employees process that will require the project. In addition, they request support from EDP for the implementation of social projects for the benefit of their communities.

- The execution of social projects, as part of EDP's social responsibility, obtained positive opinions by the various sectors of the municipality, requesting support for the activities implementation for the communities benefit, schools, churches, health centers, among others. However, most actors do not agree with the mechanism for project development, which involves the municipality, since they consider that it would be more efficient if they could take their proposals directly to EDP.

Below is a photographic record (see Photos 8.38 to 8.41) of the event's development and each activities that comprised it. In Appendix 8S, the complete photographic record is provided, with more images taken during the event:

Photo 8.37 – Images of registration for the event by the participants

Source: Own elaboration, Eco Ingeneiros, November 2016

Photo 8.38 – The Presentation Development Images by the Architect Leonora Ferrer from the Consultant Company

Source: Own elaboration, Eco Ingeneiros, November de 2016.

Photo 8.39 – Attendees to Citizen Participation Event

Source: Own elaboration, Eco Ingeneiros, November 2016.

Photo 8.40 – Open House images

Source: Own elaboration, Eco Ingeneiros, November 2016.

8.5.4 Public consultation carried out by MARN

The Public Consultation process of the environmental impact study required by MARN was carried out, according to Art. 25 (a) of the Environmental Law. After the holder published by a printed medium of national circulation a notice for three consecutive days on the EsIA consultation. The EsIA Was available for consultation, for 10 business days after the last publication, at CIDOC, the Municipal City Hall(s) of the jurisdiction and MARN's website, so that any affected person expresses their opinions in writing to the CIDOC or the Municipal City Hall during that period. As reported by MARN, no comments were received.

8.6 Follow-up Activities on Public Consultation

For the presentation of the Final EsIA and the PMA, the last citizen consultation activities, developed since 2015, have been taken into account. Through this, it was possible to obtain basic material for both risk assessment and possible impacts assessment identified by the population of Acajutla. Following the EsIA presentation, the Acajutla population consultations will continue to be monitored through the communications office, telephone numbers and mail available to the public. This monitoring process will continue in parallel with the current review process and approval of EsIA. The study will be available for the public in the communication offices of the project, after the completion of the project.

8.6.1 Communications Plan during Construction and Operation Phases

Consultation activities during the construction and operation phases are subject to the contributions received during the elaboration of the EsIA, and will be required when implementing the Communications Plan. The following is a preliminary outline of the activities proposed during those phases. Project updates will be communicated to the public to inform communities of the activities to be developed for the Project, prior and during the construction and project start-up phase . An NGO is expected to serve as an assessment body to monitor the implementation of the grievance mechanism. A community liaison officer will be assigned, who will have the following responsibilities:

- Coordinate the periodic dissemination of information and Project updates, with the EDP contractor during the construction phases;
- Provide updates to be published on the website;
- Work with communities in the disclosure of information related to the Project and feedback from communities;
- Work with the NGO that will serve as an evaluator during the complaint response process;
- Receive and answer the questions of local communities; y
- Communicate the results of all the participation activities developed and coordinate the publication of "Annual Reports", which, among other things, will report activities with communities, environmental management activities and environmental and social monitoring activities.

The results of the consultation of those phases are therefore not presented in this report since they will be made after the delivery of this document to the MARN until the Project execution.

Energía del Pacífico

Project: LNG to Power
Chapter 9: Risk Assessment and Contingency Plan

December 2016 – 16-3489

ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

DILLON CONSULTING

9.0 Risk Assessment and Contingency Plan

The Project is in Front End Engineering Design (FEED) phase. During this step, the Project has been developed under a world-class best practice approach to ensure the safety of the Facilities. All activities carried out during the preliminary engineering and design phase have demonstrated that the Project's characteristics will be within the acceptable safety range. The rigor applied to the risk identification and analysis activities carried out to date has been in accordance with international standards for Projects at this phase of development.

During the FEED phase, several studies have been carried out to establish a preliminary-base design, identify technological challenges and feasibility. Studies have been developed to identify the impacts of climate and ocean dynamics in the Project. Technical requirements in terms of anchoring and maneuvering have been identified for the current conditions. Project-related risks, such as collision of vessels due to weather conditions, have been analyzed at this phase, and a quantitative risk study has been carried out to evaluate the risks of the Project that could affect people or the environment.

At this phase, contingency planning has been carried out to ensure that all necessary measures are applied in the event of any abnormal events occurring. At the end of the engineering and preliminary design phase, the financing feasibility and approval will be obtained. In addition, local regulatory review and local authorities approval are being carried out.

After obtaining construction permits and financing, the detailed design phase starts. This phase focuses on establishing the complete definition of all aspects of the Project. The design and engineering of the FEED phase is tuned. Security and risk studies, such as the detailed QRA, will be executed, considering all the detailed characteristics of the Project to be defined during this phase step. Among these characteristics are aspects such as piping and instrumentation. Fire and explosion hazards will be analyzed in greater depth and modeled to assess the impact to the public and the environment. The evacuation routes will be defined and the detailed final contingency plan will be developed.

Later, the construction, installation and start-up will begin. At this phase begins the inspections of marine infrastructure and classification.

To date, a Risk Identification and Quantitative Risk Assessment for the preliminary / high-level Project has been completed, assessing aspects such as process risk, potential threats, navigation, location, tsunamis, earthquakes, heavy rains and anthropogenic threats at the Project location, which could trigger events

such as fires and explosions, within the Project and affect the facilities themselves and the surrounding area, taking into account the use of hazardous materials.
The global firm Lloyd's Registry (LR) was hired to carry out identification and risk studies associated with the Project. These studies went through several phases and involved the participation of most of the interested parties in the Project identified.

The process is as detailed:

1. **Identification of Risks**; The first step consisted of Hazard Identification (HAZID), which included two workshops and collision analysis, among other assessments that were used as inputs.
2. **Quantitative Risk Assessment**, considering the results of the workshops, in addition to international standards in risk management.
3. **Conceptual contingency plan.** A conceptual contingency plan and emergency response plan have been prepared outlining the content of a more detailed Contingency Plan to be developed as part of the detailed design of the Project.

The first workshop was held on October 21, 2015 at the offices of Invenergy, Chicago. Experienced staff attended the workshop from Invenergy, Moffat & Nichol (M & N), Exmar, Dillon Consulting and Lloyd's Registry. Appendix 9A lists the attendance at the first workshop.

The Risk Identification workshop was held on January 18 and 19 at the Princess Hilton Hotel in San Salvador. The workshop invited potential stakeholders involved in the development of the Project, regulatory authorities and population that could be affected by the project's implementation. The workshop was attended by representatives of various entities such as the "Ministerio de Medio Ambiente y Recursos Naturales" (Ministry of Environment and Natural Resources MARN), the "Comisión Ejecutiva Portuaria Autónoma" (Autonomous Port Executive Commission CEPA), the "Autoridad Marítima Portuaria" (Maritime Port Authority AMP), Invenergy, EDP, M & N, Shell and Exmar. Appendix 9B presents the Marine HAZID report, LNG to Power Project, Acajutla, El Salvador, which includes the analysis performed and the workshop attendance list in detail.

For the preparation of the Quantitative Risk Study (QRA), all observations and comments made by the participants of the first and a second risk Identification has been considered. Once the Risk Study was completed, a final results presentation workshop was also held in El Salvador, with the participation of: Ministry of the Environment and Natural Resources (MARN), Autonomous Port Executive Commission (CEPA), Maritime Port Authority (AMP), Ministry of Economy (MINEC), Invenergy, EDP, M&N and Exmar. Subsequently, a period of 10 days was allowed to the participants to make additional comments to the Risk Study, which were incorporated in the final version of the document. In this last workshop, a preliminary contingency plan was also reviewed. The full risk study with full details is included in Appendix 9C.

In the Hazard Identification (HAZID) and Quantitative Risk Assessment (QRA), see Appendix 9B and 9C, the assessed scenarios requested in the Terms of Reference for the Project are provided.

- Present Risk identification
- Evaluation of the frequency and probability of occurrence, and
- Determination of the magnitude and impact they would bring for the public in general, the environment, and facilities.

The assessed elements include spill scenarios, for different points and operations in the plant, probability of occurrence, environmental conditions and risks, and possible consequences. Details of the analysis are provided in the appendix.

The results obtained are described below.

9.1 Hazard Identification (HAZID)

In the risk industry HAZID, workshops are widely used to incorporate local knowledge and focus areas into risk assessments and Projects. The main objective of HAZID is to identify the main credible hazards associated with the marine Project, possible causes / consequences, frequency, possible risk reduction measures and recommendations. The topics analyzed and results of the HAZID workshops are described below.

9.1.1 First High Level Risk Identification Workshop, Chicago

The first workshop was held on October 21, 2015 at the offices of Invenergy, Chicago. Experienced staff attended the workshop from Invenergy, Moffat & Nichol (M&N), Exmar, Dillon Consulting and Lloyd's Registry. The list of attendees is provided in Appendix 9A.

The objectives of this workshop were to identify the major risks to be considered in the design development of the maritime part of the Project. The topics and elements covered during the development of the first Risk Identification Workshop were:

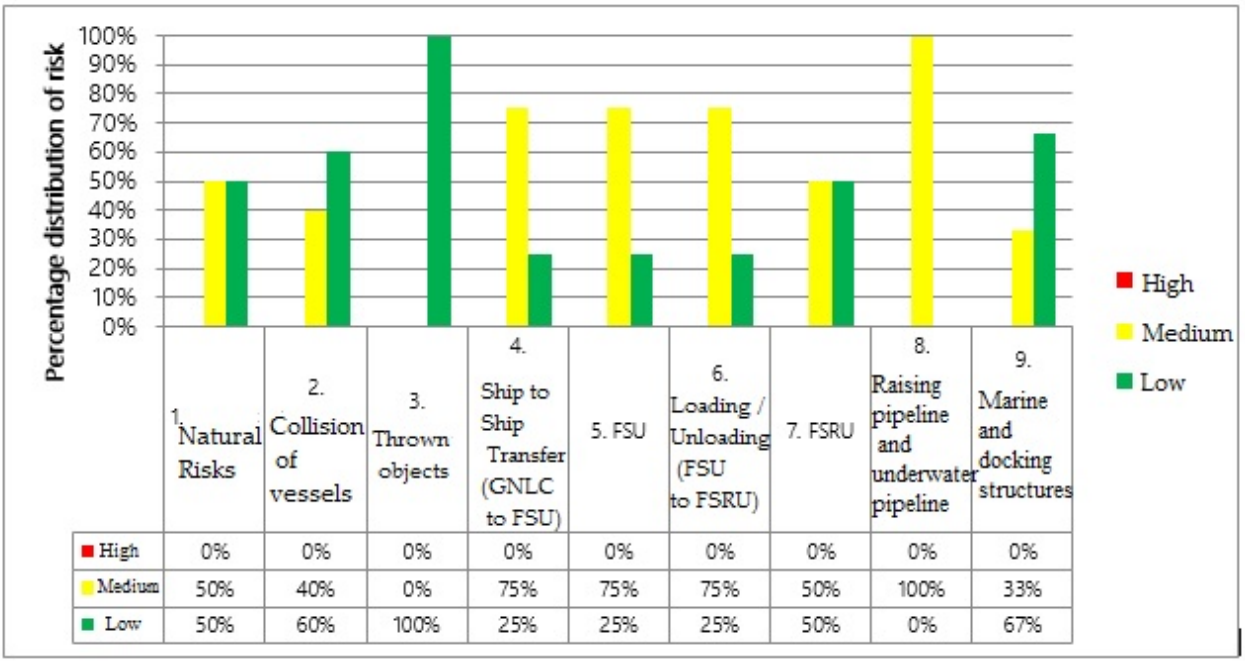
- Natural hazards (extreme weather conditions, hurricanes, wind, temperature, earthquakes);
- Vessel collision;
- Objects thrown;
- Ship to Ship Transfer (LNGC to FSU);
- LNG floating storage unit (FSU) (storage, marine systems, utility systems);
- Loading / unloading (FSU to the barge of the floating storage regasification unit (FSRU));
- FSRU (Storage, primary process, accelerated phase transition, utility systems);
- Raising pipeline and underwater pipeline; and

- Marine and berth structures.

9.1.1.1 *First HAZID Results*

During the first HAZID, 36 risk elements were reviewed, of which 19 were categorized as Medium Risk (53%) and 17 as Low Risk (47%). No High-Risk elements were identified. The distribution of risks per element is shown below in Figure 9.1.

Figure 9.1 – Distribution of Risks by Element, First Workshop of Hazard Identification



	1. Natural Risks	2. Collision of vessels	3. Thrown objects	4. Ship to Ship Transfer (GNLC to FSU)	5. FSU	6. Loading / Unloading (FSU to FSRU)	7. FSRU	8. Raising pipeline and underwater pipeline	9. Marine and docking structures
High	0%	0%	0%	0%	0%	0%	0%	0%	0%
Medium	50%	40%	0%	75%	75%	75%	50%	100%	33%
Low	50%	60%	100%	25%	25%	25%	50%	0%	67%

Source: Marine HAZID report, Project LNG to Power, Acajutla, El Salvador

The following conclusions were identified:

Given the location of the marine terminal, extreme weather conditions such as gravitational waves, tsunamis and seismic activity were identified as potential risk. Inherently, the proper design of the terminal and the process of undocking and leaving the LNGC ship and FSU when climatic conditions exceed the docking parameters, allows the mitigation of the consequences, in the case of occurrence of these events.

The short distance between the Marine Terminal and the Port of Acajutla, and the proximity of the access channel for the port, increases the risk of collision of ships with the terminal. For example, other ships may collide in the marine terminal and cause drilling in LNG storage tanks. In addition to the proper

terminal design (Dual Shell for the LNGC and FSU), mitigation measures could include a restriction zone and reduced speed in the proximity of the marine terminal.

Another risk related to the presence of other ships in the surroundings of the terminal is the occurrence of objects thrown or anchors dragged in the submarine pipeline. This situation can cause gas leaks to the environment, but can be mitigated by designing the pipe to withstand blows of foreign objects and the definition of a non-anchoring zone in the pipeline route, which will be represented in a nautical chart.

9.1.2 Second Hazard Identification Workshop, San Salvador

The second Hazard Identification workshop was held in El Salvador. For this workshop, Energy of the Pacific invited all those involved in the project development, regulatory authorities and population that could be affected by the project's implementation. The Risk Identification workshop was held on January 18 and 19 at the Princess Hilton Hotel in San Salvador. See appendix 9B "HAZID Marine Report, LNG to Power Project, Acajutla, El Salvador".

The main regulatory agencies, interested parties, and participants in the project, such as the AMP, MARN, CEPA, Invenergy, Moffatt & Nichol, Exmar, Shell, EDP and Lloyd's Register attended.

In the second HAZID two methodologies were used, in addition to the HAZID, an assessment of simultaneous operations was performed. Both are described below.

9.1.2.1 *Second HAZID Results*

A total of 26 risk elements were discussed in the HAZID, 20 of which were classified by risk. The remaining six items were not identified as major hazards, but were discussed in the workshop and captured on the worksheet without risk classification. The tables below show high-level summaries of the results of risk distribution of total risks based on the risk classification category, with and without established mitigations.

65% items were identified as high-risk hazards without mitigation measures, while 35% of the items were identified as medium risk. Considering the mitigations measures, the items were identified as medium and low-risk.

In addition to the typical hazards encountered at most LNG import terminals worldwide, specific findings were identified, considering local conditions and the location of the Maritime Terminal such as:

- Location CEPA approach navigation channel, proximity to the Port of Acajutla, CENERGICA mooring zone and traffic of ships entering and leaving the Port of Acajutla, increasing the potential of vessels collision;

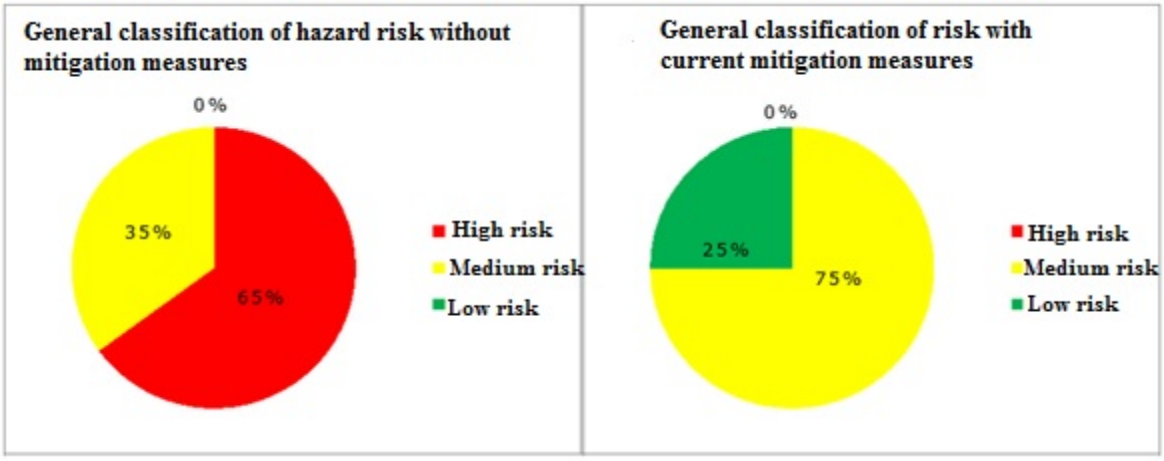
- Vessel traffic in the area, which may result in anchors being dropped or dragged into the proposed submarine pipeline;
- Possible local external threats;
- Extreme climatic conditions of waves and tsunamis due to the seismic activity of the Mesoamerican trench subduction zone in the coast of El Salvador;
- Possible limitation of resources available, to deal with two simultaneous serious accidents;
- No significant risks related to the specific operation of transfer of liquefied natural gas (LNG) from a floating storage unit (FSU) to a floating storage regasification unit (FSRU), maneuvers and mooring at night, space for keel, coastal communities, and visibility, have been identified; and
- No major risks generated by the LNG Terminal were identified to impact the two fuel terminals of Alba Petróleos (Oil Company) and RASA, or vice versa.

Safeguards will, however, be in place to mitigate these risks. Safeguards include, but are not limited to, inherently safe design, safety zone perimeter, reduced speed around the import terminal, pilot on board and vessel assisted by two tugs, Automatic Identification System (AIS), marine traffic control tower regulation, and no anchoring area above the subsea pipeline.

9.1.2.2 *Analysis Results of Simultaneous Operations*

A total of 270 simultaneous operations (SIMOPS) were discussed in the session. The overall results are shown in Figure 9.2.

Figure 9.2 – Analysis Results of Simultaneous Operations



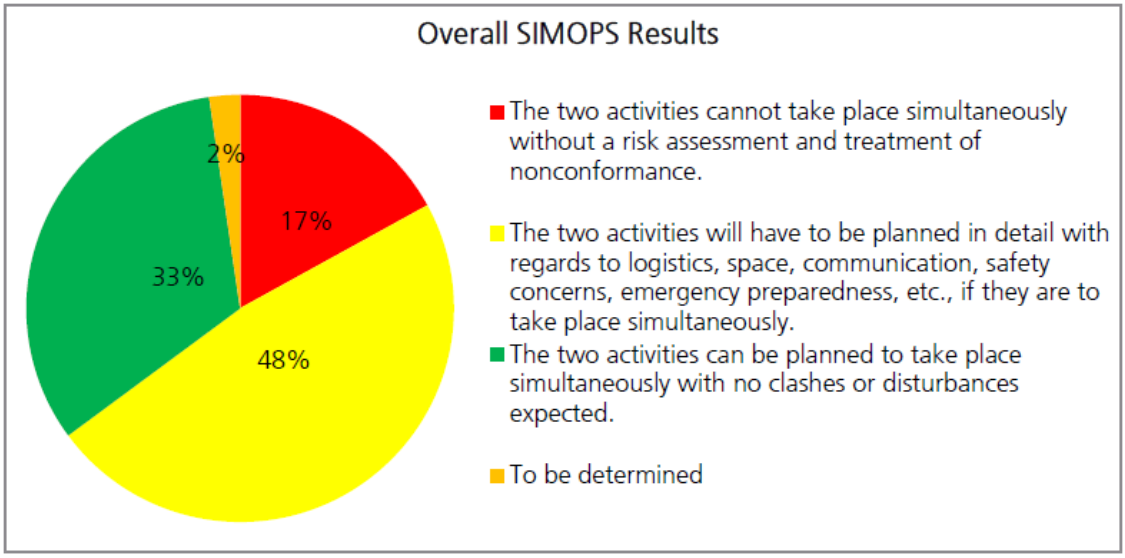
Source: Marine HAZID Report, LNG to Power Project, Acajutla, El Salvador

Findings from the SIMOPS include, but are not limited to, the following:

- With the current available resources (pilot and tugs) and the requirement to assist oil tanker/LNG carrier (LNGC) inbound from the pilot boarding area with a pilot and two tugs, oil tankers will not approach or depart the Cenérgica area while the LNGC is in transit to the pilot boarding area or to Marine Terminal;
- Normal operations at the Port of Acajutla can be performed at the same time as LNGC movement or as normal operations at the LNG Terminal.
- If an LNG leak or fire occurs on Marine Terminal, all inbound and outbound traffic should be stopped. It is identified that operations at the Port of Acajutla should be planned in detail if they are to continue in the event of an LNG leak or fire on Marine Terminal.

The results are shown in Figure 9.3.

Figure 9.3 – SIMOPS General Results



Source: Marine HAZID Report, LNG to Power Project, Acajutla, El Salvador

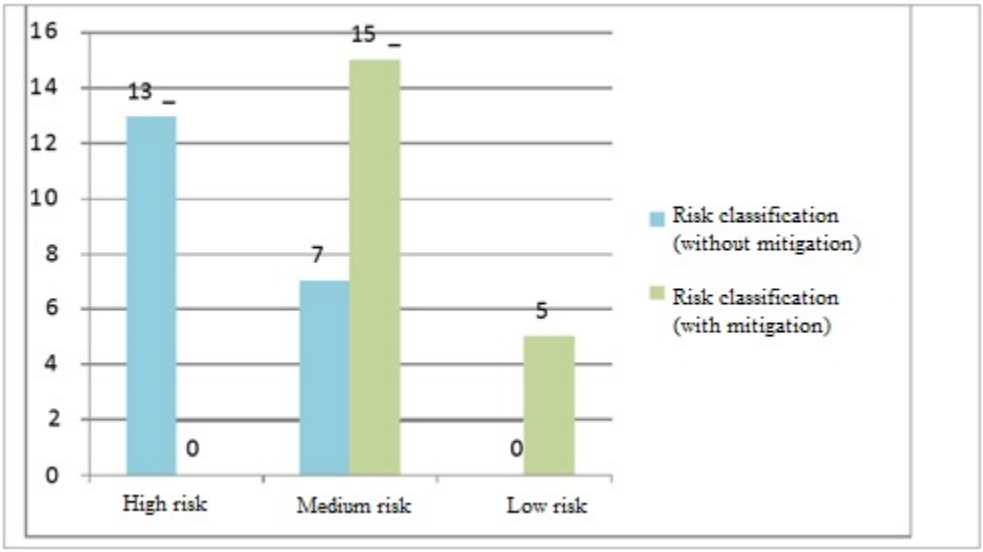
HAZID y SIMOPS General ***Results***

Twenty-six recommendations were identified in the HAZID, and five recommendations were identified in the SIMOPS.

Twenty-six hazards were discussed in HAZID, 20 of which were classified as hazardous. The remaining six items were not identified as major hazards, but were discussed in the workshop and captured on the worksheet without risk classification. The HAZID Worksheet can be found in Appendix A of Appendix 9B.

Figure 9.4 shows the number of items by risk category without and with mitigation measures in place. Medium and high-risk mitigation elements in place will be considered for further analysis, such as quantitative risk assessment (QRA) and / or emergency planning study, as opposed to low risk elements.

Figure 9.4 – Number of Items by Risk Classification Category with and without Mitigation



Source: Marine HAZID Report, Project LNG to Power, Acajutla, El Salvador

The distribution of hazard risk classification items with and without mitigation measures in place is shown in Figure 9.5 and Figure 9.6 respectively.

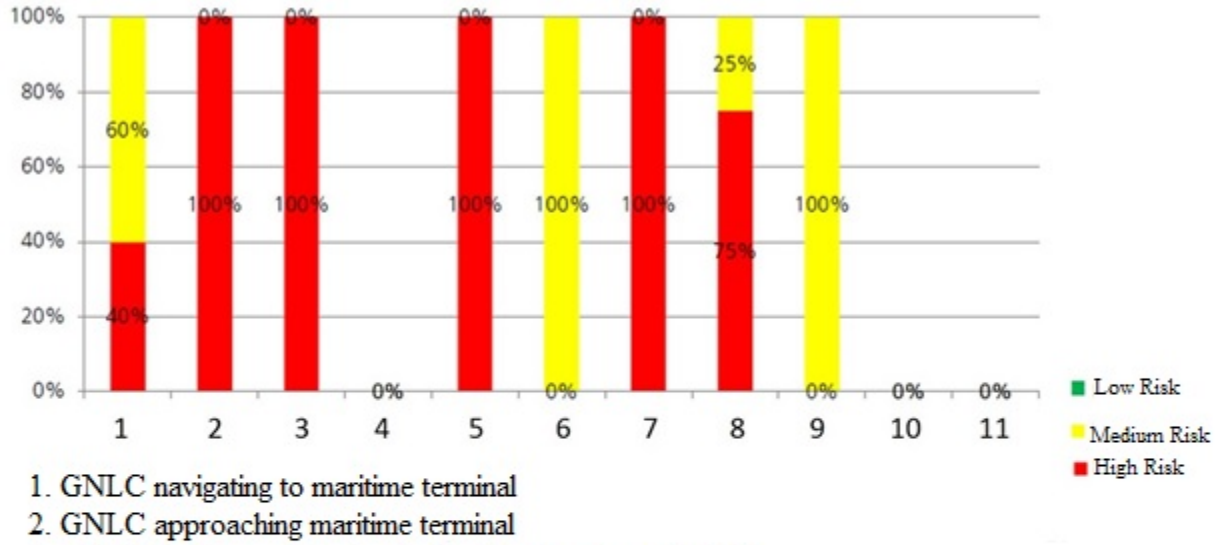
The following is concluded:

- The short distance between the import terminal and the Port of Acajutla and the proximity of the maritime lane to the import terminal for incoming and outgoing traffic on the port increases the risk of a collision of ships with the import terminal. In addition to the design intrinsically safe (LNGC double shell and FSU), the mitigation measures include AIS in boats, tower of maritime traffic control, vessel traffic system (VTS), reduced speed in the area (less than 3 knots) Pilot and two tug boats to and from the boarding area of the pilot. Currently, there are only two tugs available; as a result, it is only possible to a movement of a ship at the same time in the area, which reduces the risk of collisions of ships. It has carried out an analysis of the risk of collision of vessels; Results can be found in Appendix C. Appendix 9B MARINE HAZID REPORT.
- The navigation channel currently is not visually traced (Figure 2.5), and it is recommended to consider the formal definition of a navigation path.
- Another risk associated with the presence of other ships near the facility is the presence of a dropped or drawn anchor in the underwater pipeline. This can lead to the release of gases into

the environment, but is mitigated by the design of the pipe to withstand shocks of foreign objects and the definition of an anchoring zone in the pipeline route, which will be represented on the charts.

- There is a security risk related to the location of the Marine Terminal, as there are local threats. A patrol / safety vessel will be present to mitigate the risk and restrict traffic around the facility.
- No major hazards related to FSU's specific FSU LNG transfer operation, maneuvers and mooring at night, clearing of underwater areas, coastal communities and visibility were identified.
- No major hazards caused by the LNG terminal were identified to impact the Alba Petróleos Terminal and the RASA Terminal or vice versa.

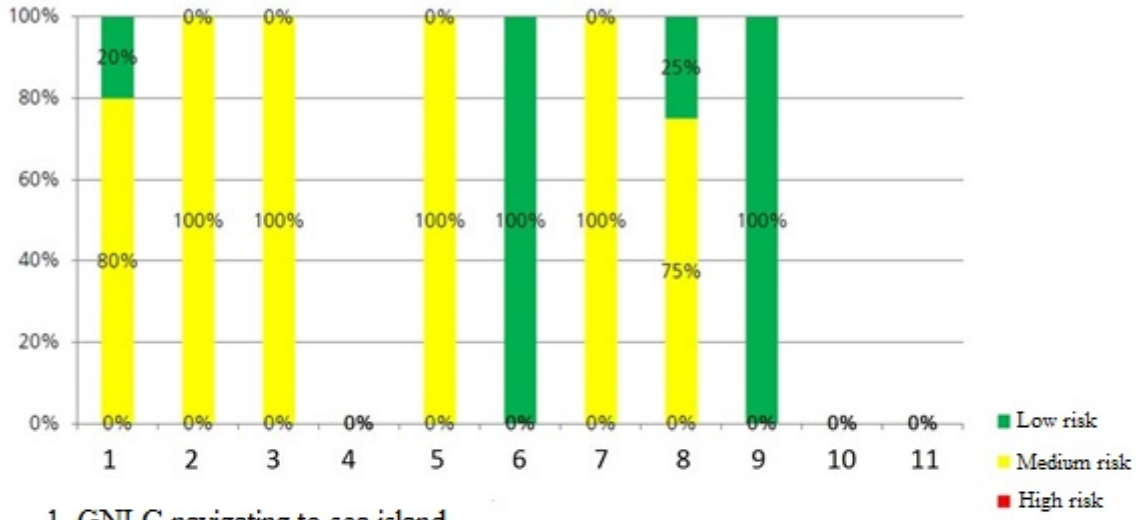
Figure 9.5 – Distribution of Items of Risk Classification by risk, without Mitigation Measures



1. GNLC navigating to maritime terminal
2. GNLC approaching maritime terminal
3. GNLC tied to maritime terminal to download or only FSU
4. Transfer of LNG from the FSU to the FSRU
5. Transfer of NG to ground through underwater pipelines
6. Navigation problems
7. Safety and Other Hazards
8. Emergency Situations
9. Climatic Conditions
10. Albapetroleos Terminal
11. RASA Terminal

Source: Marine HAZID Report, Project LNG to Power, Acajutla, El Salvador

Figure 9.6 – Distribution of Risk Classification by Hazard, with Mitigation Measures



1. GNLC navigating to sea island
2. GNLC approaching sea island
3. GNLC tied to sea island to download or only FSU
4. Transfer of LNG from the FSU to the FSRU
5. Transfer of GN through underwater pipelines
6. Navigation problems
7. Safety and other hazards
8. Emergency situations
9. Albapetroleos Terminal
10. RASA Terminal

Source: Marine HAZID Report, Project LNG to Power, Acajutla, El Salvador

9.1.3 HAZID Recommendations

Twenty-Six Recommendations were identified in the HAZID and listed in Chart 9.1. The recommendations will be further studied and will be considered during the design and development phase of final procedures.

Table 9.1 – HAZID recommendations

ID	Recommendations	Risk Classification (After mitigation)
1.1	Consider operational procedures to ensure proper pilotage and tug assistance to approach LNGC to avoid clashes and / or collisions.	M

Table 9.1 – HAZID recommendations		
ID	**Recommendations**	**Risk Classification (After mitigation)**
1.1	Set the points at which towing assistance must be in place before continuing to the final destination.	M
1.1	Identify the needs of aids to navigation.	M
1.5		L
3.1		M
3.2		M
3.3		M
1.2	Investigate the exclusion and/or safety zones for the transit of LNGC	M
2.1		
8.2		
1.2	Set by the procedure the requirement of having the escort tug for LNGC.	M
1.2	Consider establishing designated pilot boarding area (s).	M
	Consider regulating a formal transport lane for ships sailing to / from the Port of Acajutla to the southwest and validate in marine simulations. Ensure that the formal proposal has sufficient supporting documentation (marine simulations) when submitted to the Maritime Administration.	
1.2	It is recommended to hold a meeting to involve all parties affected by the change of placement of the channel (lane of embarkation) (AMP, pilots CEPA, teacher of mooring Cenérgica). It is recommended to mark the boarding lane with visual markers. Make sure that access to other terminals remains secure under the new scheme.	M
1.2	Identify the circle of rotation for the LNGC maneuver and approach to the Maritime Terminal and coordinate with AMP and the Port Authority. Consider the PIANC and SIGTTO regulations to determine the turning radius.	M
2.1		M
1.4	It is recommended to carry out bathymetry studies for navigation areas.	M
3.5		M
1.5	Consider evaluating the operational procedures to ensure adequate piloting service and towing assistance to approach LNGC and avoid collision.	L
3.1	Evaluate towing requirements (requirements, procedures) for the passage of ships to the sea, ships entering / leaving the port.	M
3.2		M
3.3		M
3.4	Develop pipeline protection as part of the design. It is recommended to include a restriction zone around the pipeline path.	M
5.1		M
3.4	Develop protection of the riser as part of the design.	M

Table 9.1 – HAZID recommendations		
ID	**Recommendations**	**Risk Classification (After mitigation)**
3.5	Investigate the composition of the seabed in the geophysical study.	M
5.1	Consider the visual marker to indicate the physical location of the pipeline. Make sure that the appropriate markers are in place to prevent fishing vessels from anchoring in the pipeline area (Indication on nautical charts and direct communication with fishermen).	M
6.1	Consider limiting the approach / exit of a ship at a time from or to the mooring zone of Cenergica or the Port of Acajutla or the LNG Terminal.	
6.1	It is recommended that you provide to the local pilots and operators of tugs the familiarization and training necessary to manage the LNGC.	L
6.2	It is recommended to start tying operations and maneuvers for the LNG Terminal during the day. The night departures will be simulated to determine the preliminary acceptability.	-
6.3	The distance between the bottom of the boat and the seabed, needs to be analyzed for moored vessels.	-
7.1	When the terminal is operating, and running on, the fishing activity will be attracted to the terminal. Ensure that security / safety and exclusion zones are proposed and instituted with respect to fishing and traffic near the terminal.	M
7.1	The International Ship and Port Facility Security (ISPS) plan for the terminal should consider local security concerns.	M
7.1	It is recommended that the Project commits itself to the national government to ensure that the government provides security measures for external threats to this international investment Project.	M
7.2	The quantitative risk Assessment (QRA) for the Project will address the risk to third parties and coastal communities (nearby populations).	-
9.1	Consider stopping the LNG transfer from LNGC to FSU and from FSU to FSRU in the occurrence of showers.	L
9.2		L
9.1	Include showers in the scenarios of marine simulations.	L
9.2		L
9.2	It is recommended to clearly define the environmental limits	L

Source: Marine HAZID Report, Project LNG to Power, Acajutla, El Salvador

9.1.4 SIMOPS Recommendations

As a result of the SIMOPS, the following recommendations are considered:

- With the current resources, available (pilot and tugs) and the requirement to help the oil / LNGC that enter from the pilot boarding area with a pilot and two tugboats, oil tankers will not approach or leave the area of Cenergica while a LNGC is in transit to the pilot boarding or up to the marine terminal.
- Normal operations in the port of Acajutla, can be done at the same time as the LNGC movement or normal operations in the LNG terminal. For example, while the LNGC approaches or leaves the Maritime Terminal, or LNG is transferred through the pipe to ground, the normal operations of the port of Acajutla, such as downloading or handling of materials, can continue.
- If there is a LNG leak or a fire at the Maritime Terminal, all incoming and outgoing traffic must be stopped. It is identified that the operations in the Port of Acajutla should be planned in detail if they are to continue in case of a LNG leak or a fire in the Maritime Terminal.
- The discharge of hydrocarbons in the terminal of Alba Petróleos or in the terminal of RASA can be carried out at the same time as the normal operations in Maritime Terminal and as a focus or a departure of LNGC.

The following SIMOPS recommendations and comments, included in Chart 9.2, will be studied and, if applicable, will be considered during the design and development phase of final procedures.

Table 9.2 – SIMOPS Recommendations

ID	Recommendations [R]/Comments [C]
2	[R] It is recommended that the Project determine if it is necessary to increase the anchorage / staging area or to assign specific anchorage areas before the LNGC enters the area.
3	[R] It is recommended that the Project obtains the operations manual and emergency preparedness procedures from the port and other terminals.
8	[R] It is recommended to determine if the resources in the Port of Acajutla are sufficient in terms of emergency response capacity for the occurrence of two accidents at the same time, for example: 1) LNG leaks in the LNG Terminal and oil leakage in the Cenérgica mooring area; 2) LNG in LNG Terminal and fire in Port of Acajutla). Mitigation measures could be to stop the transfer and production to avoid two accidents at the same time.
9	[R] It is recommended to run a simulation in the QRA to cover the consequences of a natural gas vapor escape.
10	[R] It is recommended to evaluate the frequency of scenarios that have a consequence in port operations and, potentially, determine contingency planning for these situations.

Source: Marine HAZID Report, Project LNG to Power, Acajutla, El Salvador

9.2 Quantitative Risk Assessment (QRA)

The Quantitative Risk Study (QRA) considered all observations and comments made by the participants of the first and second risk identification workshop.

Lloyd's Register (LR) was contracted to conduct a Quantitative Risk Assessment (QRA). A production rate of 140 million standard cubic feet per day (MMSCFD) of natural gas (NG) as a base case. In addition, EDP plans to develop the LNG import terminal in the future to include a third additional train to achieve a production rate of 280 MMSCFD of natural gas. This future development is also discussed in the QRA. The scope of the QRA includes the LNG import terminal to the isolation valve pipeline on the ground (also referred to in this report of the emergency shut-off valve on the ground). The Project was presented to all interested parties during the workshops under the assumption that the FSRU's capacity would be 50,000 m3; However, it later became apparent that an FSRU storage of up to 100,000 m3 could be required to meet Project delivery requirements. Due to the limited contribution of the FSRU scenarios to the overall risk, the increase in storage capacity is not expected to materially affect the outcome of the QRA results presented in this report.

9.2.1 Objective

The main objective of the QRA at the Front-End Engineering Design (FEED) phase is to examine the potential risks to the environment and the public as a result of significant and worse, and credible, events at the LNG import terminal and associated infrastructure. In addition to support the Project's Environmental Impact Assessment (EIA).

9.2.2 Methodology

The risk posed by the Project is assessed in the FEED based on an identification of 13 major and worst credible scenarios identified in the HAZID sessions that took place prior to the QRA. For each scenario, the following is analyzed:

- Scenario description
- Frequency analysis
- Consequence assessment
- Risk assessment as a combination of frequency and consequence
- Risk assessment with risk criteria and recommendations to reduce risk

The risk acceptance criteria used in the QRA are shown in Table 9.3.

Table 9.3 – QRA Criteria of Acceptance Criteria		
Risk region	**Description**	**Average Criteria of Individual Public Risk (IR) (Annual)**
Intolerable risk	The requirements of authority, corporate requirements, international standards and best practices jointly define a higher level of risk above which the risk is unacceptable. Intolerable risk cannot be justified except in extraordinary circumstances.	≥ 1E-04
Tolerable risk, whenever the risk is ALARP	Approaches recognized and accepted across the industry demonstrate that an adequate level of scrutiny and mitigation has been applied to the risks arising from identified hazards and that the residual risk to the public and the environment is As Low As Reasonably Practicable (ALARP).	1E-06 < IR < 1E-04
Risk widely acceptable	These risks are generally regarded as insignificant and adequately controlled.	≤ 1E-06

Source: Quantitative Risk Assessment

Individual iso-risk curves (LSIRs) are often used in the early phases of Project planning and are considered conservative in estimating risk to the public. The LSIR measures the risk to nearby areas (industrial or public areas) and is used in this QRA to measure Project risk to the public and indirectly to the environment. The LSIR is calculated for two locations: LNG import terminal (synonymous with Marine Terminal) and land location.

The ALARP methodology to evaluate risk reduction and mitigation is applied in conjunction with good engineering practices, legislative requirements, codes and standards. The ALARP principle is widely recognized in the industry to demonstrate that the appropriate level of scrutiny and mitigation measures to be applied to the identified risks and that the residual risk to workers, the public and the environment are ALARP.

The requirements of the authorities, international standards, and best practices together define the level of risk considered unacceptable. In unacceptable region, the risk cannot be justified except for extraordinary circumstances.

9.2.3 Results

The results of the individual risk (IR) by location of release of the process are provided in Chart 9.4.

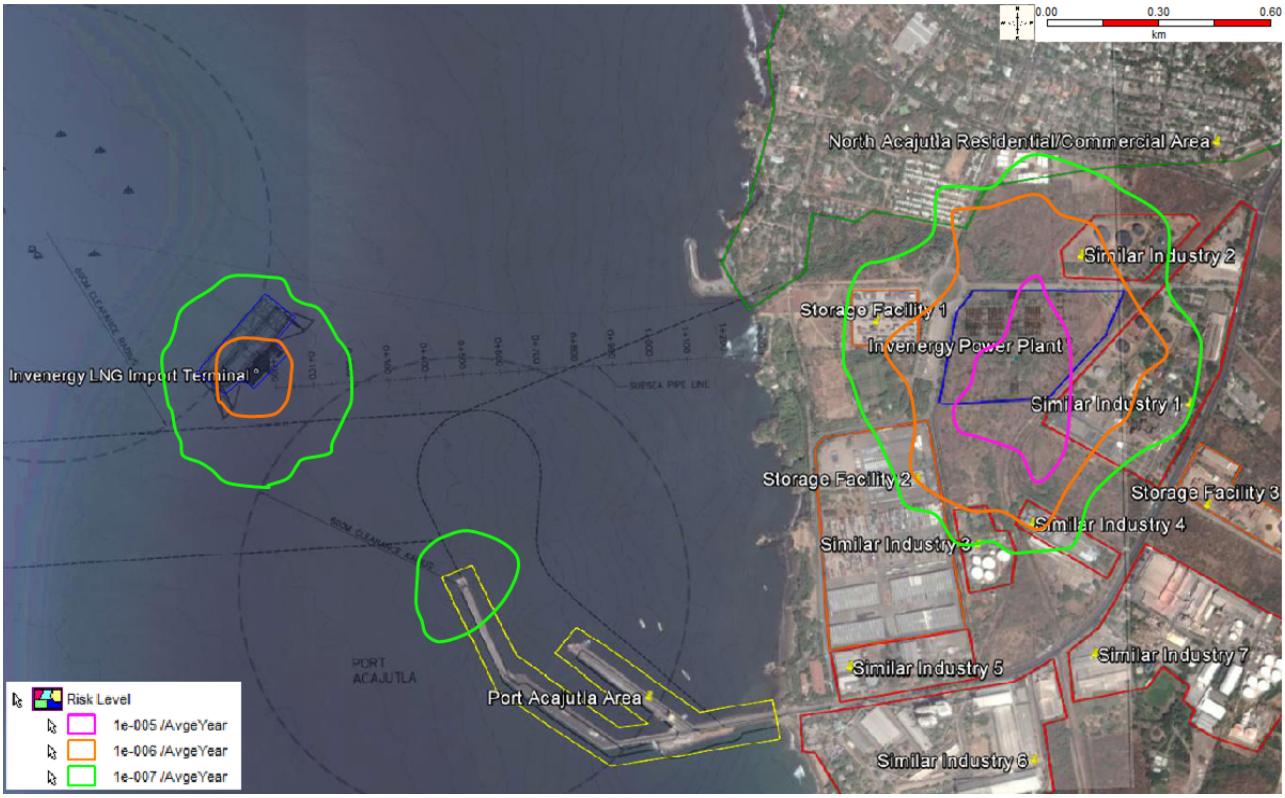
Table 9.4 – Results of Individual Risk (IR)		
Location of the release process	**IR per year**	**Risk Region**
LNG Import Terminal	8.89E-07	Widely acceptable
On the ground	3.49E-05	ALARP

Source: Quantitative Risk Assessment

On the one hand, the results show that the risk in the LNG import terminal is within the range widely acceptable per the criteria of risk (≤ 1E-06 per year). The largest contributor to the risk is the liberation of the load arm FSU to FSRU. Given the high flow and pressure, the event will lead to a large release of LNG, giving rise to dispersion of gas, fire-jet and events of the pool fire . On the other hand, the risk in the location on land falls within the risk region ALARP (between 1E-04 per year and 1E-06 per year). The major contributor is the release of the input ESD valve on the ground due to the large inventory of natural gas pipeline of the lifting platform and its high flow.

The iso-risk contours of LSIR for both sites are shown in Figure 9.7.

Figure 9.7 – Iso-Risk LSIR Contours for LNG Import Terminal and Land Location



Source: Quantitative Risk Assessment

9.2.4 LNG Import Terminal

The ISO-risk LSIR contours for the LNG import terminal fall within the region of widely acceptable risk. As a result, all public areas close to the LNG import terminal are considered acceptable based on the risk acceptance criteria.

The orange risk curve (1E-06 per year) is located around the import terminal and does not reach the current transport lane. The green risk curve (1E-07 per year) reaches the sea, but corresponds to a risk that is widely acceptable (≤ 1E-06 per year) and as such no further mitigation measures are required for the public and the environment. Figure 9.7 also shows a green hazard curve in the port of Acajutla due to potential sources of ignition in the port that can ignite a gas cloud if exposed. Although it is an unlikely event, the gas cloud can be extended to the port. However, the LSIR iso-risk curve is a magnitude of 1E-07 per year, which is within the widely-accepted risk region.

9.2.5 Land Location

All LSIR iso-risk contours are within the ALARP risk region (1E-06 per year <IR <1E-04 per year) or in the region of widely accepted risk (IR ≤ 1E-06 per year). The pink risk curve (1E-05 per year) could reach adjacent industrial areas.
The other two curves (orange: 1E-06 per year and green: 1E-07 per year) represent the iso-risk contours that lie within the widely acceptable risk region and no additional measures are required. The risk for ground localization meets the risk criteria, is within the ALARP region and sensitivity analyzes were performed to analyze possible risk mitigation measures within the ALARP region.

9.2.6 Future Development Results

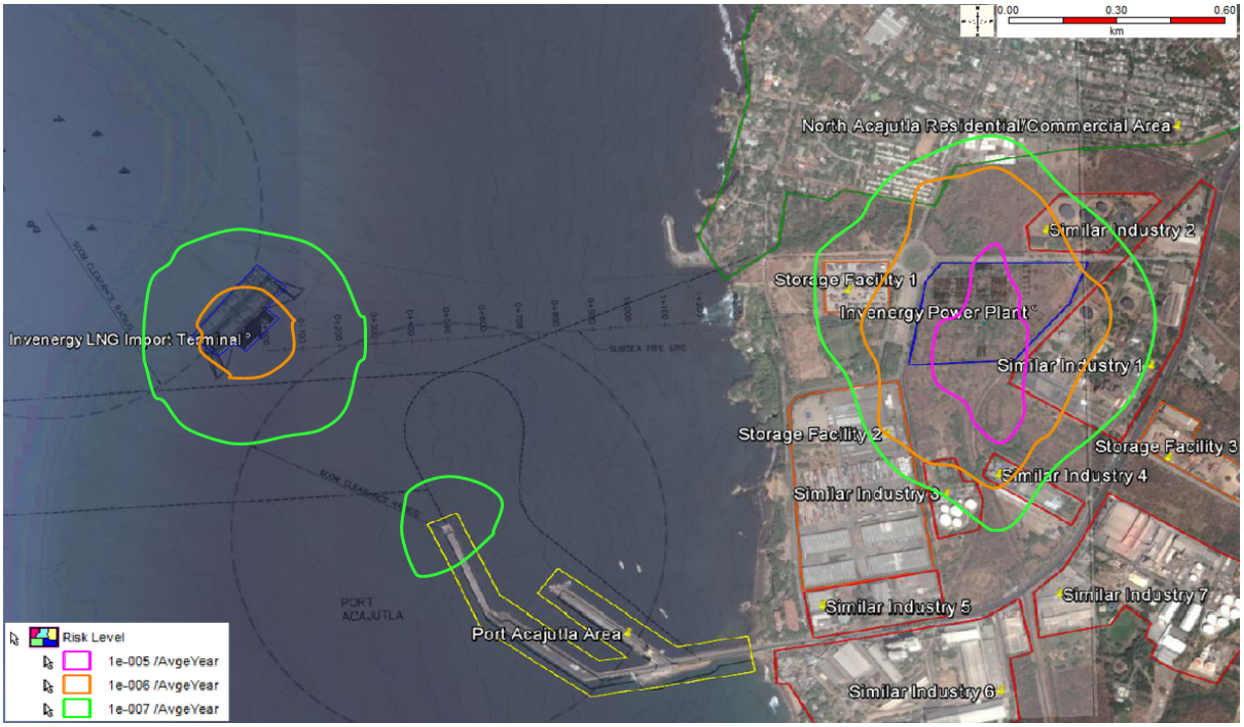
The individual risk of development (IR) of the output rate results of 280 MMSCFD per process release location is provided in Chart.5. Figure 9.8 shows the future LSIR iso-risk contours for both locations.

Table 9.5 – LSIR Results

Location of the launch process	IR per Year	Risk region
LNG import terminal	8.95E-07	Widely acceptable
On land	3.89E-05	ALARP

Source: Quantitative Risk Assessment

Figure 9.8 – LSIR Iso-Risk Contours for the LNG Import Terminal and Land Location in case of Future Development



Source: Quantitative Risk Assessment

The results show that the risk in the LNG import terminal is within the broadly acceptable range according to the risk criteria (≤ 1E-06 per year). The risk in the onshore location falls in the ALARP risk region (between 1E-04 per year and 1E-06 per year). The main contributor is the release of the ground-based ESD valve due to the large inventory of the natural gas pipeline of the lifting platform and its high flow rate. These results are similar to the base case with a production rate of 140 MMSCFD, but have an increase in individual public risk of 11.3% for ground emissions and 0.6% for LNG terminals. This increase in risk is expected with greater natural gas flow and additional third line.

9.2.7 Conclusions

In summary, the QRA Study developed in the FEED phase did not identify LSIR in the region of intolerable risk according to risk acceptance criteria. The public and the environment are not exposed to unacceptable risks from the EDP Project. During the detailed design phase another detailed QRA Study will be developed which will consider advanced design aspects such as piping and instrumentation diagram/drawing, P & ID's. It should be noted that under the final design inputs the ISO- risk LSIR contours could change in breadth. The Project will be designed to ensure that the risk region is ALARP by applying all the measures detailed in Section 9.2.8 and others that arise from the detailed design phase.

The LSIR iso-risk contours can be used to determine more stringent exclusion zones. For example, the pink hazard curve at the ground location extends approximately 190 meters south of the power plant and can be used to define an area where the public should be restricted from entering. The orange risk curve at the LNG import terminal extends approximately 90 meters from the edge of the terminal and can be used to define a maritime exclusion zone where unauthorized traffic should not be allowed. The LSIR is an input to define the range of safety zones. However, other inputs not included in the LSIR, such as security risk, may require a larger marine exclusion zone.

The QRA shows that the risk of the LNG import terminal exposing the shipping lane is widely acceptable since the green and orange curves that reach the lane of shipment fall within the region of widely acceptable risk. In general, the shipping lane is acceptable as it is. However, the Project may consider moving the maritime lane out of region 1E-07 per year for other reasons not reflected in the LSIR, such as safety risk, required turn radius for ships or traffic control. Another option is to advise ships to navigate inside and outside the port of Acajutla further south, below the currently marked traced maritime lane.

The detailed QRA will investigate the mitigation measures for the potential release of natural gas from the terrestrial inlet ESD valve, similar to what has been investigated in cases of sensitivity in the QRA.

At the detailed design phase, the design of shelters and process equipment buildings at the LNG import terminal will be analyzed to minimize confined spaces to reduce explosion events. Explosion scenarios were not analyzed in the FEED phase. Explosion events will be analyzed in more detail in detailed engineering as is typically done.

Accidents at the LNG import terminal and the power plant area may affect the nearest neighboring industry. An active fire protection, such as gas detectors, will be installed around the facility, and an emergency response plan will provide a process to notify people at neighboring facilities and at the LNG import terminal during an emergency event related to LNG or NG.

9.2.7.1 *Gas Detection*

Gas detectors will be added in the port of Acajutla, if they are not already installed, and an alarm system and an emergency response plan will be coordinated, including the port in case of an incident at the LNG import terminal.

Appropriate gas detection will be provided by ultraviolet (UV), infrared (IR), electro-catalytic or other detectors based on their suitability for site and based on cost-effectiveness. For areas near the maritime terminal, the Project will use point-type (IR or catalytic) gas detectors for off-site alerts / directions. The type of instrument and the level of integrity will be similar to those of marine installations. These will be

separate packages of gas detectors with certified panel / detectors / light / alarm / basic interface and communications. The typical layout is as follows:

- 2 integrated gas detectors in a dedicated certified panel with a red stroboscopic light and an audible alarm.
- The panels only need an external power supply and means to communicate with the control rooms.
- Functionality is typically as follows:

a) The signal reception of 1 of every 2 instruments will indicate a possible gas detection and the unit will notify the Control Room and possibly the Fire Department of a possible problem.

b) The reception of signal of 2 of every 2 instruments is a confirmed gas detection and initiates the stroboscopic light and the audible alarm, notice to the Operator and possibly to the Fire Department. Signaling scheme 2 of 2 is used to prevent false alarms that can disturb the public.

- Independent fire and gas specialists will certify the panel and recertify the facility on a regular, most typically on an annual basis.

9.2.7.2 *Safety zones*

The QRA did not identify IR in the region of intolerable risk as defined in Section 4.1. Therefore, based on risk acceptance criteria, the public and the environment are not exposed to an unacceptable risk. ALARP regions and widely accepted risk regions have been identified.

9.2.7.3 *Power Plant on land*

The LSIR curves of the power plant on land are in the tolerable region, since the risk is ALARP and is defined by the risk curve 1E-05 per year (pink risk curve in Figure 8.3 of the QRA Study) and 1E-06 per year (orange risk curve in Figure 8.3 of the QRA Study). This region encompasses the entire onshore power plant and the nearest neighboring industries by the power plant. The orange contour of the iso-risk goes about 340 meters in the neighboring industry from the edge of the ground power plant.

The 1E-05 risk curve per year for the ground-based power plant extends beyond the limits of the power plant to approximately 190 meters south of the plant and can be used as an exclusion zone where the public must not be allowed to enter.

9.2.7.4 *LNG Import Terminal*

The calculated IR for the LNG import terminal falls into the acceptable region as defined in Section 4.1 of the QRA Study. No LSIR was found in the region of intolerable risk or in the ALARP region. The orange iso-risk curve (1E-06 per year) extends approximately 90 meters from the edge of the LNG import terminal. This region can be used to define the marine exclusion zone where no traffic or unauthorized public should be allowed to enter.

The LSIR contour is an input to define the range of the safety zones. However, other inputs not included in the LSIR contour, such as safety risk, may require a larger marine exclusion zone.

9.2.7.5 *Navigation Route*

The navigation route as currently defined (for example, in Figure 8.2 of the QRA Study) is acceptable in terms of LSIR. The risk from the LNG import terminal on the sea lane is in the widely-accepted region (1E-07 per year).

In general, the navigation route is acceptable as it is. However, the Project may choose 1E-07 per year as a criterion for the navigation route and may consider moving the navigation route out of the 1E-07 regions per year (as shown in green risk curve in Figure 8.2 of the QRA Study).

The LSIR contour is an entry to define the acceptability of the navigation route. However, there are other inputs not included in the LSIR contour, such as the safety risk, the radius of rotation required for ships or the traffic control that may require the navigation path to shift. Another option is to advise ships to navigate in and out of the port of Acajutla further south, below the currently marked/traced transport route.

9.2.8 Safety Objective of the Project

The Industrial Safety and Hygiene Objective of the Project will always be to protect the community. EDP is committed to working only under conditions that are safe for employees, the public, and the environment during the construction and operations phases. During the detailed design phase, a series of detailed safety studies will be carried out, with the objective of studying all potential risks and determining whether they are acceptable or establishing mitigation measures. To manage the Project's potential risks to public safety, EDP is committed to undertake several initiatives and studies as part of future Project planning and design work. These initiatives and studies are described in Section 9.3.2.

9.3 High Level Contingency Plan

Lloyd's Register (LR) has been contracted by the Project to carry out a high-level contingency plan for the EDP liquefied natural gas (LNG) terminal in Acajutla, El Salvador. This version was developed early in the initial engineering phase (FEED) of the Project with limited information. The purpose was to ensure that it is prepared a preliminary course of action and that different interested parties are prepared to respond to abnormal events when they occur.

A conceptual level contingency plan and emergency response plan have been prepared outlining the content of a more detailed Contingency Plan to be developed as part of the detailed design of the Project. This conceptual level plan specifically describes the risk events that should be considered in the detailed Contingency Plan. Elaborated, to take all necessary measures to address events or emergencies that may cause effects of the public, the environment and materials, as a result of the Project operations.

This plan provides a high-level review of contingencies for the Project, at early phases of the Project. EDP and other interested parties will develop a detailed contingency plan later in the Project, in detailed engineering. It is best practice to begin contingency planning early in the life of the Project and update it as work progresses through the Project life cycle.

9.3.1 Contingency Planning Workshop

As part of the methodology of preparation of the plan, a contingency planning workshop was carried out in the FEED phase of the Project by a team of competent personnel. The purpose of the workshop was to review the contingencies of the Project and the contingency / emergency response in the occurrence of an abnormal event.

The workshop was held in San Salvador, El Salvador, on June 15, 2016. The purpose of the workshop was to discuss contingencies for the Project.

Consequences for personnel, concurrent operations at the port, environment, and third parties, including the appropriate emergency response, were discussed and captured in a worksheet. The complete worksheet can be found in Appendix A, Appendix 9D.

The participants of the workshop included key staff of regulatory entities, stakeholders and participants in Projects of the Maritime Port Authority, Government, strain, Invenergy, M&N, Exmar, Energy in the Pacific, and LR. The team's experience, both with respect to the technical engineering as the maritime operational experience, was considered adequate and appropriate for the workshop. In the Chart 9.6 presents a list of participants in the workshop.

Table 9.6 – Workshop participants on contingency planning

	Name	Entity	Discipline
1	Captain Marco Aguirre	CAMS	Marine Advisor
2	Captain John E. Keon	CAMS	Local Marine Advisor
3	Alonso Valdemar Sarania	STPP	Electrical Engineer
4	Ernesto Mendez	STPP	Electrical Engineer
5	Mario Chavarría	MINEC	Legal Advisor
6	Manuel Aicides Mejía Valiente	MINEC	Inspector
7	Salvador Eliú Avendaño Vásquez	MINEC	Inspector
8	Jesús Ricardo Andrade Hernández	MINEC	Technical coordinator, supervision and control
9	José E. Hernández	CEPA	Pilot
10	Roberto Mendoza	CEPA	Port Manager of Acajutla
11	Tatiana Chacón	AMP	Port infrastructure
12	Yid Zelada Quán	MARN	Environmental Assessment
13	Lisbia Teresa Jarquin	Eco Ingenieros	Consultant, Environmental Management
14	Luc Saerens	Exmar	SSO
15	Ashwini Kumar	Exmar	Project Manager
16	Eric Smith	M&N	Coastal Navigation Engineer
17	Bob Beasley	M&N	Project Manager
18	Horacio Larios	EDP	Project Manager
19	Javier Mina	EDP	Engineering
20	Rupal Soni	Invenergy	Engineering
21	Diego Canal Sáez	Invenergy	Project Engineer
22	Felipe Mazzini	Invenergy	Project Director
23	Rey Lee	LR	Technical safety / risk
24	Daniela Cran	LR	Facilitator

Source: EDP, 2016

The main conclusions of the workshop to be applied for the Project are listed below.:

- A detailed contingency plan for the LNG import terminal will be developed in detailed engineering. It will include the main hazards as discussed in the workshop, such as an LNG leak, fire and explosion. See section 9.3.2;
- The main hazards, identified at Hazard Identification Workshop (HAZID) sessions, were considered to analyze risks to people, the environment and assets. See section 9.3.2;
- The Project will assess the need for the LNG carrier and floating storage unit (FSU) to leave the LNG import terminal in the event of a tsunami or surge. The Project will consider an autonomous FSU or dedicated tugs to move the FSU in case the FSU needs to be moved to a safe location;
- The port of Acajutla is equipped with fire extinguishing capacity, including firefighters, a fire tug and ambulance. However, the port will give priority to assistance to its own facilities and to commercial vessels. Therefore, the contingency plan of the Project will complement the port's response and rescue;
- A spill response plan for the LNG import terminal will be developed in detailed engineering to cover contingencies in case of release of other hydrocarbons such as diesel; and
- The Port Facility Security Assessment (PFSA) will include the safety related risks at the port and the management contingency in the occurrence of a safety threat.

9.3.2 Content of the Contingency Plan

Due to the nature of LNG, it is necessary to prevent and control the following events:

- Spill
- Gas cloud formation
- Fragile fracture when in contact with deck planks
- Rapid heating
- Burning
- Fires of high radiation, heat and pressure
- Explosion (Explosions of vapor clouds are not relevant due to open areas and there are non-existent confined gas trapping of defined spill scenarios)

The contingency plan will include mitigation measures and measures to prevent the Scaling of the occurrence of these events. Examples of mitigation measures include not allowing any ship to enter the port when a containment loss has been identified at the LNG import terminal to prevent Scaling of fires. Some of the safety equipment to control and prevent climbing include the following:

- Water spray system of cover in the tanker;
- Dry chemical system on the vessel or terminal;

- High-expansion foams and dual-agent systems to suppress and control LNG vapor clouds on the tanker or terminal; and
- Water monitors on the tanker or in the terminal.

In Appendix A, Appendix 9D presents the risks and worksheet of the preliminary plan. That includes for each event considered:

1) Defined risk and scenario of the accident. Hazards of normal operation, as identified in the HAZID [1] or marine HAZID;
2) Description of the scenario. Description of the scenario and possible staggering of the scenario;
3) Consequences. Consequences for personnel, environment and third parties (public);
4) Main focus areas for emergency response. General response to the accident scenario, such as ensuring / evacuating the scene of the accident, for emergency alert authorities and ensuring the integrity of assets;
5) Response Procedure /Main Strategy. Response as it relates to the following, where applicable, that presents the timeline for response to an emergency:
    1. Alert the relevant authorities
    2. Fight the accident
    3. Rescue personnel
    4. Evacuation of personnel or population
    5. Normalization: action to return to safe normal operations
6) Response Equipment. Equipment involved in the accident response, including equipment on board or at port, when applicable;
7) Response personnel. Personnel involved in the accident response and may include LNG import terminal personnel or firefighters;
8) Interfaces and requirements. Actions by authorities, including port authority;
9) Comments and Recommendations; and
10) Comments and recommendations are indicated in this column.

Chart 9.7 shows an outline of the major risk events and the initiatives that EDP will undertake to address these events. Chart 9.8 lists and explains each of the committed initiatives and studies.

Table 9.7 – Activities to be carried out as part of the Contingency Plan				
#	**Defined Risks and Accident Scenario**	**Scenario Description**	**Prevention and Management Plans**	**Initiatives**
1	**Main events**			
1.1	Leakage of hydrocarbons (LNG) / gas dispersion	Large LNG spill into the environment (spill over water) that reaches the port. Non-ignition case.	-Analysis of Fire and Explosion -Study of Hazards and Operability (HAZOP) -Contingency Plan - ESD system	-A detailed assessment will be made of the extent of the leak, the ability to isolate the leak, the gas cloud, the weather conditions and which areas are in result at risk. The recommendation to the port (e.g.: evacuation, traffic management stop) will be done accordingly. The Project will evaluate the need to withdraw the LNGC or FSU. - This risk and corresponding action will be addressed in the Contingency Plan which will be submitted for approval to Civil Protection (governmental agency). '- A protocol of performance will be established by CEPA and the AMP in case the established risk areas require suspension of the Operations of the port of Acajutla. - The Contingency Plan will establish emergency notification procedures, port evacuation if necessary, stop / traffic management in the affected area. - The detection and protection of fires and gases will be part of the analysis of fires and explosions in detailed engineering.

Table 9.7 – Activities to be carried out as part of the Contingency Plan				
#	**Defined Risks and Accident Scenario**	**Scenario Description**	**Prevention and Management Plans**	**Initiatives**
1.2	Fire (if LNG is on)	Environmental LNG leak (poured over water). Fire if the ignition source ignites the gas cloud.	- Fire and Explosion Analysis - Operations Plan -Contingency Plan - ESD system	- This risk and corresponding action will be addressed in the Contingency Plan which will be submitted for approval to Civil Protection. - A protocol of performance will be established by CEPA and the AMP in case the established risk areas require suspension of the Operations of the port of Acajutla. -The Contingency Plan will establish the emergency notification procedures, evacuation of the port if necessary, stop / manage the traffic in the affected area. - It will have a marine vessel which will have the capacity to fight fires -The terminal and FSU / FSRU will have detection and prevention of fires according to international standards -The detection and protection of fires and gases will be part of the analysis of fires and explosions in detailed engineering.
1.3	Rapid Phase Transition (RPT)	There is a large leakage of LNG to the sea and conditions for RPT. Scaling: Possible cold explosion. Consequence depends on the composition of LNG, water temperature, the quantity of spills and flow rate in the water. With the right conditions to have RPT, the probability is very low for a well-designed installation	-Analysis of Fire and Explosion -Hazard and Operability Study (HAZOP) -Contingency Plan	- This risk and corresponding action will be addressed in the Contingency Plan which will be submitted for approval to Civil Protection. - Port authority: Emergency notification, evacuation of the port if necessary, stop / traffic management in the affected area. -The detection and protection of fires and gases will be part of the analysis of fires and explosions in detailed engineering.

Table 9.7 – Activities to be carried out as part of the Contingency Plan				
#	**Defined Risks and Accident Scenario**	**Scenario Description**	**Prevention and Management Plans**	**Initiatives**
1.4	Toxic or flammable chemical leaks	Diesel stored in the FSRU is flammable and can lead to the possibility of fire in case of ignition. Scaling: Fire if the ignition source ignites the diesel	- Hazard and Operability Study (HAZOP) -Contingency Plan - ESD system	-This risk and corresponding action will be addressed in the Contingency Plan which will be submitted for approval to Civil Protection. - A protocol of performance will be established by CEPA in case the established risk areas require suspension of the Operations of the port of Acajutla. -The Contingency Plan will establish emergency notification procedures, port vaccination If necessary, stop / manage the traffic in the affected area. -We will have a marine vessel that will have the capacity to fight fires -The terminal and FSU / FSRU will have detection and prevention of fires according to international standards -The detection and protection of fires and gases will be part of the analysis of fires and explosions in detailed engineering.
1.5	Explosion	Explosion	-Fire and Explosion Analysis - Hazard and Operability Study (HAZOP) -Contingency Plan - ESD system	-This risk and corresponding action will be addressed in the Contingency Plan which will be submitted for approval to Civil Protection. - Port authority: Emergency notification, evacuation of the port if necessary, stop / traffic management in the affected area. -The Contingency Plan will establish the conditions under which it would be recommended to evacuate the surrounding population, and the coordination of these events.

Table 9.7 – Activities to be carried out as part of the Contingency Plan				
#	**Defined Risks and Accident Scenario**	**Scenario Description**	**Prevention and Management Plans**	**Initiatives**
1.6	Fire or Explosion in the Thermoelectric Plant	Fire or explosion	-The plant will be designed following the fire prevention and explosion guidelines of the NFPA (National Fire Protection Agency) -Contingency Plan	-This risk and corresponding action will be addressed in the Contingency Plan which will be submitted for approval to Civil Protection. - Port authority: Emergency notification, evacuation of the port if necessary, stop / traffic management in the affected area. -The Contingency Plan will establish the conditions under which it would be advisable to evacuate the surrounding population, and the coordination of these events.
2	**Natural Risks**			
2.1	Short-term maritime movements	Local atmospheric conditions, such as cyclones, can give rise to sea movements for a short period of time, creating waves up to 3,6 m in height. Scaling: This can lead to excessive movement of the LNGC and / or FSU.	- Operations Plan -Contingency Plan	-Activate the Contingency Plan and notify, including VTS to ensure maritime safety communications including coordination with rescue resources, notify the Civil Protection entity if necessary

Table 9.7 – Activities to be carried out as part of the Contingency Plan				
#	**Defined Risks and Accident Scenario**	**Scenario Description**	**Prevention and Management Plans**	**Initiatives**
2.2	Long-term surge	Climate, storms and hurricane activity can lead to long-term waves with waves up to 2.4 m in height. Scaling: This can lead to excessive movement of the LNGC and / or FSU	- Operations Plan -Contingency Plan	-Activate the Contingency Plan and notify, including VTS to ensure maritime safety communications.
2.3	Tsunami, near the land	The climate, the subduction zone off the coast of El Salvador, or seismic activity can result in a tsunami. Advanced warning not provided and / or exceeds design event Scaling: This can lead to excessive movement of the LNGC and / or FSU. In the worst case, the FSU breaks and collides with the LNG terminal or the Moorings mooring buoys, which leads to contention loss (only if the impact energy is> 28 mJ).	- Docking System Design - Hazard and Operability Study (HAZOP) Contingency Plan - ESD system	-This risk and corresponding action will be addressed in the Contingency Plan which will be submitted for approval to Civil Protection. - Port authority: Emergency notification, evacuation of the port if necessary, stop / traffic management in the affected area. -There will be a marine vessel that will have the capacity to fight fires

Table 9.7 – Activities to be carried out as part of the Contingency Plan				
#	**Defined Risks and Accident Scenario**	**Scenario Description**	**Prevention and Management Plans**	**Initiatives**
2.4	Tsunami, far from land	Climate, subduction zone off the coast of El Salvador, or seismic activity can result in a tsunami. Scaling: LNGC and FSU can leave the terminal with an advanced warning. Other vessels may collide in LNGC / FSU, leading to contention loss (only if the impact energy is> 28 mJ). No damage is anticipated to the FSRU cofferdam structure. Potential damage to the cofferdam structure.	- Docking System Design -Study of Hazards and Operability (HAZOP) Contingency Plan - ESD system	-This risk and corresponding action will be addressed in the Contingency Plan which will be submitted for approval to Civil Protection. - Port authority: Emergency notification, evacuation of the port if necessary, stop / traffic management in the affected area. -Tug dedicated to the Project dedicated to the Project - Implementation of a redundant warning system, in addition to the Pacific Tsunami Warning System (PTWC) during the detail design phase, will be considered.

Table 9.7 – Activities to be carried out as part of the Contingency Plan				
#	**Defined Risks and Accident Scenario**	**Scenario Description**	**Prevention and Management Plans**	**Initiatives**
2.5	Seismic activity, earthquake	Climate, subduction zone off the coast of El Salvador can result in seismic activity or earthquake. Scaling: Other ships may collide in FSRU; No anticipated damage to FSRU given the cofferdam structure. Potential damage to the structure of the cofferdam, pipeline, fixed equipment / infrastructure. Potential fire.	-Design of the Maritime Terminal - Hazard and Operability Study (HAZOP) -Contingency Plan - ESD system	-To notify Port Authority and Civil Protection, as necessary, to activate the Contingency Plan.
2.6	Electric storm	Showers in the region may cause thunderstorms. Scaling: This can cause damage to infrastructure and potential deaths.	-Design of the Maritime Terminal - Hazard and Operability Study (HAZOP) -Contingency Plan - ESD system	- The facility shall be designed in such a way that operations can continue safely in the event of a thunderstorm (ventilation mitigation measures).

Table 9.7 – Activities to be carried out as part of the Contingency Plan				
#	**Defined Risks and Accident Scenario**	**Scenario Description**	**Prevention and Management Plans**	**Initiatives**
2.7	Strong wind	Showers in the region can cause strong winds. Scaling: This can lead to breakage of the mooring lines.	-Design of the Maritime Terminal - Docking System Design - Hazard and Operability Study (HAZOP) -Contingency Plan - ESD system	[C] The installation of the LNG import terminal must be designed to withstand strong winds and to continue operations in the event of high wind conditions
3	**Falling of Objects**			
3.1	Falling of objects during elevation of the crane in the FSU or FSRU	N/A	-Analysis of Fallen Objects	- Port Authorities or Civil Protection will be alerted if an emergency happens.
3.2	Fallen object in the undersea pipeline on the shore	Dragged and / or thrown anchor from another vessel in the underwater pipeline. Scaling: Damage to the underwater pipeline. Potential loss of containment.	-Design of the Marine Terminal -Analysis of Fallen Objects -Contingency Plan	- Port Authorities or Civil Protection will be alerted if an emergency occurs. - Work with AMP to establish a non-anchoring area on the underwater pipeline route

Table 9.7 – Activities to be carried out as part of the Contingency Plan				
#	**Defined Risks and Accident Scenario**	**Scenario Description**	**Prevention and Management Plans**	**Initiatives**
4	**Vertical Tube and Underwater Pipeline**			
4.1	Gas leakage to the environment, underwater source (underwater pipeline or underwater rise)	Rupture of the submarine vertical tube. Scaling: Release of gas into the environment. Case of ignition	-Design of the Terminal -Analysis of Fire and Explosion - Hazard and Operability Study (HAZOP) -Contingency Plan - ESD system	A detailed assessment of the extent of the leak, the ability to isolate the leak, the gas cloud, the climatic conditions and, as a result, which areas are at risk will be carried out. The recommendation to the port (evacuation, traffic management stop) will be done accordingly. The Project will evaluate the need to withdraw the LNGC or FSU. -This risk and corresponding action will be addressed in the Contingency Plan which will be submitted for approval to Civil Protection. - Port authority: Emergency notification, evacuation of the port if necessary, stop / traffic management in the affected area. -The detection and protection of fires and gases will be part of the analysis of fires and explosions in detailed engineering.
4.2	Gas leak to the environment, upper side source (connection to FSRU, part of the vertical tube over the sea)	Rupture of the vertical tube due to the collision of the ship with the tube. Scaling: Release of gas into the environment. Potential fire jet if high pressure gas ignites.	- Design of the terminal -Fire and Explosion Analysis - Hazard and Operability Study (HAZOP) -Layer of Protection Analysis (LOPA) Contingency Plan - ESD system	-A detailed assessment of the extent of the leak, the ability to isolate the leak, the gas cloud, the climatic conditions and, as a result, which areas are at risk will be carried out. The recommendation to the port (e.g. evacuation, traffic management stop) will be done accordingly. The Project will evaluate the need to withdraw the LNGC or FSU. -This risk and corresponding action will be addressed in the Contingency Plan which will be submitted for approval to Civil Protection. - Port authority: Emergency notification, evacuation of the port if necessary, stop / traffic management in the affected area. -The detection and protection of fires and gases will be part of the analysis of fires and explosions in detailed engineering.

Table 9.7 – Activities to be carried out as part of the Contingency Plan				
#	**Defined Risks and Accident Scenario**	**Scenario Description**	**Prevention and Management Plans**	**Initiatives**
5	**Safety**			
5.1	Safety Threats	Local security threats can have an impact on staff safety and on assets and production.	Port Facilities Safety Assessment (PFSA)	-The PFSA will be developed in conjunction with Civil Protection. -This study will establish the most appropriate physical security infrastructure to be included in the Project and ensure that detailed design features of security systems are included as accurately as possible. Made for installations according to the ISPS code. -The contingency plan will establish action protocols for the entry of third parties to the restricted areas. These measures will be identified during the PFSA and will be endorsed by CEPA and AMP.
6	**Other**			
6.1	Leaking of hydrocarbons from another ship (for example, sailing or born in the port of Acajutla, docked at the terminal of Cenérgica, moored at the Rasa terminal, or docked at the Alba terminal)	Hydrocarbons leak from a ship Scaling: Potential fire if ignited	Contingency Plan	- Due to the distance between the LNG import terminal and the port/ Cenergica terminal / Rasa terminal / Alba terminal, it is not expected that a localized fire is not expected to affect the LNG import terminal. -However, this eventuality will be analyzed in the contingency plan

Source: Quantitative Risk Assessment

Table 9.8 – Additional Safety Studies to Perform	
Study	**Description**
Detailed Engineering	
Hazard and Operability Study (HAZOP)	HAZOP assesses the top processing systems to identify the risks to people (personal and public), the environment and goods. This workshop identifies potential risks with a primary focus on process systems. The top-level processes, cargo systems and major FSRU public service systems have been reviewed.
Layer of Protection Analysis (LOPA)	In addition to the HAZOP, an in-depth review of LOPA is required to confirm the level of safety integrity required for the safety instrumented systems (SIS) identified for the upper part processes and load systems according to IEC standards 61508/61511.
Security Requirements Specification (SRS) - Security Integrity Level Analysis (SIL) Review.	In addition to LOPA, a SRS study and SIL review are required to state the requirements and verify that the SIS as designed meet the required SIL level as defined in the previous LOPA study in accordance with IEC standards 61508/61511 for hardware and software. Identifies instrumented safety systems (SIS) and assesses whether SIS meets its integrity requirements.
Analysis of fallen objects	Evaluates and quantitatively reviews the risk of scenarios of fallen objects (material handling study) during normal operations for the maritime terminal. The risk of fallen objects is reflected in the detailed QRA.
Fire, Explosion and Risk Analysis (FERA)	The possible fire and explosion scenarios identified in HAZID and HAZOP are detailed in the quantitative FERA study. The study will include gas dispersion analysis. In particular, for the explosion risk assessment, a 3D computational fluid dynamics (CFD) study is required in the detailed design considering design details and congestion. The FERA study confirms dimensional accidental loads (DAL) for critical targets that must be considered in the detailed design to achieve ALARP risk for possible fire and explosion scenarios. The study can also model the effects of smoke, thermal radiation and overpressure with respect to evacuation and escape routes from facilities.
Cryogenic spill analysis	In addition to the possible scenarios of cryogenic spillage (loss of containment) identified in HAZID and HAZOP, a detailed quantitative study is required for FSRU, FSU and load operations to analyze the risk of cryogenic spillage. This study confirms the dimensions required for the containment of accidental cryogenic spills that must be considered in the detailed design to achieve ALARP.
Ventilation Dispersion Analysis	Ventilation dispersion analysis will model the effects of ventilating the process (natural gas) in the FSRU during an emergency, given the rates of operating scenarios in a range of weather conditions. Modeling of LNG vapor emissions enables the assessment of whether the respective LNG vapor cloud is compatible with the design of the FSRU / terminal.

Table 9.8 – Additional Safety Studies to Perform	
Study	**Description**
Finite element for the collision of the ship	A finite element analysis was performed for a respective consequence of the impact of a potential collision on the LNGC and / or FSU.
Detailed QRA	Assessment of the risk and impacts of hazardous events on staff, people (public) and the environment for the specific location of the Project in El Salvador. All risks to the public and the environment must be within the ALARP range.
Analysis of escape, evacuation and rescue (EERA)	Evaluates qualitatively the effectiveness of the facilities, evacuation and rescue. In addition, the potential risk for the loss of integrity of the escape routes of the FSRU / marine facility is ALARP for the FERA scenarios are evaluated quantitatively. The FERA scenarios and the CFD calculations are used as input for this analysis to estimate the risk.
Contingency planning	Plan the response to abnormal events when they occur.
As Low As Reasonably Practicable (ALARP)	This study examines and discusses the main mitigation measures to achieve ALARP for marine facilities in normal operation (LNGC, FSU and FSRU). It assesses whether sufficient risk mitigation measures are in place to meet the least reasonable cost principle.
Port Facility Security Assessment (PFSA)	It ensures that the physical security infrastructure included with the Project is the most appropriate and that all the detailed design features of the security systems are included as accurately as possible. Made for installations according to the ISPS code.
Operations	
Emergency preparedness / contingency plan	It ensures that risk mitigation, preparedness, response and recovery are in place to lessen the impacts of abnormal events.
Performance Monitoring	Shows that there are arrangements to monitor the performance of HSE.
Occupational safety / risk analysis.	Identifies the dangers of specific tasks to reduce the risk of injuries to workers.
Plan for the prevention and control of spills	Documents the procedures to be followed to prevent spills and the response in the event of a spill.
Boat Safety Plan	It provides prevention and early detection of attacks and improved surveillance coverage, detection equipment, lighting use and crew responses.

Source: EDP 2016

9.4 Summary of Commitments

The EDP Project's natural gas pipeline and marine facilities are committed to providing fuel to the power plant with reliable supply in a safe and environmentally acceptable manner. The objective of the safety, health and environmental plan will be to provide a safe environment for the public and for the Project's personnel.

To ensure that this objective is met, EDP commits itself to an irrigation management process and an extremely strict technical safety program in line with industry best practices and the most expensive international codes and standards. The following is a summary of key commitments to manage potential Project risks, including contingency planning:

9.4.1 Starting with Safer Facilities

The processes that involve the handling of hydrocarbons have great potential for the occurrence of abnormal events, incidents or accidents. Responsible development of these Projects includes extensive hazard identification, risk analysis and hazard management activities to ensure that the risk is tolerable to the public, facilities and operators.

In mitigation and abnormal (hazard) advice from EDP, preference is given to the elimination of hazards to produce an inherently safe design. Risk reduction measures are prioritized in the following order:

1. **Prevention is First**– Achieve an inherently safe design through the elimination of hazards, decrease plant complexity, decrease hydrocarbon inventory, decrease operating pressure and decrease process fluids etc.
2. **Control is next** – Control hazards through active methods in the Distributed Control System (DCS) and training.
3. **Finally, Mitigation** – Mitigation of risk through active and passive measures such as the fire system.

This approach is already reflected in key Project decisions, such as locating LNG storage facilities at sea.

9.4.2 Technical Safety

EDP is carrying out a rigorous process to ensure the technical safety of the facilities. The FEED phase considers, as far as possible, the potential for major accident hazards, their associated risks and the identification of potential risk mitigation measures. This work is well underway with the completion of the HAZID, the preliminary QRA Study, and the preliminary Contingency Workshop in which most of the involved in the Project's development participated.

These inputs will be incorporated into the design package which, at a minimum, will include basic safety studies, documents and activities, including:

- Marine and General Arrangement HAZIDs (Layout);
- HAZOP and LOPA studies;
- SIL study to ensure at the level of integrity of systems critical to safety is sufficient for the associated level of potential risks;
- ALARP study and report;
- QRA Which will reflect the results of extensive studies, including at least:
    - FERA, which will include a probabilistic analysis of explosions based on computational fluid dynamics (CFD);
    - Smoke and gas dispersion analysis (including combustion units and pressure reliefs);
    - Cryogenic spill analysis;
    - EERA Study;
    - Analysis of collision of ships;
    - Study of fallen objects; and
    - Study of transportation of personnel.

The technical studies and workshops of HAZID, QRA and Preliminary Contingencies were facilitated and completed by Lloyd's Register, an independent well-recognized consulting organization in the industry, which is also a classification society.

The results of the preliminary QRA, which included limited trials of vapor dispersion, radiation analysis, as well as a preliminary quantitative Project risk assessment (marine installations, piping and gas supply to the power plant) indicate that the risks of EDP Project are manageable and are within the ALARP region. These results will be refined as Project engineering progresses.

9.4.3 Safety Commitments

EDP has carried out workshops and assessments of hazards, contingencies, preliminary QRA studies and other safety activities in the FEED phase. The design and approach to hazard management will continue when the Project is in the detailed design phase in which the Project is committed to carrying out activities that address hazards to ensure that these are acceptable. The safety commitments are provided in Table 9.9.

Table 9.9 – Safety Commitments by EDP

Potential Event	EDP Safety Commitment
Release of hydrocarbons	The release of hydrocarbons are extremely serious potential events and therefore facilities will include extensive measures to detect and mitigate the risk associated with the release of these.

Table 9.9 – Safety Commitments by EDP	
Potential Event	**EDP Safety Commitment**
	• **Rugged design:** The marine terminal and gas pipeline will be designed using best practices and international codes to ensure that the release of hydrocarbons is minimized. The control system will ensure that the processes operate within the appropriate range. The control system alerts operators when conditions approach operational limits and shut down processes before the system can operate outside its design conditions. • **Gas detection:** Marine facilities will be equipped with an extensive gas detection system to ensure that the release of hydrocarbons is quickly identified and that the appropriate response is made. The gas detection system shall be of high integrity and shall be independent of the main control system. • **Emergency isolation valves:** Equipment and pipelines containing hydrocarbons shall be provided with high integrity, fire-tight, and tightly closed emergency isolation valves to minimize hydrocarbon release and prevent scaled damage. • **ESD Systems:** Marine installations will be equipped with an emergency shutdown (ESD) system that, when activated, will automatically alert the operator, and will put the plant in a safe state (de-energizes motors and closes isolation valves to minimize the amount of escape). This system will be of high integrity and will be regularly tested to verify that it will operate when necessary.

Fire	A fire is possible at marine facilities under various scenarios, such as a fire in the galley in the accommodation block, fire in the engine room or more seriously, the ignition of released hydrocarbons. Protection measures will be included in EDP's marine facilities to handle potential scenarios:
	• **Fire and Smoke Detection:** Marine facilities shall be equipped with an extensive fire and smoke detection system to ensure that the fire is quickly identified and the appropriate response is made.
	• **Portable Fire Fighting Equipment:** The facilities will contain portable Fire Fighting equipment such as extinguishers, fire blankets, etc.
	• **Passive fire protection:** Passive Fire Protection (PFP) will be applied to the main structures and equipment identified as susceptible to prevent unacceptable escalation of events.
	• **Fixed Fire Equipment:** The marine facilities will be equipped with fixed fire-fighting equipment which will include:
	  ○ Water-based fire-fighting system whose engines operate on diesel. This system will be set up periodically to ensure its operation.
	  ○ Dry powder and chemical systems in machinery spaces, galley and

Table 9.9 – Safety Commitments by EDP	
Potential Event	**EDP Safety Commitment**
	other areas. ○ N1 or CO2 systems for emergency relief to ensure that these fires can be extinguished.
LNG Release	The release of inadvertent LNG may result in several hazards given the physical properties of LNG and the flammability of the associated vapor cloud. The design will incorporate features to mitigate the risks associated with cryogenic spills. These will include: • **Detection.** The detection of LNG spills will be facilitated with a CCTV system which will monitor the LNG transfer operations, presence of operators during the connection and start of transfer, and gas or cold detection in the marine terminal. • **Water curtain.** During the transfer operations, a water curtain shall be established to ensure that the inadvertent release of LNG is rapidly vaporized and does not damage the attached steel given the low LNG temperatures. • **Cryogenic spill management strategy:** LNG management facilities systematically consider and correct the risks associated with LNG operations. Depending on the area, LNG protection measures include: ○ **Minimization of leakage potential.** Potential LNG leakage points will be minimized and, where required, installed near each other to facilitate handling. ○ **Containment and catchment areas w**hich have high probabilities of LNG leakage points and routes to a safe point. ○ **Passive cold protection** Is similar to PFP but designed to prevent LNG from damaging steel or carbon steel structures. It will be applied when necessary based on a detailed study. ○ **Water and flood curtain.** It will be an integral part of the LNG leakage strategy related to the location and size of the potential leak.
Fallen objects in facilities	Equipment, supply and waste are transferred between the marine facilities and supply the vessels by means of lifting cranes permanently. This means that the objects launched represent a risk which EDP is strictly committed to manage in the following manner: • The supply and operations vessel dock is located away from the gas riser to prevent objects from being thrown and impacting this sensitive spot. • The upper parts of the FSRU do not allow lifting operations on active process equipment. • Fixed rails and gantry cranes are included in the top of the FSRU and within machinery spaces to facilitate maintenance with limited potential for fallen

Table 9.9 – Safety Commitments by EDP	
Potential Event	**EDP Safety Commitment**
	objects. • As a final measure, protection against fallen objects will be applied to the equipment in which hydrocarbons are handled which have an inadmissible risk of fallen objects.
Objects thrown on the pipeline	Crawling anchors or vessels that may damage submarine pipeline has a low probability of occurrence, but with serious potential damage should it occur. Some measures to mitigate this situation include: • The pipeline will be protected and installed on a route in which the nautical charts show a non-anchoring area. • The inlet and outlet of the pipeline will be equipped with an emergency stop valve that will minimize the volume that can escape from the pipe.
Port Facility Safety	A port facilities safety assessment (PFSA) was carried out during the FEED phase by an independent company specializing in this management. The evaluation included the revision of the perimeter of the Power Plant, the collection area and the marine terminal area. The PFSA process was carried out in accordance with the International Ship and Port Security Code (ISPS). The evaluation covered the following items: 1. Identification and evaluation of important assets and infrastructure; 2. Identification of possible threats to them and their probability of occurrence; 3. Identification, selection and prioritization of countermeasures and procedural interventions and an estimate of their level of effectiveness in reducing vulnerabilities; 4. Identifying tenuities, including human factors, in infrastructure and procedures. The evaluation methodology used was taken from the National Institute of Standards of North America (ANSI) and from the 780 Standard of the North American Petroleum Institute (API). The methodology included five sequential steps: 1. Characterization; 2. Assessment of the hazard; 3. Vulnerability Assessment; 4. Risk Assessment 5. Risk Prevention. Based on the experience of the company that managed the study and the previously mentioned standards, medium and high hazards and possible mitigations were identified. Detailed safety plan approaches were also identified which will be carried out during the detail design phase. These approaches include: • Safety management plans, • Transportation safety plans, • Contingency plans, among others.

Source: EDP 2016

EDP provides a level of detail on the mentioned safety commitments, as well as new commitments, if necessary, as the Project progresses in the detailed design and the risks and facilities are better defined.

9.4.4 Contingency Plan

The EDP contingency plan is in process, starting with the preliminary security studies and the holding of a contingency workshop in San Salvador in June 2016. The contingency plan is of utmost importance to mitigate the effects of risks potential for the Project, since it will help ensure that stakeholders are prepared to respond to extraordinary events when they occur.

The contingency plan is an activity that is being carried out and will have as final product a detailed contingency plan and emergency response before the facilities enter operations.

- Early in the Project design phases, the contingency plan is based on risk identification and subsequent risk analysis to identify abnormal events and contingency planning in cases of occurrence of such events.
- In the operational phase of the Project, the contingency plan should consider other sources of information such as accident reports and inspections to keep always the plan updated.

EDP is currently in the Front-end Engineering and Design (FEED) phase and the contingency plan is preliminary, but this allows establishing that the Project, the community and the port of Acajutla will be able to respond effectively to a wide range of events Such as tsunamis, loss of hydrocarbon containment or fire at the LNG marine terminal.

As EDP progresses with the definition of risks associated with facilities, the contingency plan will be refined and the level of detail will increase. Finally, the contingency plan will help ensure that EDP is prepared to respond to accidental or abnormal events and that the plan is in line with existing emergency procedures. In addition, it will help ensure an integrated response plan with other key authorities involved such as port authorities (AMP, CEPA) and the Ministry of Environment and Natural Resources. (MARN).

The final contingency plan will include, as a minimum, the following events:

A. Emergency Response Procedures, including notice to personnel and appropriate use of equipment to respond to emergencies, isolation of certain parts of equipment, and other applicable safety steps to ensure that a gas or liquid leak is stopped or reduced in the shortest possible time.

B. Procedures to recognize a non-controllable emergency and take measures to ensure that damage to personnel at the facility and to the public is reduced by ensuring that the flammable

mixture does not spread outside the emergency area and that the thermal radiation from a fire Do not exceed the acceptable values of the applicable regulations.

C. Procedures for immediate notification of the emergency to the corresponding local authorities, including possible evacuation of the surrounding personnel.

D. Coordination procedures with local authorities, during the preparation of the emergency evacuation plan, which will establish the necessary steps to protect the public and their care in health centers, if required.

The contingency plan shall include or refer to design documents describing measures to mitigate potential emergency events, considering as a minimum:

E. Systems for detecting leaks, flammable gases, flames, smoke and cold;

F. Alarm Systems;

G. Protection for overpressures, release systems, venting and purging of hydrocarbons;

H. Definition of measures for emergency exits, emergency care;

I. Active and passive management and fire suppression systems for marine facilities, and

J. Contingency measures for:
   a. Natural gas storage operations.
   b. LNG Regasification Operations, and
   c. Thermoelectric plants based on natural gas.

9.4.5 Measures to be Included Within the Environmental Management Program

The measures to be incorporated into the environmental management program in chapter 10 are listed below:

1) Fire Protection System Installation of fire extinguishing equipment: extinguishers, hydrants, hoses, valves, mobile foam units, etc. Includes providing fire extinguishing and drill training
2) Leak Detection System. Plant leak detection equipment (fixed) and portable gas meters to detect leaks in the visual inspections of the facilities.
3) Detail the risk assessment and the contingency plan. Carry out a detailed risk assessment as part of the detailed design work. Development of the Contingency Plan and Planning of Risks of Greater Risk. Where procedures, organization, resources, communications, etc. will be provided in greater detail. Provided in section 9.4.4.

Energía del Pacífico

Project: LNG to Power
Chapter 10: Environmental Management Program

December 2016 – 16-3489

ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

DILLON CONSULTING

10.0 Environmental Management Program

Once that we have established the main environmental effects that the project will generate on the environmental factors, the next step is to define the environmental measures that shall be taken to prevent and/or control the impacts, or to improve and/or enhance the compatibility of the project with the environment.

The owner of the project is responsible for the execution of each of the proposed measures, and give the respective monitoring at all project´s phases. The Ministry of Environment and Natural Resources, in accordance with the Law of the Environment, is the institution responsible for ensuring the minimization of the negative environmental impacts.

10.1 Framework for Environmental and Social Management of the Project

At the time of drafting this report, the key roles of the various entities who will build and operate the project are as follows:

1) Project's Sponsor: EDP
    - Final responsibility for all aspects of the project;
    - Owner of Thermal Power Plant, Maritime Terminal and Gas Line; and
    - To date, EDP is evaluating the property and lease agreements for the FSRU and the FSU.
2) Thermal Power plant contractor: Wärtsilä.
    - Engineering design, acquisition and construction of the power plant
3) Thermal Power Plant, operation and maintenance contractor: Wärtsilä.
    - Operation and Maintenance of the thermal power plant;
4) Maritime Terminal EPC Contractor: to be determined
    - Engineering design, acquisition and construction of the Maritime Terminal, including gas pipeline;
5) FSRU and FSU O & M Contractor: to be determined
    - Operation and maintenance of the FSRU and FSU, including the pipeline;
6) Fuel supply contractor: Shell
    - Operation of LNGC to supply LNG periodically;

The EDP agreements with each of its contractors should clearly identify the relevant expectations of environmental and social performance related to the scope of supply of each one. To facilitate a coherent approach to the issues among all, share lessons learned and promote continuous improvement throughout the project, EDP will establish a system of environmental and social management (ESMS) and will require the same from its contractors.

Prior to construction, and in consultation with their contractors, EDP will develop and implement an ESMS based on the guidance provided in "Manual for the Implementation of the Environmental Management System and Social Construction" (IFC, Revision 2.2 4 June 2014). The ESMS will be updated prior to the operations, as appropriate, based on "Manual for the Implementation of the Environmental Management System and Social Construction" (IFC, Revision 2.2 4 June 2014). The SGAE of EDP will address, as appropriate to the scale and scope of the activities of the project, the nine elements of an effective SGAE listed in the two manuals:

- Policies;
- Identification of risks and impacts;
- Organizational, Capacity and Competence;
- Emergency Readiness and Response;
- Involvement of stakeholders;
- External Communications and Arbitration; and
- Continuous Reports to the Affected Communities.

Each one of the main contractors of EDP are international companies that are well established and experienced. Each one has its own ESMS established, as well as plans and detailed procedures for environmental, health and safety. Before starting the activities in situ, each contractor shall provide to EDP its documentation on the ESMS and confirmation on how they have incorporated the various methods and actions of mitigation, management and monitoring into their plans and internal processes set out in this ESIA report.

EDP will receive periodic reports from each contractor that will contain indicators of environmental performance and social and coordinate periodic coordination meetings, which shall be attended by the directors of the ESMS of each contractor.

10.2 Description of Environmental Measures, Construction Phase

Each of the proposed measures to mitigate, prevent, correct or compensate for the environmental impacts generated by the project, in the construction phase are explained in the following pages.

10.2.1 Reduction of Air Emissions

Measure Type: Attenuation

Description of the Measure

To reduce air emissions, the following mitigation measures shall be applied:

- Plan for equipment maintenance , maintenance program, and record of observed monitoring;

- Locate the stationary power generators at more than 50m of the property north side boundary;
- Have a protocol in relation to idling (shutdown of equipment when stopped); and
- Use of buses to transport workers from outside Acajutla to the site, which are coming from the main cities: Sonsonate, Lourdes, San Salvador. Meeting points and hours will be established in these cities. This measure also prevents the saturation of local buses at the peak of construction.

Location of the Environmental Measure

The project area and transport routes for the construction personnel.

Estimated Amount of Environmental Measure

Table 10.1 – Calculated Amount of the Environmental Measure – Reduction of Gas Emission

Description	Quantity	Unit	Unit price	Term (months)	Total
Equipment and truck maintenance plan	1.00	s.g.	$2,000.00	1.00	$ 2,000.00
				TOTAL	**$ 2,000.00**

Source: Consulting Team

10.2.2 Dust Management Plan

Measure Type: Attenuation

Description of the measure

To prevent dust during the construction phase, a dust management plan is proposed which includes:

- Application of water irrigation in the internal streets of the Project during the dry season and the days with greater wind, in the earth works activities; and
- Install a tire washing system at the exit for trucks and the installation of a paved area before the entrance so that the dust adhered in the tires is deposited in the ground before leaving the property.

Photo 10.1 – Image of the tire washing system

Source : https://venzario.com/2010/01/26/sistemas-de-lavado-de-ruedas-mobydick/

- Stabilize the promontories of dirt material with water or plastic cover;
- Establish a vehicle speed limit of 20 km / h on the inner streets; and
- Coverage of trucks with awnings, all the trucks transporting material that can produce dust.

Location of the environmental measure

Within the Project Property in areas uncovered during earth works and at the laydown area, where containers will be installed with materials and equipment.

Estimated Amount of Environmental Measure

Table 10.2 – Irrigation estimate	
Description	**Quantity**
Layer to spread	2mm
In meters	0.002m
Irrigation volume in 1 m	$0.002m^3$
Three times a day (A)	$0.006m^3$ / m^2
Uncovered surface: (50% of the land)	
Project land	40,000.00 m^2
Temporary Collection Site	23,000.00 m^2
Total area to moisturize (B)	63,000.00 m^2
Total volume by 3 watering's per day (AXB)	$378.00m^3$
Price per m^3	$ 0.10
Price per day	$ 37.80

Table 10.2 – Irrigation estimate	
Description	**Quantity**
Per month	$ 1,134.00
Per semester	$ 6,804.00
Price per day per pipe plus 2 people	$ 56.00
Per month	$ 1,680.00
Per semester	$10,080.00
TOTAL	**$ 16,884.00**
For three years	$ 50,652.00

Source: Consulting Team

Table 10.3 – Estimated Amount of Environmental Measure - Dust Management Plan Measure					
Description	**Quantity**	**Unit**	**Unit price**	**Term (month)**	**Total**
Irrigation	3.00	years	$16,884.00	1.00	$ 50,652.00
Tire washing	1.00	s.g.	$ 3,000.00	1.00	$ 3,000.00
Temporary paving at exit	60.00	m^2	$ 6.00	1.00	$ 360.00
				TOTAL	**$ 54,012.00**

Source: Consulting Team

10.2.3 Noise Management during Construction

Measure Type: Attenuation

Description of the measure

The main activities that produce noise during construction are the piles drilling and the use of vehicles and machinery. A Noise Management Plan will be developed which will consider the following measures to reduce construction noise, including:

- Coordination of type, number, duration and location of pile drilling;
- Use low noise techniques for pile drilling if possible (ex: Vibratory stack, stacking by pressing);
- Hours of construction activity, including pilotage and operation of the temporary generator in batches;
- Routes and establishment of schedules for transport.

Location of the Environmental Measure

Within the construction site and area of influence.

Estimated Amount of Environmental Measure

Table 10.4 – Estimated amount of the environmental measure l - Management of Noise During Construction					
Description	**Quantity**	**Unit**	**Unit Price**	**Term (months)**	**Total**
Noise Reduction Plan	1.00	s.g.	$ 1,000.00	1.00	$ 1,000.00
TOTAL					**$ 1,000.00**

Source: Elaboration by Conulting Team

10.2.4 Soil and Rainwater Management in Construction

Measure Type: Attenuation

Description of the Measure

Apply all the soil management measures established in the procedures of the Wärtsilä Company, builders of the Thermal Power Plant, in the document "Instruction for quality and installation, earthwork, for Power Plants" which includes:

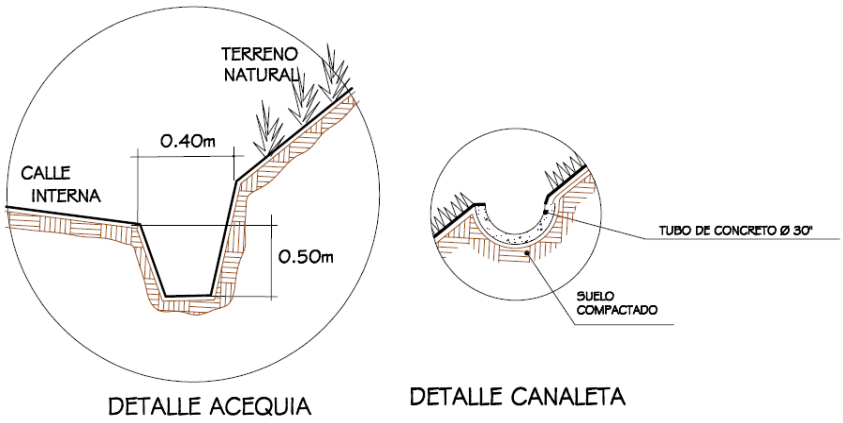
- Cut and separate organic soil for reuse from common soil;
- Use of berms and barriers for sedimentation and erosion control and to prevent sediment in the rainwater;
- Installation of barriers to prevent the passage of machinery outside work areas ;
- Protect and stabilize exposed material (using grass, plastics, concrete or other material);
- Protect corners and curves with rocks or gravel;
- Placement of sedimentation ponds prior to discharge rainwater.

Location of the Environmental Measure

Due to the flatness of the property, a single perimeter ditch has been placed on the edges of the less elevated areas and sedimentation ponds before being discharged to the existing drainage system at CEPA. In the property for the Thermal Power Plant, a temporary pond will not be necessary, since the final pond will be built at the beginning of the construction.

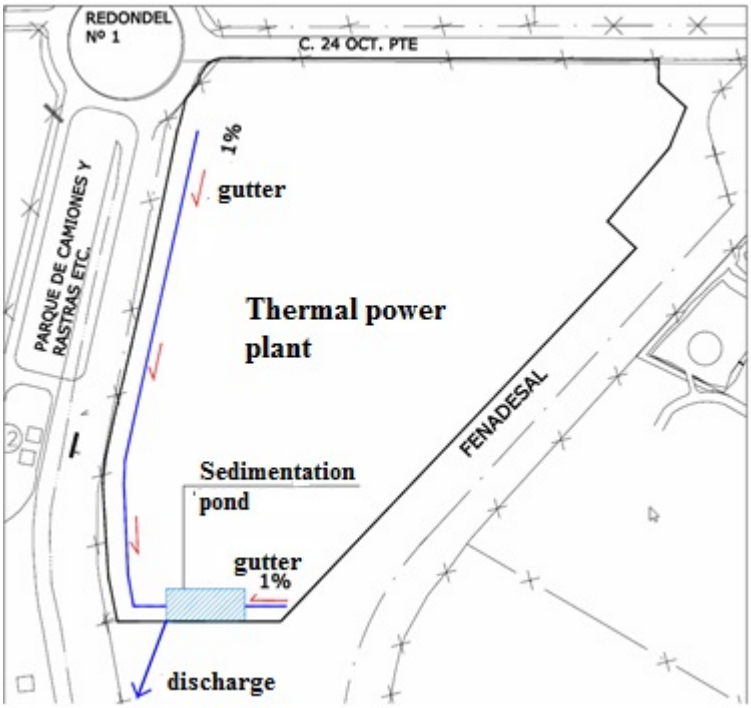
A detail of the temporary ditches and channels is presented below in Figure 10.1., Figure 10.2 and 10.3, which show the location of proposed temporary drainage and ponds.

Figure 10.1 – Detail of ditch and / or canal to transport rainwater during the site preparation and construction phase



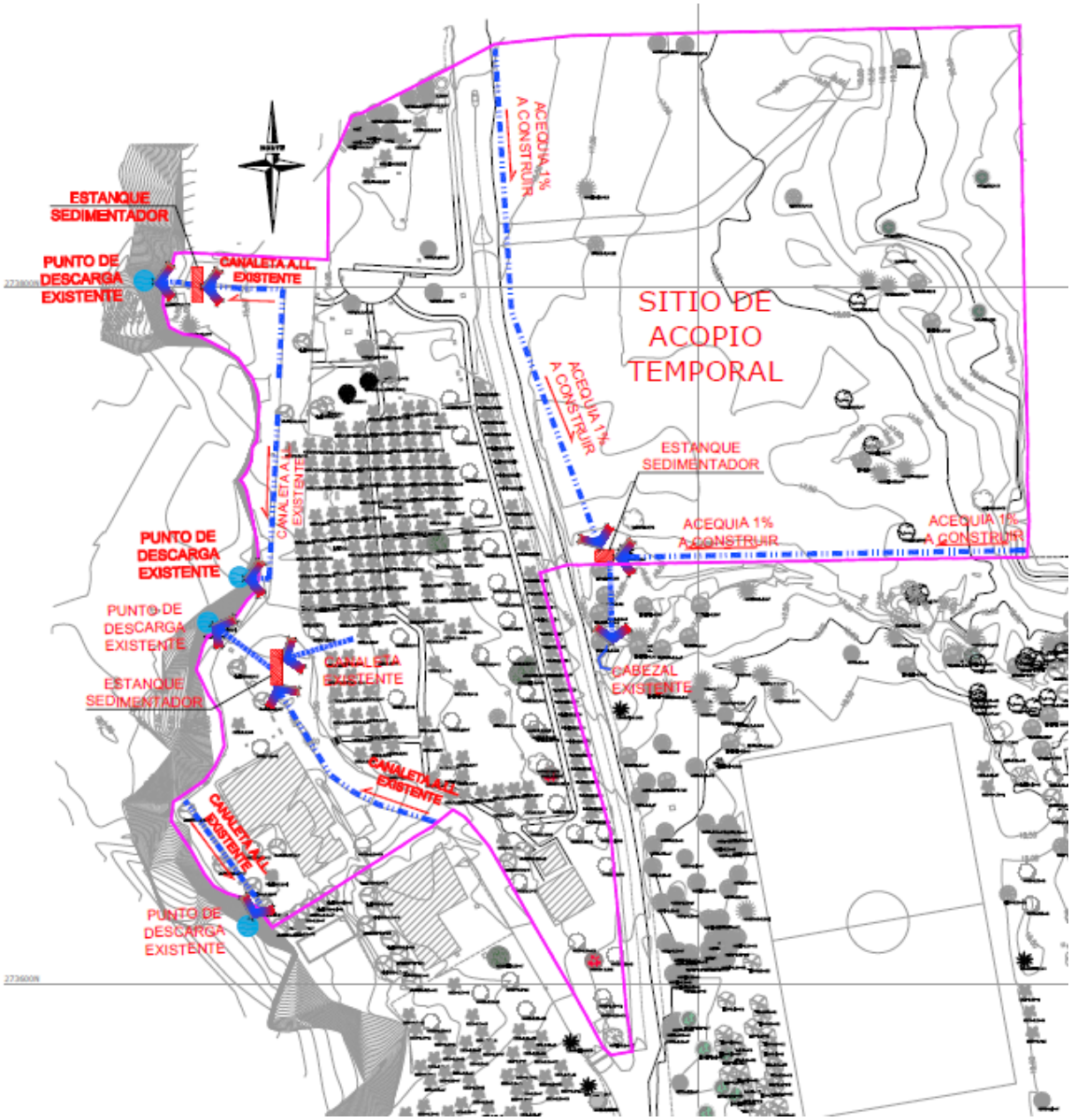
Source: Consulting Team DILLON-ECO

Figure 10. 2 – Temporary Drainage During Construction



Source: Consulting Team DILLON-ECO

Figure 10.3 – Temporary drainage during construction, temporary collection site



Sitio de Acopio temporal = Temporary storage site,Punto de descarga existente= Existing discharge point
Estanque sedimentador=Sedimentation pond, Acequia= gutter

Source:Consulting Team DILLON-ECO

Sedimentation ponds will be 1m high by 10m long by 3m wide to handle water in a peak storm (see measure 3.2.25).

Estimated Amount of Environmental Measure

Table 10.5 – Estimated amount of the environmental measure - Soil and Water Management in Construction

Description	Quantity	Unit	Unit Price	Term (months)	Total
Organic soil collection in main land	50,000.00	m^3	$ 0.80	1.00	$ 40,000.00
Organic soil collection in collection site	35,000.00	m^3	$ 0.80	1.00	$ 28,000.00
Sedimentation pond	3.00	Unit	$ 3,000.00	1.00	$ 6,000.00
Rainwater channels	600.00	M	$ 3.00	1.00	$ 1,800.00
				TOTAL	**$ 75,800.00**

Source: Elaboration by Consulting Team

10.2.5 Handling and Storage of Hazardous Materials

Measure Type: Attenuation

Description of measure

The tasks and activities to be developed during the construction put at risk the safety of personnel; with the aim of preventing health risks and minimize the likelihood of incidents, during construction activities the personnel working in the construction will be instructed on the proper handling of equipment and tools.

The contractor shall be responsible for requiring workers the use of safety equipment such as gloves, helmet, and harness for protection during construction activities.

Construction personnel should implement and be trained in the proper handling of hazardous materials. Fire extinguishers shall be provided where necessary, as well as proper personal protective equipment. Works will be carried out to reduce the risk of spills.

To effectively inform the personnel, a management plan should be implemented to keep a complete list of hazardous materials, as well as material safety data sheets. In addition, personnel should be trained on the use of material safety data sheets.

Industry best practices for the handling, storage and use of hazardous materials will be used, including:

- Training of personnel and use of personal protective equipment;
- Overfill and spill protection;
- Inventory control and signalling;

- Use of secondary containment, when applicable;
- Separate storage of incompatible materials; and
- Material for response to spills and clean-up will remain available.

Hazardous materials to be used include:

1. Fuels for equipment and vehicles;
2. Lubricating oils, for daily filling. Oil changes will be made outside the construction site at an authorized location;
3. Solvents;
4. Paints;
5. Muriatic acid or other for cleaning;
6. Among others.

These materials will be stored in the laydown area and within the Project property, so two fenced and closed areas have been considered for this purpose.

The area will be equipped with the following:

- Aboveground fuel tank (diesel) with approximately 1,000 gallons capacity, with its containment berm;
- Spill containment sand;
- Wipes;
- Gloves;
- Listing of Material Safety Data Sheets; y
- Eyewash sink.

The materials that are listed in Table 10.6, will be held in the site in large quantity, so its handling is detailed.

Table 10.6 – List of Hazardous Materials in Construction Site

Product	Risks	First aid	Signaling	Protection Equipment	Waste Treatment
DIESEL FUEL	Flammable and combustible Health: Low degree of toxicity by inhalation or ingestion,	Eyes: Rinse with soft jet of water. Skin: In Cold: Apply plenty of water, remove contaminated clothing and wash with soap and water. Inhalation: Remove to fresh site and call your doctor. If	SIGNALING: "FLAMMABLE"	Only for high exposure or risk of contact: cartridge respirator and goggles with side protection.	Spills: Isolate an area of 50-100 m depending on the spill. Eliminate all sources of ignition, confine the spill contain with sand or other absorbent

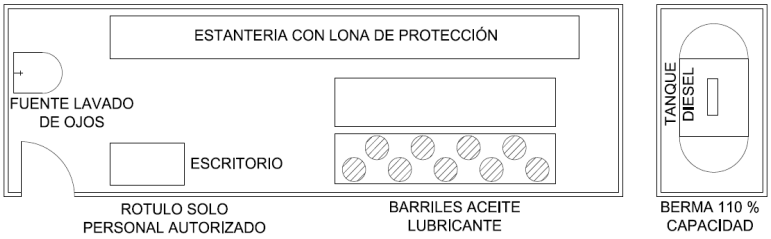
Table 10.6 – List of Hazardous Materials in Construction Site					
Product	**Risks**	**First aid**	**Signaling**	**Protection Equipment**	**Waste Treatment**
	skin and eye irritation. Carcinogenic Potential.	not breathing start resuscitation and apply oxygen. INGESTION: Do not induce vomiting, keep at rest, and call the doctor.			material. Subsequently properly dispose this material.
LUBRICATING OILS	Fuel Health: Irritant to eyes, skin and inhalation by prolonged exposure. Abdominal discomfort, nausea and diarrhea on ingestion.	Eyes: Flush with running water, soft. Skin: Apply plenty of water, remove contaminated clothing and wash with soap and water. Inhalation: Remove to fresh site and call your doctor. INGESTION: Do not induce vomiting, keep at rest, call the doctor.	NOT REGULATED	Foam, water spray, chemical dust, carbon dioxide.	In case of spill, absorb and contain. Wear protective equipment for vapors.

Source: Material Safety Data Sheets

Diesel storage: Keep the area of storage of these materials away from sources of ignition. Keep the barrels closed when not in use. Installation of contention berm is necessary to protect the receiver of any spilled fuel. This must be in a waterproofed area and with absorbent material.

Figure 10.4 shows the schematic storage of hazardous materials.

Figure 10.4 – Hazardous Materials Storage Scheme



Fuente lavado de ojos = Eyewash sink, Escritorio = desk, Estanteria con la lona de proteccion = Shelf with protective cover, Barriles aceite lubricante = lubricating oil barrels, Tanque Diesel = diesel tank, Berma = berma, Capacidad = capacity

Source: Consulting team

Signalling and location of extinguishers: The signalling of the areas indicating the different zones at the site, the risk, the use of protective equipment and the handling of hazardous materials is necessary. In addition, fire extinguishers should be located in a visible, accessible site and without any obstruction and with the proper information. Suitable fire extinguishers for stored products should be installed.

Training in occupational safety and hygiene: The environmental management in the site requires changes in attitudes, patterns of behaviour and thought processes of employees, in addition to basic knowledge of environment conservation. This process begins with the improvement of the understanding of all individuals of environmental matters, and of the elements of an environmental management process.

For the training of personnel, the most important trainings for safety should focus on establishing methods by which the employee is being continuously transmitted with information about hazardous materials that could be exposed. These include label types, signals used within the site, first aid, the importance of protective equipment, care and use of machines, as well as how to act in case of any accident or emergency, such as fire and earthquakes, among others.

The most important areas to include in the training are:

a. Introduction to environmental management: the importance and understanding of environmental management.
b. Aspects on occupational health and safety:
    - First aid;
    - Fire Prevention and control;
    - Handling of hazardous materials or chemicals;
    - Signalling;
    - Use and importance of personal protective equipment;

- Contingency Plan: knowledge and training.

c. Contingency Plan and accident prevention.

Due to the handling of hazardous materials such as explosives and the risks identified in chapter 9: Risk Assessment and Prevention and Contingency Plan, there should be a contingency plan for the plant, a preliminary plan is included in the same chapter. The final Contingency Plan to be developed during the detailed design phase will include: description of possible and probable accidents, information on the mechanisms and intervention and communication measures in cases of emergency, description of security measures, review and update of the contingency measures.

The contingency plan should be implemented in the Laydown areas and work fronts, through signage, training and drills. A record of accidents and incidents must be kept, to update the contingency plan.

Location of the Environmental Measure

Laydown area, material storage sites and Project Property.

Estimated Amount of Environmental Measure

Table 10.7 – Estimated Amount of Environmental Measure - Handling and Storage of Hazardous Materials

Description	Quantity	Unit	Unit Price	Term (month)	Total
Fence	260.00	m	$ 35.00	1.00	$ 9,100.00
Kit for collection of oil spills: sand, wipes, shovel.	3.00	s.g.	$ 300.00	1.00	$ 900.00
Safety Training	150.00	c/u	$ 4.00	1.00	$ 600.00
Fire Extinguishers	20.00	c/u	$ 80.00	1.00	$ 1,600.00
				TOTAL	**$ 12,200.00**

Source: Consulting Team

10.2.6 Sewage Waste Water Treatment

Type of measure: Prevention.

Description of measure

In the different sites of work: given the type of project and the areas to be used, to avoid the disposal of open excreta, portable toilets for the management of excreta disposal shall be installed. One toilet for 25 or fewer workers in the work fronts will be installed. During the construction phase, between 10 and 48 portable toilets will be available for the approximately 1,200 construction employees distributed in

the construction area. Portable toilets will be maintained according to personnel at each phase. (See Table 10.8).

Table 10. 8 – Estimated Portable Toilets per Month

MONTH	Estimated employees per month	Number of portable toilets
Month 1	6	1
Month 2	79	4
Month 3	190	8
Month 4	244	10
Month 5	406	17
Month 6	339	14
Month 7	580	24
Month 8	670	27
Month 9	734	30
Month 10	772	31
Month 11	993	40
Month 12	1001	41
Month 13	1239	50
Month 14	1270	51
Month 15	1084	44
Month 16	1072	43
Month 17	1102	45
Month 18	959	39
Month 19	843	34
Month 20	781	32
Month 21	554	23
Month 22	412	17
Month 23	236	10
Month 24	197	8
Month 25	95	4
Month 26	95	4
Month 27	95	4
Month 28	95	4
Month 29	73	3
Month 30	95	4
Month 31	62	3
Month 32	62	3
Month 33	40	2
	TOTAL UNITS PER MONTH	**674**

Source: Own elaboration ECO/DILLON based on information from EDP/Wärtsilä, 2014.

The portable toilets services will be leased to companies that have the appropriate permissions, who will be responsible for the cleaning and maintenance, which should take place on a regular basis. These will be distributed in the various work fronts.

Location of the Environmental Measure
Distributed on different work fronts.

Estimated Amount of Environmental Measure

Table 10.9 – Estimated Amount of Environmental Measure - Domestic Wastewater Treatment Measure

Description	Quantity	Unit	Unit Price	Term (months)	Total
Portable toilets	674.00	c/u	$70.00	1.00	$ 47,180.00
				TOTAL	**$ 47,180.00**

Source: Consulting Team

10.2.7 Hazardous Materials in Construction of Maritime Terminal

Type of measure: Prevention

Description of measure
In addition to the general processes for storing and handling hazardous materials, in the case of the construction of the Marine Terminal and temporary trestle the following complementary measures will be taken:

1. Store hazardous materials, including fuels and lubricants in confined areas.
2. Spill containment materials shall be available:

- Spill containment barriers (oil booms) (1.000 m); material for absorption of spills (500 m);
- Floating oil collector (2) Training will be provided to personnel working on offshore tasks on spill prevention, response and cleaning.

3. Workers trained in spill prevention, immediate response and cleaning will be available at work fronts.

Location of the Environmental Measure
Construction site of the Maritime Terminal at open sea.

Estimated Amount of Environmental Measure

Table 10.10 – Estimated amount of the environmental measure - hazardous materials in construction of temporary maritime terminal and dock					
Description	**Quantity**	**Unit**	**Unit Price**	**Term (months)**	**Total**
Floating barriers (1,000 m)	1.00	s.g.	$ 7,000.00	1.00	$ 7,000.00
Floating Absorbent (500 m)	1.00	s.g.	$ 2,000.00	1.00	$ 2,000.00
Floating oil separator	2.00	c/u	$ 900.00	1.00	$ 1,800.00
Training	20.00	persons	$ 6.00	6.00	$ 720.00
				TOTAL	**$ 11,520.00**

Source: Consulting Team Elaboration

10.2.8 Closing of Perforations in Soil

Type of measure: Prevention

Description of measure

At the end of the hole drilling activities for soil studies, among others. Where ever is necessary to drill holes more than 5 m deep, we will proceed to:

1. Close any open hole during the construction process with bentonite or other suitable material.

Location of the environmental measure

Where ever there were piles, in location of tank on land, Power House or other.

Estimated amount of the environmental measure

Table 10.11 – Estimated Amount of Environmental Measure – Soil Perforation Holes closing					
Description	**Quantity**	**Unit**	**Unit Price**	**Term (months)**	**Total**
Closing of an estimate of 10 holes with bentonite	1.00	s.g.	$ 1,000.00	1.00	$ 1,000.00
				TOTAL	**$ 1,000.00**

Source: Consulting Team elaboration

10.2.9 Discharge of Test Water

Type of measure: Prevention

Description of measure

The water of hydrostatic pressure test will be analysed to confirm the absence of contamination. The water free of contamination will be released to local drainage areas. If it does not comply with the applicable criteria, the water will be treated prior to discharge. The water will be channelled to the sedimentation pond and then to the CEPA channel.

If seawater is used for the test, it must be done using barriers in the pipe or hose to be used to prevent the entrainment of fauna and sediments.

Location of the Environmental Measure

Tanks and pipes.

Estimated Amount of Environmental Measure

Table 10.12 – Estimated Amount of Environmental Measure - Test Water Discharge

Description	Quantity	Unit	Unit Price	Term (months)	Total
Tank truck with pump	1.00	m	$ 3,000.00	1.00	$ 3,000.00
				TOTAL	**$ 3,000.00**

Source: Elaboration by Consulting Team

10.2.10 Relocation of Fauna

Type of measure: Attenuation

Description of measure

With the protection of fauna is pursued:

- Develop actions for the protection and care of wildlife;
- Train workers for the environmental sustainability of the project area during the execution of the construction activities;
- To promote individual and collective responsibilities for nature, the environmental and economic sustainability, and human solidarity with the environment;
- Generate awareness of environmental protection among the workers, through the placement of educational messages in the common areas of the Project.

To mitigate the impact on wildlife during construction activities, an appropriate training program on wildlife conservation is proposed.

Hunting or destruction of wildlife that move within the property or its surrounding is prohibited during the entire execution of the project. Fishing is also prohibited in the sea.

Fauna Rescue

Before starting the construction, trained personnel will take a tour around the site trained to catch the fauna that inhabits in the place; this will be properly handled in appropriate cages and given to an NGO for relocation in appropriate sites.

If fauna is harmed or there are birds or other circumstances that require wildlife management during the site preparation, will proceed as follows:

- Cages for transporting fauna will be available on the Project site and on the personnel's transportation vehicles to the field. The collected specimens will be taken to the office in the Laydown area;
- From the Laydown area they will be taken to an appropriate organizations like FUNZEL or other dedicated to recover affected animals and be able to reintegrate them to their environment, already recovered;
- A record of the affected animals and delivered to these institutions will be kept.

Specific activities

- Recognition of the main species of wildlife: fish, mammals, birds, etc; identified in the project area;
- Discussion on the concept of over-exploitation, extinction, sustainable use and other related topics. To encourage participation in the commitment to the care of the environment in general;
- Foundation of principles and attitudes of management of the environment occupied or inhabited, by means of environmental education;
- Training.

Training talks to construction workers, 1 hour once a month, at the general safety meeting, during the site preparation stage.

<u>Location of the Environmental Measure</u>

Laydown area.

<u>Estimated Amount of Environmental Measure</u>

(See table 10.13)

Table 10.13 – Estimated Amount of Environmental Measure - Fauna Relocation Measure					
Description	**Qantity**	**Unit**	**Unit Price**	**Term (months)**	**Total**
Relocation of fauna	2.00	persons	$ 1,100.00	2.00	$ 4,400.00
Training for construction personnel	300.00	persons	$ 2.00	3.00	$ 1,800.00
				TOTAL	**$ 6,200.00**

Source: Elaboration by Consulting Team

10.2.11 Reforestation and Support to FIAES

Measure Type: Attenuation

Description of measure

To compensate for the loss of vegetation by the cutting of trees, as well as the loss of infiltration by waterproofing areas and the use of water from the well is proposed the following:

1. Revegetation in areas of the Project;
2. Revegetation on land of the Municipality of Acajutla; y
3. Donation to FIAES, for revegetation projects and other environmental projects.

Calculation of compensation for logging

Logging is summarized in the following Table 10.14:

Table 10.14 – Trees to Cut		
Location	**Common**	**Threatened**
Project Property	207	0
Pipeline right of way	112	0
Laydown area	284	2
Total of trees to cut down	**603**	**2**

Source: Elaboration by Consulting Team

The trees will be compensated according to the compensation requirements of the MARN, 10 trees for each tree cut, and 25 for each tree cut, for the trees in delicate state, totalling 6,080 trees to plant.

Calculation of compensation for water use and waterproofing

Table 10.16 and 10.17 summarizes the calculation of compensation for water use and for waterproofing, based on the water balance in Table 10.15

Table 10.15 – Hydric balance		
Concept	**mm**	**%**
Precipitation	1,754.00	100%
Evapotranspiration	1,182.00	67%
Infiltration	343.00	20%
Runoff	229.00	13%

Source: Hydrological Study

Table 10.16 – Compensation for use of water from the well		
Description	**Quantity**	**Unit**
Extraction Flow	4.5	L/S
Flow per minute	270	L/MIN
Conversion to:	16,200.00	L/H
Conversion to:	324,000.00	L/Day (20 h)
Litters per year:	118,206,000.00	L/YEAR
TO COMPENSATE	118,260.00	m^3/year
Rain	1,754.00	mm
% Infiltration	20%	
Having an infiltration	343.00	mm
Infiltration in m	0.34	m
To infiltrate	118,260.00	m^3 (B)
Needed:	344,781.34	m^2 (B into A)
In hectares	34.47	
Distancing	25.00	distance 5x5
Total Trees	**13,791.25**	

Source: Elaboration by Consulting Team

Table 10.17 – Compensation for Loss of Infiltration		
Description	**Quantity**	**Formula**
Area to waterproof:	53,748.19	m^2 (B into A)
In hectares	5.37	
Distancing	25.00	distancia 5x5
TOTAL	**2,149.92**	

Source: Elaboration by Consulting Team

So the amount of trees to be planted for compensation totals 22,022.

For planting compensation:

1. Revegetation on Project grounds: 1,781;
2. Revegetation in the Municipality of Acajutla: 18,114.

The remaining trees, 2,127, their equivalent amount will be donated to the Initiative for the Americas Fund (FIAES). FIAES is a non-profit organization that catalyses resources from governments, civil society and private sector for environmental conservation projects. Since 1993, FIAES has been supporting the conservation of ecosystems such as forests, wetlands, coastal areas, basins and agroecosystems, such as the Los Cobanos conservation area, El Imposible-Barra de Santiago, Apaneca-Ilamatepec Biosphere Reserve, among others.

Below, we detail the specifications for planting in these sites.

Planting method

Preparation of the site to plant: The tree should be planted, making sure it is vertical, centered in the hole, and stable. When planting, roots must be extended with care and cut the broken or wilted parts, immediately place the soil in the hole in the form of layers.

Individuals to plant shall have at least 1m height. The suggested species for planting, has been selected mainly under the principles of adaptability in the area and considering native species of flora, the existence of the species in the project area, determine the adaptation to the site.

To estimate the spacing between plants and rows, soil fertility and water availability, soil inclination and planting (protection / recreation) will be taken into account in addition to the characteristics of the selected species. The recommended planting period is at the beginning of the rainy season, between the third week of May and the second week of June.

Species maintenance starts from the time they are planted (early winter or rainy season) or depending on construction activities according to program) and will last up to two years:

- Irrigation of planted species: the process must be repeated until the plant has been established for at least 2 years. Special care must be taken during dry days, during the heat stroke, rainy-dry and dry transitional season;
- Protection with cover (mulsh): it is advisable to place a dry plant material cover, with a thickness of 3 to 5 cm around the plant, to minimize the loss of water from the soil and avoid the possibility of the growth of weeds around the same;
- Tutoring: Some plants need the support of a tutor, to avoid lodging (tilt);

- Cleaning and replanting: this consists in the elimination of weeds that are competing with the ground, keeping the area clean on the crown (1m diameter) and the refitting of mulsh. When it is necessary to replace the malformed plants and of course the dead, with the aim of maintaining the appropriate density of vegetation cover. The developer as owner of the project will have the responsibility of maintaining the planting until the end of the project and the delivery of planted to the corresponding institutions.

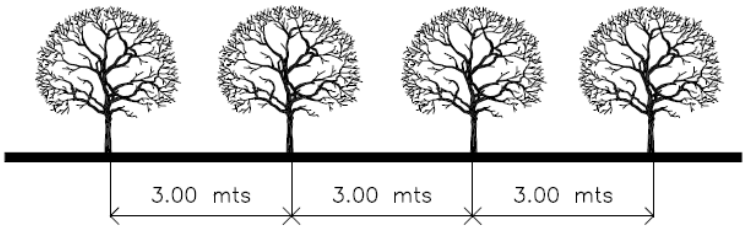
Methods of planting

For the implementation of the three planting, there are different methods for the settlement of the plantation, depending on the characteristics of the areas to revegetate and of selected species. Below is a brief description of the recommended planting methods according to the characteristics of each place.

Row Method

It is used in areas parallel to the roads (border), the distance between plants depends on the size reached by the species in its maturity, so that planting can vary between 3 to 5 meters, as presented in Figure 10.5. The species to be considered must also present characteristics of primary root deep, in order to prevent damage to the urban infrastructure to implement.

Figure 10.5 – Row Planting Method

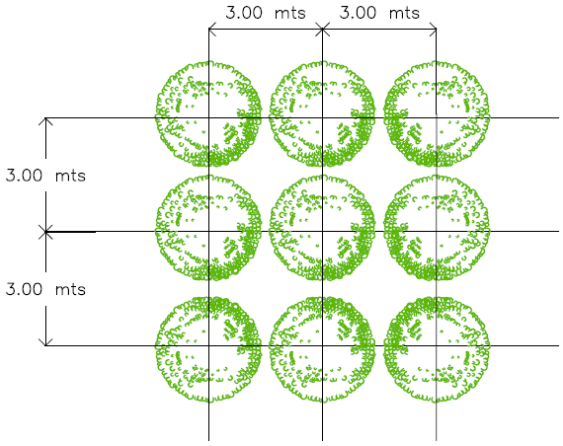


Source: Consulting Team Elaboration

Method of the square

In this method the plants are distributed in rows, formed a square, with a spacing between rows of 5.00 to 3.00m; Combining threads of different species. (See Figure 10.6)

Figure 10.6 – Square Planting Method



Source: Consulting Team Elaboration

Species

The total compensation of trees, is shown in Table 10.18, indicating, species, distance and number of individuals.

Table 10.18 – Square of trees

Common name	Scientific name	Distance	Quantity
“anona poshte” (cherimoya)	Annona cherimola	3.00	37.00
“coco” (coconut)	Cocus nucifera	3.00	150.00
“limón persa” (persina lime)	Citrus latifolia	3.00	150.00
“limón indio” (citrous lime)	Citrus aurantifolia	3.00	150.00
“mandarina” (mandarin orange)	Citrus reticulata	3.00	150.00
“marañon” (cashew tree)	Anacardium occidentale	3.00	150.00
“naranja valencia” (sweet orange)	Citrus sinensis var. Valencia	3.00	150.00
“naranja victoria” 8Victoria Orange)	Citrus sinensis var. Tehuacan	3.00	150.00
"morro"	Crescentia alata	3.00	150.00
“madrecacao”	Gliricidia sepium	3.00	149.00
“naranja” (orange)	Citrus sinensis	3.00	150.00
“Achiote”	Bixa orellana	3.00	148.00
“Casco de cabro”	Bauhinla purpurea	3.00	97.00
		TOTAL OF TREES	1,781.00

Source: Consulting Team Elaboration

Environmental compensation for the 2,127 trees it is in the Table 10.19.

Table 10.19 – Compensation to Environmental Fund for the 2,127 Trees				
Calculation of tree costs for FIAES, based on a MARN document				
Task	**Quantity**	**Unit**	**Unit Price**	**Total**
Cost per tree	2,127.00	each	$2.50	$5,317.50
Tracing and stacking at field level	2.00	day	$250.00	$500.00
Transportation, travel with 200 plants	10.64	Trip	$50.00	$531.75
PLANTING				
Digging 0.40x0.40x0.40	136.13	m^3	$2.50	$340.32
Fertilizing with 1 oz of fertilizer per plant	1.20	quintal	$15.33	$173.23
Laboring with 20 plants per day	106.35	day	$4.81	$511.54
TOOLS				
Pickax	6.00	each	$15.00	$90.00
Duplex shovels	6.00	each	$25.00	$150.00
MAINTENANCE				
Maintenance personnel, weed removal, re-planting of lost or damaged plants, pest and disease control	2,127.00	trees	$4.86	$10,337.22
TOTAL DIRECT COSTS				**$17,951.56**
INDIRECT COSTS				
Cost of administration			12%	$2,154.19
Technical Assistance			25%	$4,487.89
Unforeseen			10%	$1,795.16
TOTAL INDIRECT COSTS				**$8,437.23**
TOTAL SOWING + MAINTENANCE				**$26,388.80**

Source: Consulting Team Elaboration

With a total cost per tree $12.41 each, including maintenance, for the construction phase is considered a tree planting with a cost of $5.59 per tree and a cost of $6.82 of maintenance, which will be distributed at the operations phase, in the first three years (See measure 10.3.8).

Location of the environmental measure

For the compensation for planting:

1. Revegetation in the grounds of the Project: 1.781. As shown in Figure 10.7. (See Map in Appendix 10.A)
2. Revegetation in the Municipality of Acajutla: 18.114. (See Appendix 10.B)
3. Donation to the Environmental Fund of El Salvador, in the location that they consider, an amount of $26,388.80.

193600 193800 194000 194200

1503600 1503400 1503200

C. 24 OCT. PTE

LINEA DE CONSTRUCCION

ÁREA DE USO FUTURA / AREA OF FUTURE USE

ÁREA DE USO FUTURA / AREA OF FUTURE USE

POZO DE MONITOREO 2 / MONITORING WELL 2

PARQUE DE CAMIONES Y RASTRAS

BOULEVAR Cnel OSCAR OSORIO

CASA DE MAQUINAS / POWER HOUSE

POZO DE MONITOREO 1 / MONITORING WELL 1

LÍNEA DE CONSTRUCCIÓN

POZO DE PRODUCCIÓN 1 / PRODUCTION WELL 1

POZO DE RESPALDO 2 / WELL BACK 2

LÍNEA DE CONSTRUCCIÓN

SERVIDUMBRE PARA TENDIDO ELECTRICO

FRANJA PARA TUBERIA DE IMPELENCIA PROPIEDAD DE CEPA

SUBESTACIÓN ELECTRICA / ELECTRIC SUBSTATION

ESTANQUE DE SUBESTACIÓN / SUBSTATION POND

ESTANQUE DE RESTO DEL PROYECTO / PROJECT REST POND

Energía del Pacífico

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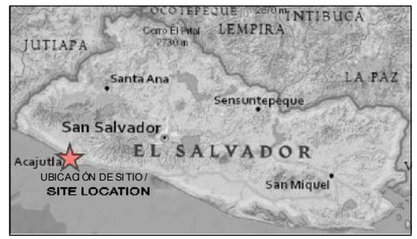
LNG TO POWER PROJECT

ARBORIZACIÓN EN EL PROYECTO / TREE PLANTING IN THE PROJECT

FIGURA 10.7 / FIGURE 10.7

CUADRO DE ÁRBOLES			
NOMBRE COMÚN	NOMBRE CIENTÍFICO	DISTANCIAMIENTO	CANTIDAD
"anona poshte"	Annona cherimola	3.00	122.00
"coco"	Cocus nucifera	3.00	142.00
"limón persa"	Citrus latifolia	3.00	133.00
"limón indio"	Citrus aurantifolia	3.00	90.00
"mandarina"	Citrus reticulata	3.00	150.00
"marañon"	Anacardium occidentale	3.00	150.00
"naranja valencia"	Citrus sinensis var. Valencia	3.00	150.00
"naranja victoria"	Citrus sinensis var. Tehuacan	3.00	150.00
"morro"	Crescentia alata	3.00	150.00
"madrecacao"	Gliricidia sepium	3.00	149.00
"naranja"	Citrus sinensis	3.00	150.00
Achiote	Bixa orellana	3.00	148.00
Casco de cabro	Bauhinia purpurea	3.00	97.00
TOTAL DE ÁRBOLES			1,781.00



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N W E S

FUENTE / SOURCE :
PLANOS WÄRTSILÄ / WÄRTSILÄ SITE PLAN

MAPA CREADO POR / MAP CREATED BY: ECO INGENIEROS
MAPA REVISADO POR / MAP CHECKED BY: LF
PROYECCIÓN DE MAPA / MAP PROJECTION :
UTM ZONA 16 WGS84 / UTM ZONE 16 WGS84

ARCHIVO / FILE
C:/CAP 10 ,ECO,DRAWING 1, EL SALVADOR/ ECO INGENIEROS
C:/CAP 10 ,ECO,DIBUJO 1, EL SALVADOR/ ECO INGENIEROS

PROYECTO / PROJECT: 14-9114
ESTADO / STATUS : FINAL / FINAL
FECHA / DATE: 12/01/2016

DILLON CONSULTING

ECO INGENIEROS

Estimated Amount of Environmental Measure

The cost of planting is included in the construction stage and the cost of maintenance in the stage of operations of the Project for three years.

Table 10.20 – Estimated amount of the environmental measure - reforestation and support to the Environmental Fund of El Salvador

Description	Quantity	Unit	Unit Price	Term (months)	Total
Trees in the Project site	1,781.00	c/u	$5.59	1.00	$9,955.79
Trees in municipal land	18,114.00	c/u	$5.59	1.00	$101,257.26
Environmental Fund of El Salvador	2,127.00	c/u	$5.59	1.00	$11,889.93
	22,022.00			**TOTAL**	**$123,102.98**

Source: Elaborated by Consulting Team

10.2.12 Barrier in Beach Area

Type of measure: Prevention

Description of the measure

A fence will be installed at the edge of beach and cliff, in the area of the pipe and access road to the temporary trestle, to prevent damage to the beach area and the entry of construction workers in these areas. In addition, to avoid storage in these areas of hazardous materials and heavy equipment.

Location of the environmental measure

Coastline in pipeline zone (See Figure 10.16 Environmental Measures Plan).

Estimated Amount of Environmental Measure

Table 10.21 – Estimated Amount of Environmental Measure - Beach Area Barrier Measure

Description	Quantity	Unit	Unit Price	Term (months)	Total
Beach protection fencing	20.00	m	$35.50	1.00	$ 710.00
				TOTAL	**$ 710.00**

Source: Elaborated by Consulting Team

10.2.13 Prevention of Interaction with Fauna

Type of measure: Prevention

Description of measure

Avoid attracting fauna to the site by all wastes to be generated. It includes a description of each type of waste to be generated and the management proposal for each of these.

Disposal of waste and residues

There will be wastes from the construction of the works, consisting of gravel from the construction, carton from cement bags, reinforcing steel pieces, PVC pipes, among others. These wastes and residues should be separated and handled appropriately.

The recommended handling for the waste and residues produced during the construction stage and site preparation, is summarized in the Table 10.22.

Table 10.22 – Wastes and Residues to be Generated in the Construction Stage

Disposal/Waste	Origin	Handling	Disposition
Fuel or used oil	Preparation of machinery and equipment daily	Storage in recyclable oil tank.	Sale to be used as fuel.
Used absorbent material (wipes, sawdust).	Preparation of machinery and equipment daily	Storage in closed containers or bags, properly closed and labeled as "hazardous waste"	Incineration through controlled methods, in sites with the authorization of the competent authority.
Wood or firewood	Cutting and logging	Collection in a designated area. The wood will be cut and placed in order.	Sale of wood or firewood
Leaves and branches	Cutting and logging	Collection in a designated site on every work front.	Eviction to authorized site, will be collected by the City Hall. (See Appendix 4E)
Paper	Office and packing	Store in signposted container	Sale for recycling
Domestic (cafeteria and offices)	Food, various	Storage in closed containers	Collected by municipal garbage truck (see Appendix 4E)
Glass	Bottles	Storage in closed container	Sale for reuse
Plastic	Packing material	Storage in closed container	Sale for recycling
Building Rubble	From own construction	Storage	Taken to an authorized rubble dump.
Metal pieces	Spare parts of support structures and metal pipes	Storage	Selling as scrap
Sterile earth moving material	Earth movements	Stacked in a defined area of land	Eviction to site defined for filling

Source: Elaborated by Consulting Team

Hazardous wastes include: empty deposits, used lubricating oil, solvents and other reagents, batteries and other consumables.

The construction rubble will be taken to an appropriate disposal site, authorized by the Municipality and by MARN.

Deposits to be used for domestic waste shall be fauna-proof and shall be emptied and cleaned regularly to avoid accumulation thereof.

At the end of the construction, the removal of all types of waste and residues should be verified at the site where the building material was located.

As a monitoring, a record of the amount of waste and waste generated, by type of waste or waste, of the transportation and delivery receipts of the waste and / or residue, and a photographic record of the storage site shall be kept, at least once a month.

Location of the Environmental Measure

Temporary storage sites, Laydown Area and work fronts within the site.

Estimated Amount of Environmental Measure

Table 10.23 – Estimated amount of the environmental measure - a measure preventing Interaction With fauna

Description	Quantity	Unit	Unit Price	Term (months)	Total
Plastic containers	60.00	c/u	$40.00	1.00	$ 2,400.00
				TOTAL	$ 2,400.00

Source: Elaborated by Consulting Team

10.2.14 Noise Reduction During Pilotage in Sea

Type of measure: Attenuation

Description of measure

Noise reduction and management plan will be implemented in the construction of the temporary piles in the dock, which will take as a guide the guidelines of the JNCC (Joint Nature Conservation Commiittee) of the United Kingdom. JNCC is the public body that advises the Government of the United Kingdom and the devolved administrations in the conservation of nature throughout the UK and internationally.

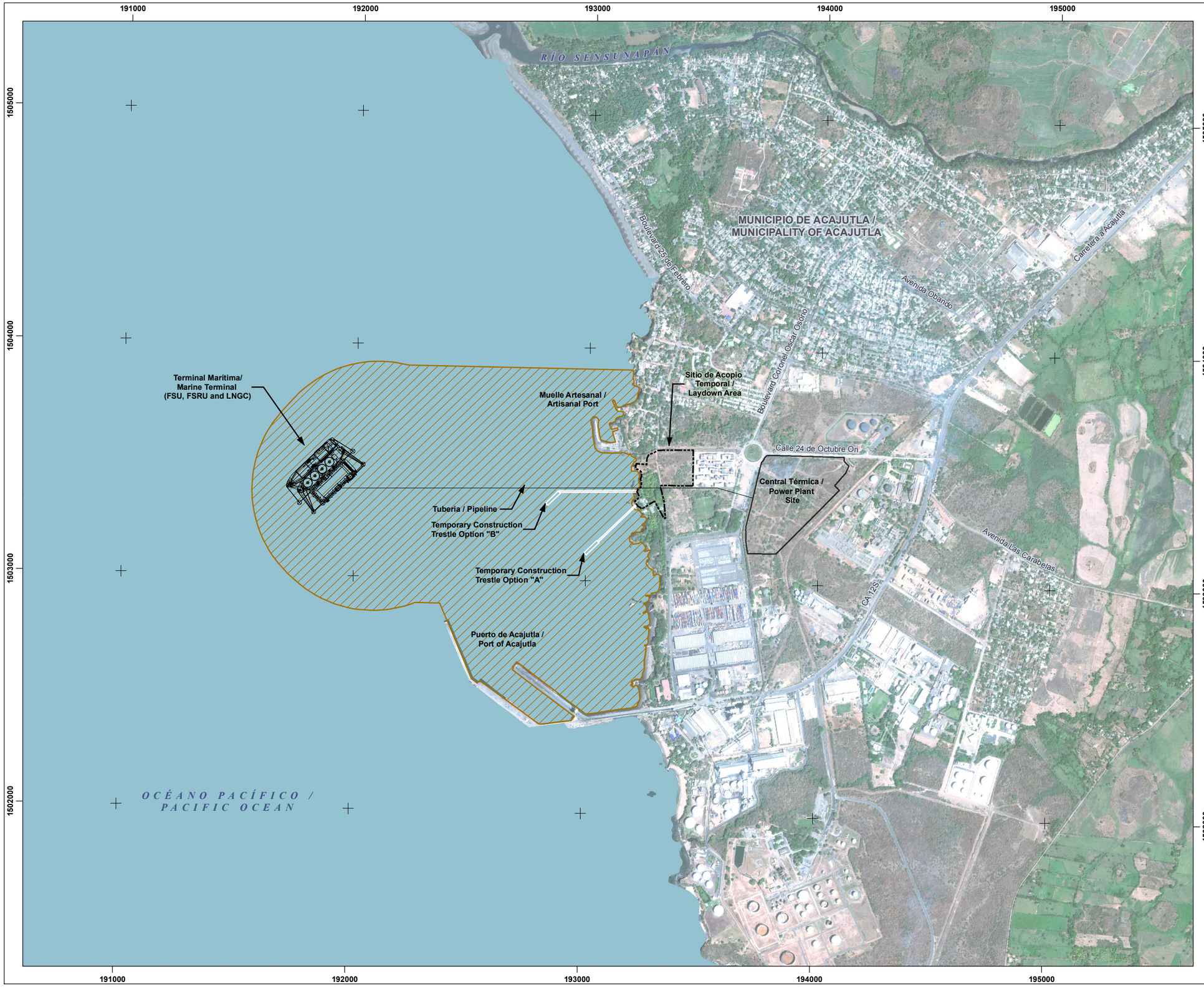
The JNCC to minimize the risk of damage to marine mammals by the noise of piloting, August 2010, describes a protocol for the mitigation of the potential impacts of underwater noise arising from the actuations. The protocol is designed to the construction of wind farms on the high seas, however also has relevance to other industries in the marine environment using drilling, including the oil and gas industry.

The plan to be developed will include at least

- Identify a safety zone and communicate it to fishermen and divers using the area.
- If feasible, consider using low noise techniques to drill the ground.
- Check the presence of divers and marine mammals in the mitigation area prior to drilling activities (500 m radius of piloting, temporary trestle and installation of Maritime Terminal)
- Delay activity if divers, turtles and / or marine mammals have been detected within the mitigation zone
- Smooth Start-up of the task of drilling and protocol reset after the breaks.
- The keeping of records and reporting

Location of the environmental measure

In an area of 500 m of site installation of piles, trestle, and the installation of the Maritime Terminal, as shown in Figure 10.8.



Energía del Pacífico

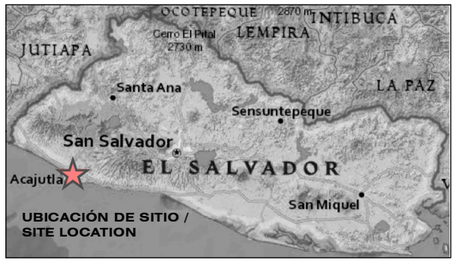
ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

CONSTRUCCIÓN DE ZONA DE MITIGACIÓN MARINA / CONSTRUCTION MARINE MITIGATION ZONE

FIGURA 10.8 / FIGURE 10.8

- SITIO DEL PROYECTO / PROJECT SITE
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA
- CONSTRUCCIÓN DE ZONA DE MITIGACIÓN MARINA / CONSTRUCTION MARINE MITIGATION ZONE



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N W E S

FUENTE / REFERENCE
VISIÓN DEL MUNDO 2 IMÁGENES DE ALTA RESOLUCIÓN / WORLDVIEW 2 HIGH RESOLUTION IMAGERY (2014-02-12)

MAPA CREADO POR / MAP CREATED BY: PFM
MAPA REVISADO POR / MAP CHECKED BY: MW
PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONE 16 WGS84

ARCHIVO / FILE: I:\GIS\163489 Acajutla\GIS\MXDs\Reporting - 2016\7-5 - Construction Marine Mitigation Zone.mxd

PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL / FINAL
FECHA / DATE: 12/7/2016

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LÍDERES EN CONSULTORÍA AMBIENTAL

Estimated Amount of Environmental Measure

Table 10.24 – Estimated Amount of Environmental Measure - Noise Reduction Measure During Sea Piloting					
Description	**Quantity**	**Unit**	**Unit Price**	**Term (month)**	**Total**
Development of the plan	1.00	m	$1,000.00	1.00	$ 1,000.00
Supervisor of mammals and turtles	1.00	each	$600.00	6.00	$ 3,600.00
Brochures and training for fishermen	1.00	s.g	$500.00	1.00	$ 500.00
				TOTAL	**$ 5,100.00**

Source: Elaboration by Consulting Team

10.2.15 Lighting Plan for Maritime Terminal and Temporary Trestle

Type of measure: Attenuation

Description of measure

Establish a management plan for the lighting, for works at sea, specifically the construction of temporary trestle, Maritime Terminal and pipeline, so as not to affect the marine fauna. The plan is to:

- Reduce the lighting at night in non-essential areas, particularly during critical periods of the life cycle of the fauna, such as for example during the sea turtle nesting;
- Use screens to direct lighting to work areas;
- Direct all lighting to work areas without illuminating directly to the water.
- Low light mounting where possible;
- Use of light shielding to reduce the amount of glare, as well as reduce visible light to animals, so there is less chance of them being trapped, repelled, or their day / night patterns altered;
- Installation of long wavelength lights (like amber and red lights) which makes visible light appear less intense for nocturnal animals (State of Florida 20141).

Location of the Environmental Measure

Maritime Terminal and temporary dock

[1] State of Florida. 2014. "Wildlife Lighting - About Light Pollution" Florida Fish and Wildlife Conservation Commission. Online: http://myfwc.com/conservation/you-conserve/lighting/pollution/

Estimated Amount of Environmental Measure

Table 10.25 – Estimated Amount of Environmental Measure - Measure Plan of Lighting of the Maritime Terminal and Temporary Dock					
Description	**Quantity**	**Unit**	**Unit Price**	**Term (months)**	**Total**
Temporary dock Lighting Plan	1.00	s.g.	$1,000.00	1.00	$ 1,000.00
				TOTAL	**$ 1,000.00**

Source: Elaboration by Consulting Team

10.2.16 Measures to Reduce Turbidity and Oyster Biomonitoring

Type of measure: Prevention

Description of measure

Temporarily suspend or reduce dredging activity if turbidity criteria are exceeding applicable limits detected through monitoring.

Monitoring will be carried out using a portable on-site turbidimeter, and will start 4 hours after starting dredging activities and two hours later to verify levels. With the data the average weekly and monthly levels will be estimated, to be compared with the reference standard.

Standard to be used for sediment suspension control: US EPA STANDARD PER STATE. California Standard, considering that is the same ocean and have developed port projects that are active. The standard establishes levels of 75 NTU, average of 30 days and 100 NTU average of 100 days.

In order to verify the sediment trawling impact, biomonitoring will be carried out in oysters, when the activities of the Marine Terminal and underground pipeline are carried out. It is proposed a monitoring at the beginning, to establish the baseline, a monitoring when starting construction activities, in the middle of its execution, and at the end.

The dredging, which is the activity which can generate the impact on oysters, according to the project schedule is 1 month, monitoring can be divide: 1 prior to the beginning, the second at the end.

Biomonitoring in oysters will be carried out following the following steps:

1. Identification of the areas of concentration of oysters that are a source of collection.
2. Preparation and sterilization of glass containers for storage of samples.
3. Selection of 4 samples from different sites of 400 grams each.
4. Storage in containers and in cooling conditions for transport.

5. Delivery of the samples in the laboratory for analysis.
6. Sample processing and obtaining results (approximately 15 days)
7. The baseline will be established before starting, where the parameters with which they are to date will be kept, and the same parameters will be checked for subsequent sampling to verify if there is an increase in contamination.

Significant increases, will force adjust the construction method or timing, or other methods to reduce the increase of sediments in the soil.

Location of the Environmental Measure

Points M1 and M3 of sampling performed, M1 at coordinates 13 ° 35'3.10 "N and 89 ° 50'42.35" O and M2 at coordinates 13 ° 35'1.49 "N and 89 ° 50'42.19" W. See figure 5.38.

Table 10.26 – Turbidity Monitoring Point

No	Date	Sample	Coordinate	
			Latitude	Length
1	17/08/2016	M01	13°34'50.59	89°50'10.80
23	24/08/2016	M12	13°35'28.37	89°51'3.10

Source: Elaboration by Consultation Team

Biomonitoring in an area identified as oyster banks in the place known as La Pedrera.

Estimated Amount of Environmental Measure

Table 10.27 – Estimated Amount of Environmental Measure - Turbidity Reduction Measure

Description	Quantity	Unit	Unit Price	Term (months)	Total
Turbidity Measurement	72	Unit	$55.00	1.00	$3,960.00
Oyster Biomonitoring	20	Sample	$ 150.00	1.00	$ 3,000.00
				TOTAL	**$ 6,960.00**

Source: Elaboration by Consultation Team

10.2.17 Environmental and Social Management Plan

Type of measure: Prevention

Description of measure

In addition to standard precautions for access control to unauthorized personnel. A communications plan must be established throughout the Project's execution, to be carried out by the project's social and environmental management office.

Objetives

This measure pursues the following objectives:

- Provide information to the local population and the general public on the progress, virtues and benefits of construction;
- Avoid collective speculation and rumours to prevent social and environmental conflicts;
- Notify ahead of time to the possible affected about the development of the Project;
- Prevent social conflicts and maintain a good relationship with the neighbours of the Project;
- Prevent inconvenience to the population residing in areas immediately to the project area;
- Serve the population that is affected in some way during construction.

Resources

The Office will have the following staff, as minimum:

1. Social Specialist: Will be responsible for all the social management of the project. The required profile for the person in charge of social management is as follows:

   Bachelor degree (BA) in Social Work, Sociology or Anthropology;
   - Experience in mediation of conflicts and processes of citizen participation;
   - Experience in social promotion of communal development projects.
2. Environmental Specialist: will be responsible for verifying the correct implementation of the project's environmental management plan. The required profile is as follows:
   - Graduated in Civil Engineering or similar, with specialization in environment;
   - Experience in implementing environmental measures in similar projects;
   - Experience in environmental impact assessments or environmental audits.

Functions of the office and its personnel

- Respond to queries and complaints from the population and answer or coordinate a response for them;
- Verify that the ENVIRONMENTAL MANAGEMENT PROGRAM is executed, as planned. Keep a record and prepare an annual report, which will be available when MARN carries out the environmental audits;
- Coordinate the environmental management of the Project related to activities outside the property;
- Conduct briefings. These meetings should include community leaders, representatives of the main institutions and the municipality. At least every six months;

- Talks to workers related to environmental protection, respect for customs and values, monthly, to different groups of 50 people;
- Organize campaigns to prevent health effects;
- Carry out communication campaigns of the Project;
- Prepare written informational documentation of the Project, in surrounding areas, municipality, schools.

Consideration should be given to the installation of 2 notices visible to passers-by and drivers, on the location of the Office of Social Management, in the perimeter walls of the Project.

Minimum requirements for operation

Must have at least three desks, a telephone, a computer and space for short meetings for at least five people, to serve small groups that might visit.

Location

The office will be established in the City of Acajutla.

Period of Office Operation

The office will be established before starting the construction process and will be in operation until the end of construction.

Guidelines for the Construction Stage

The responsibilities that the construction company acquires in the matter of social management of a project entails, giving full compliance with what is established within the technical conditions and of the contract that is subscribed, these responsibilities are framed in function of performing the following activities and / or actions:

a. To formulate an operational work plan, for which it will take as base the Social Management Program, which will require an update of the same if necessary, given that the period of time between the study and the execution of the Project can be broad, and the existence of changes in the environment thereof.
b. Incorporate the person in charge of social management into the monthly follow-up meetings.
c. Prepare monthly monitoring reports and a final report, which reflects the compliance with the measures and the processes implemented for it, these documents must have their respective support.
d. Inform and communicate to the communities about the proposed Project, impacts and compensation measures proposed.
e. Identify possible sources of local resources to cooperate in the implementation of mitigation measures and notify the Project holder so that it assesses the appropriateness of the sources and initiates the pertinent steps to formalize the

cooperation.

f. Document properly (photographs, registration of participants and visits, reports, memory aids, etc.) activities implemented and / or followed up.

Location of the Environmental Measure

Municipality of Acajutla

Estimated Amount of Environmental Measure

Table 10.28 – Estimated Amount of Environmental Measure - Environmental and Social Management Plan Measure

Description	Quantity	Unit	Unit Price	Term (months)	Total
Social Specialist	1.00	person	$800.00	33.00	$ 26,400.00
Environmental Specialist	1.00	person	$800.00	33.00	$ 26,400.00
Office and materials	1.00	Total	$950.00	33.00	$ 31,350.00
				TOTAL	**$ 84,150.00**

Source: Consulting Team Elaboration

10.2.18 Open Sea Safety

Measure Type: Attenuation

Description of measure

In coordination with CEPA and the Port Authority, a safety plan will be established, which will include at least:

- A 300 meter exclusion circle centred around the Maritime Terminal has been analysed and preliminarily approved by CEPA operational personnel. This exclusion zone applies to all ships, including port commercial traffic. The Project will formalize this circle of exclusion with the Port Authority with the concurrence of CEPA.
- An additional safety zone with a minimum radius of 500 m shall be established, applicable to ships of maritime terminals other than CEPA or EDP.
- Signalling of safety zones around the construction site of the temporary trestle;
- Signalling at the nearest location of the CENERGICA pipeline (60 m at its closest part)
- Reinforcement of CEPA patrols and security measures;
- Communication with fishermen and other people who use boats in the area; y
- Coordinate activities with CEPA.

Location of the environmental measure
Construction zone of the Maritime Terminal.

Estimated Amount of Environmental Measure

Table 10.29 – Estimated amount of the environmental measure - Safety on the Open Sea

Description	Quantity	Unit	Unit Price	Term (months)	Total
Development of the plan in coordination with CEPA	1.00	Total	$2,000.00	1.00	$ 2,000.00
Materials	1.00	Total	$3,500.00	1.00	$ 3,500.00
				TOTAL	**$ 5,500.00**

Source: Elaboration by Consulting Team

10.2.19 Traffic Plan

Type of measure: Attenuation

Description of measure
A traffic management plan will be developed, during construction, to coordinate the entry of materials, labor and equipment into the Project site. The plan will include at least:

- Use of collective transportation vehicles, provided by the company to reduce the effect on the public transportation of the city;
- Specify designated routes;
- Heavy vehicles will not be allowed to pass through city streets (See Figure 4.3 - Equipment and Materials Road for Project Construction);
- Driver training on the traffic management plan as well as good driving practices;
- Announce and schedule, if necessary, closure of the entrance street, for the movement of heavier equipment: motors, generators, etc.;
- Appropriate signs and traffic controllers; y
- Report to the municipality, local schools and communities the traffic plan and potential dangers or affectation.

Location of the environmental measure
Project's area of influence.

Estimated amount of the environmental measure

Table 10.30 – Estimated amount of the environmental measure - Traffic Plan Measure					
Description	**Quantity**	**Unit**	**Unit Price**	**Term (months)**	**Total**
Signalling	1.00	Total	$500.00	1.00	$ 500.00
Driver Training	30.00	Person	$4.00	11.00	$ 1,320.00
				TOTAL	$ 1,820.00

Source: Elaboration by Consulting Team

10.2.20 Employment of local workers

Type of measure: Attenuation

Description of measure

To ensure that local workforce is used as possible, a person in charge of human resources will be hired, who will operate in the Project's communications office, to assist and coordinate with contractors the different elements of the Project specifically the identification of workers local.

The unskilled workforce must be from the municipality of Acajutla, to the extent possible.

Publicity will be made to inform the population of the assistance of personnel in the communications office of the Project. No work requests will be received in the main access of the Project site.

The measure includes:

- Human resources manager;
- Advertising material.

Location of the Environmental Measure

Project Communications Office and Project Access.

Estimated Amount of Environmental Measure

Table 10.31 – Estimated amount of the environmental measure - employment for local workers

Description	Quantity	Unit	Unit Price	Term (months)	Total
Human resources manager	1.00	person	$800.00	30.00	$ 24,000.00
Advertising material	1.00	Total	$1,500.00	1.00	$ 1,500.00
				TOTAL	$ 25,500.00

Source: Elaboration by Consulting Team

10.2.21 Prevention of Informal Stores near the Site

Type of measure: Prevention

Description of measure

Within the project site there will be a space for the construction workers for rest and feed, however, to prevent the proliferation of informal sales of food at the entrance of the project that would impede the passage of vehicles to the project and to the port, it will take the following measures:

1. Workers will be made aware through talks, flyers, about not to purchases food from informal sales;
2. Five signs will be installed on the perimeter fences of the Project prohibiting the establishment of street or informal sales;
3. When informal businesses are set up, they will coordinate with the Municipality for possible removal from the area.

Location of the Environmental Measure

Project Entry and Protection Fence

Estimated Amount of Environmental Measure

(See table 10.32)

Table 10.32 – Estimated Amount of Environmental Measure - Informal Store Prevention Measure Nearthe Site					
Description	**Quantity**	**Unit**	**Unit Price**	**Term (months)**	**Total**
Signs	5.00	m	$40.00	1.00	$ 200.00
Employee training	1.00	Total	$500.00	1.00	$ 500.00
				TOTAL	**$ 700.00**

Source: Elaboration by Consulting Team

10.2.22 Pipeline Safety Barrier

Type of measure: Prevention

Description of measure

A barrier will be installed to block and provide safety between the pipe construction site and recreational green areas of CEPA and employee housing, also from CEPA. The barrier will be temporary. It will be located on the entire south side of the pipe construction site. See Figure 10.16.

Location of the Environmental Measure

South side of pipeline construction site.

Estimated Amount of Environmental Measure

Table 10.33 – Estimated Amount of Environmental Measure - Noise Barrier and Pipeline Safety					
DEscription	**Quantity**	**Unit**	**Unit Price**	**Term (months)**	**Total**
Protection barrier	401.00	m	$22.00	1.00	$ 8,822.00
				TOTAL	**$ 8,822.00**

Source: Elaboration by Consulting Team

10.2.23 Compensation for Fishermen

Measure Type: Attenuation

Fishermen Measure Description

As a measure of compensation for the effects on the reduction of fishing areas and distance traveled by fishermen, the following environmental measures have been proposed, which were identified in the public consultation process of the Project:

Fishermen Cooperatives and independent fishers in general:

1. For the benefit of the fishermen of both cooperatives and independent fishers in general: Replacement of damaged winch; and,
2. The installation of fish aggregating devices (FADs) near the artisanal dock - A FAD is an object that is used to attract fish. They usually consist of buoys or floats tied to the bottom of the ocean with concrete blocks. More than 300 species of fish gather around planted FADs.
3. Installation of artificial reefs. The measure contemplates the rehabilitation of the marine coastal ecosystems by means of artificial reefs which constitute an efficient tool of ordering and protection not only of oysters but of variety of species. The implementation of the Artificial Reef will promote the sustainability of the resource and will be addressed to the beneficiary communities which must be committed to the guidelines of proper maintenance of the reefs.

In Appendix 10C profiles of these projects are presented, a list of fishermen and an analysis of the possible impacts of some of the elements to be installed.

These measures are considered equitable, in which all fishermen would benefit equally, and that these projects can be implemented effectively before the start of construction.

Oyster-catchers and tuberos

In addition to the benefit of the FAD and compensate even more oyster-catchers and tuberos for the loss of fishing sites, EDP will provide these fishermen with an option to receive support and training to remain in the fishing sector, or to make a change to an alternative way of livelihood.

The support will consist of the following:

1. Those who wish to remain in the fishing option
    a. Participate in building themselves a rowboat to replace the "Tubes ";
    b. Receive training on safety, fish marketing and food safety;
    c. Receive improved materials and equipment for fishing.
2. Leaving the fishing option:
    a. Receive support for training in an alternative line of job skills/employment; y
    b. Eligible for ongoing counselling related to finding a job.

It is expected that any of these options will provide opportunities for affected fishermen to improve their livelihoods compared to the existing situation.

Location of the Environmental Measure

Coastal area in front of the City of Acajutla. See Figure 10.9.

Estimated Amount of Environmental Measure

Table 10.34 – Estimated Amount of Environmental Measure - Fishermen's Compensation Measure

Description	Quantity	Unit	Unit Price	Term (months)	Total
Purchase of winch for artisanal dock	1.00	Unit	$1,500.00	1.00	$ 1,500.00
Fish aggregating device and accessories	15	Unit	$1,000.00	1.00	$ 15,000.00
Artificial Reefs for Oyster-catchers	1.00	Total	$10,650.90	1.0	$ 10,650.90
Support to "Tuberos" and Local Oyster-catchers	57.00	person	$500.00	1.00	$ 28,500.00
				TOTAL	**$55,650.90**

Source: Elaboration by Consulting Team

10.2.24 Construction of Wastewater Treatment Systems

Type of measure: Preventive

Description of the environmental measure

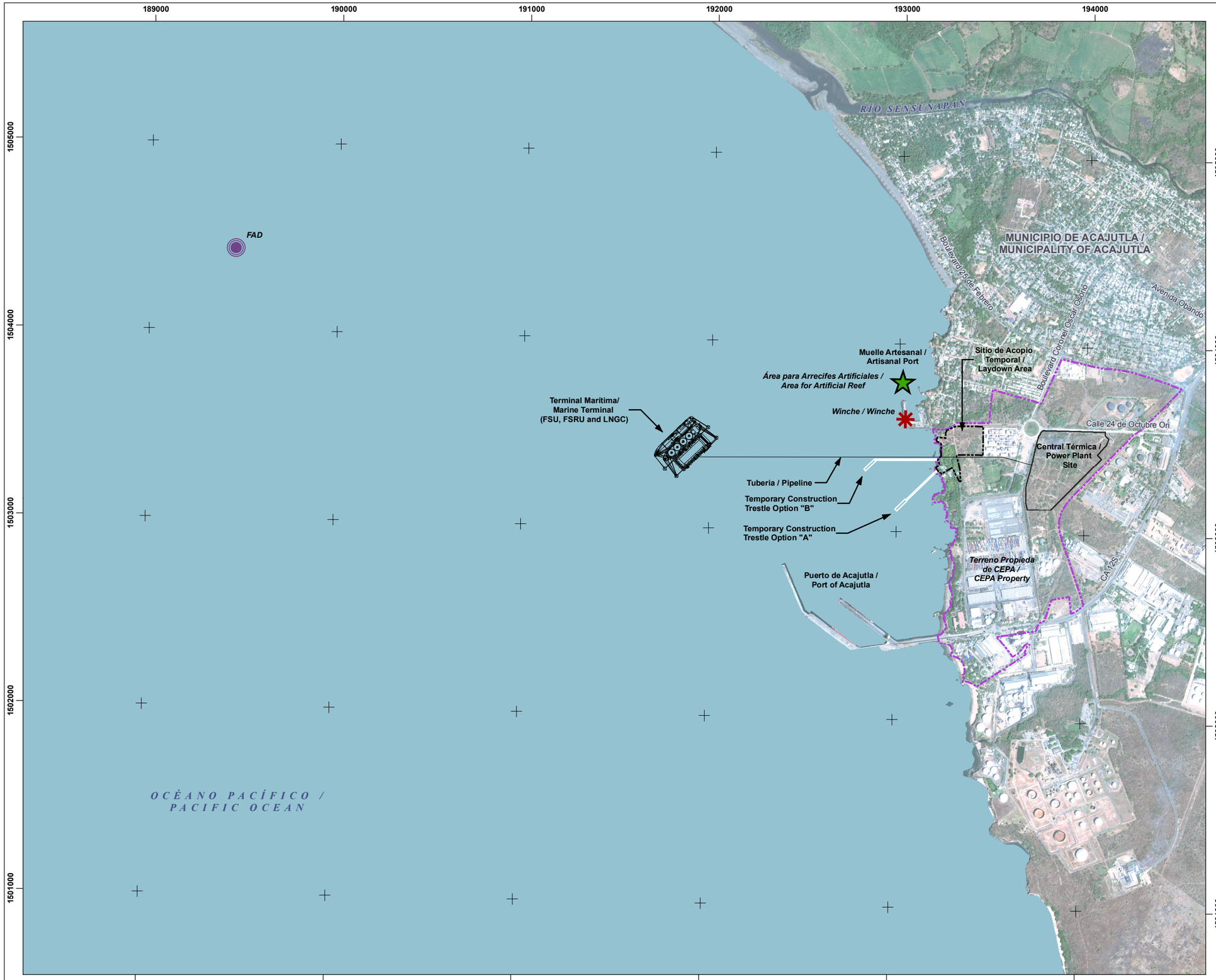
This measure includes the systems to treat wastewater from employees, cafeteria and cleaning to comply with the quality standard for waste water to be discharged to a receiving body in El Salvador. The treated effluent will be discharged to the CEPA drainage channel at the south-west corner of the site. The sludge from the domestic wastewater treatment plant will be sun dried and used as fertilizer in the green areas of the plant or removed by an authorized company.

A SBR "Sequencing Batch Reactor" process system will be installed. This process is divided into the following stages:

During the initial loading phase (sludge damping and storage) the solids (sludge) settle and the sludge water from the upper layer is transferred to the second stage of the treatment (The bioreactor).

The draining water is aerated inside the bioreactor with fine bubbles of oxygen and this causes the microorganisms that consume the nutrients to increase. This can be seen in the aeration phase.

After aeration, which lasts for a relatively long time, there is a rest phase inside the bioreactor. During this phase the water rests completely and the rest of the sludge is set at the bottom of the tank and a zone of clear water is created.



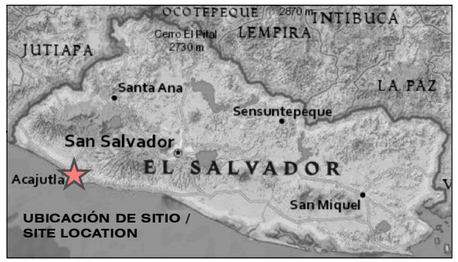
ENERGÍA DEL PACÍFICO

LNG TO POWER PROJECT

COMPENSACIÓN A PESCADORES / COMPENSATION TO FISHERS

FIGURA 10.9 / FIGURE 10.9

- FAD
- WINCHE UBICACIÓN / WINCHE LOCATION
- ÁREA PARA ARRECIFES ARTIFICIALES / AREA FOR ARTIFICIAL REEF
- SITIO DEL PROYECTO / PROJECT SITE
- SITIO DE ACOPIO TEMPORAL / TEMPORARY LAYDOWN AREA
- TERRENO PROPIEDA DE CEPA / CEPA PROPERTY



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N W E S

FUENTE / REFERENCE
VISIÓN DEL MUNDO 2 IMÁGENES DE ALTA RESOLUCIÓN / WORLDVIEW 2 HIGH RESOLUTION IMAGERY (2014-02-12)

MAPA CREADO POR / MAP CREATED BY: PFM
MAPA REVISADO POR / MAP CHECKED BY: MW
PROYECCIÓN DE MAPA / MAP PROJECTION: UTM ZONE 16 WGS84

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\\dillon.ca\DILLON_DFS\Toronto\Toronto GIS\163489 Acajutla\GIS\MXDs\Reporting - 2016\10-X - Compensation

PROYECTO / PROJECT: 14-9114
ESTADO / STATUS: FINAL / FINAL
FECHA / DATE: 12/13/2016

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ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

The clear water is extracted for disinfection with Ultraviolet light, which kills e. coli bacteria. The settled sludge returns from the bioreactor to "Cushioning and sludge storage". After this the cycle starts again from the beginning.

The following figure 10.10 shows the different phases of the SBR process. The proposed system operation is the same, but may have different tanks or cameras.

Figure 10.10 – Treatment in the Wastewater Treatment Plant

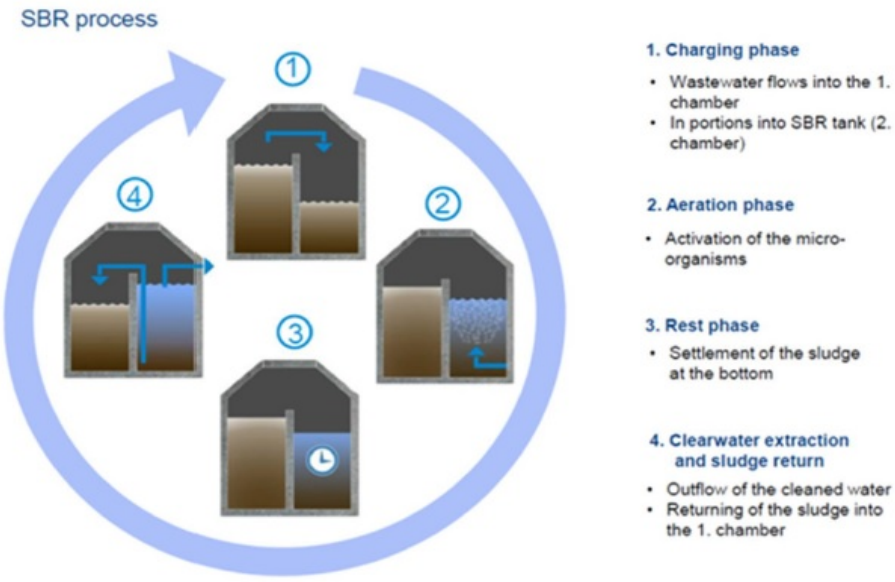


Figure 1 The different stages of the SBR process.

Source: Wärtsilä 2016

The monitoring and control of the plant is presented in 10.1.24. The water to discharge will comply with what is established in the standard of "wastewater discharged to a recipient body" normative.

FSRU and FSU will have a sewage treatment unit suitable for the crew with 14 days of wastewater storage.

The FSU will also be equipped with an on-board wastewater treatment plant. Approximately 7m3 / day of wastewater treated according to the MARPOL Annex IV specification (Marine Environment Protection Committee Resolution 159 (55)) and comply with the local discharge requirements of El Salvador.

Monitoring and control

The physic and chemical characterization of the discharges with its corresponding flow measurement will be performed, to size the treatments for the reduction of levels of: COD, BOD, solids, sedimentary, suspended solids and fats and oils.

The standard of "WASTEWATER DISCHARGED TO A RECPIENT BODY" sets the following frequency of monitoring for domestic waste. In the case of the plant applies the less than 10 m^3 per day.

Table 10.35 – Parameters and Sampling Frequency

Characteristics	Flow rate m^3 / day		
	< 10	10 a 100	> 100
Temperature, PH, Sedimentable Solids and Flow	Monthly	Weekly	Daily
Other mandatory parameters according to standard	Annual	Biannual	quarterly

Source: Salvadorian Normative

For discharges less than or equal to 5 m^3 / day they will be exempt from presenting operational reports; However, they must implement the necessary measures to comply with the maximum permissible values in this standard. Therefore it is recommended to keep the corresponding record.

However, the Temperature, pH, Sedimentable Solids and Flow, do not need to be performed by an accredited laboratory. Yet, should be included in the operational report.

It is recommended to acquire a pH meter, thermometer, several Imhoff cones and a flow meter to perform their respective monthly measurements of Temperature, PH, Sedimentable Solids and Flow.

At least once a year hire a certified laboratory to perform at least one analysis and make validation of data taken by plant personnel.

Table 10.36 – Parameters to Monitor According to Standard

Parameter	Unit	Standard
BOD5	mg/l	60
COD	mg/l	150
Ph	mg/l	5.5-9.0
Oils and grease	mg/l	20
Sedimentable solids	mg/l	1
Total Suspended Solids	mg/l	60

Source: Elaboration by Consulting Team

The minimum frequency of sampling and analysis is defined according to the flow rate of effluents from wastewater treatment systems of ordinary type, which for the plant is estimated to be between 10.84 and 25.43 m^3 per day. These shall be carried out as set out below:

Table 10.37 – Frequency of Monitoring according to Residual Water Flow in m3 per Day.			
Parameter	**Less than 50**	**between 50 and 00**	**Over 100**
PH, Sedimentable Solids and Flow	Monthly	Weekly	Daily
Oil and grease	Annual	By quarterly	Quarterly
$BOD_{5,20}$	Quarterly	Quarterly	Quarterly
Total Suspended Solids	Annual	Biannual	Quarterly
Coliforms	Quarterly	Quarterly	Quarterly

Source: Elaboration by Consulting Team

The costs of the analysis are detailed:

Table 10.38 **– Annual Cost of Analysis**			
Analysis	**Price**	**Quantity**	**Total Cost**
Biochemical Oxygen Demand	$29.00	4	$116.00
Chemical oxygen demand	$19.40	4	$77.60
Hydrogen Potential	$7.80	12	$93.60
Oils and grease	$19.70	1	$19.70
Sedimentable solids	$7.80	12	$93.60
Total Suspended Solids	$15.50	1	$15.50
Chlorides	$11.00	1	$11.00
Coliforms	$11.00	1	$11.00
TOTAL			**$ 438.00**

Source: Elaboration by Consulting Team

The total cost is $ 438.00 per year of monitoring, per treatment plant.

The periodic operational reports should contain as minimum requirements the following information:

a) Flood record;
b) Record of laboratory analysis carried out by the holder and carried out by accredited laboratories, according to the pertinent legislation;
c) Registry of infrastructure damage, caused by accidental situations or accidents in the operation and operation of the system;

d) Fortuitous situations or accidents in the handling and operation of the system that generate discharges of waste water with levels of contaminants that contravene the limits allowed by the respective technical standards;
e) Evaluation of the current state of the system, and corrective and control actions.

Location of the Environmental Measure

South-west corner of the site of the Thermal Power Plant.

Estimated Amount of Environmental Measure

Table 10.39 – Estimated Cost of Environmental Measure - Construction of Wastewater Treatment Plant

Description	Quantity	Unit	Unit Price	Term (months)	Total
Package type wastewater plant	3.00	each	$ 35,000.00	1.00	$105,000.00
Transportation to the plant and taxes	1.00	each	$ 8,320.00	1.00	$8,320.00
Civil works for the installation of the plant	1.00	s.g.	$ 9,000.00	1.00	$9,000.00
Characterization of effluent (1 year and initial)	3.00	each	$ 438.00	3.00	$3,942.00
TOTAL					**$126,262.00**

Source: Elaboration by Consulting Team

10.2.25 Oily Water Treatment System

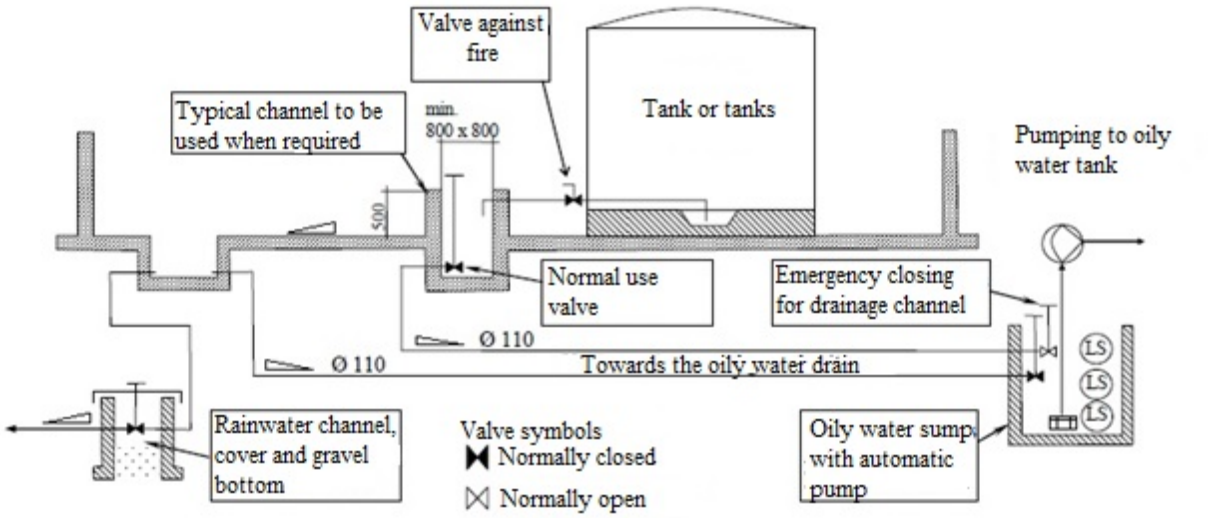
Type of measure: Preventive

Description of the environmental measure

All tanks with oil content, will have a drainage system. The main purpose is to perform the collection of water and cleaning of the tank areas, resulting in a lower risk of rainwater contamination.

The main diagram is shown below, in figure 10.11.

Figure 10.11 – Diagram of the Oil/Water Separator System



Source*: Wärtsilä 2016*

The philosophy and the most important rules that prevent spills are the following

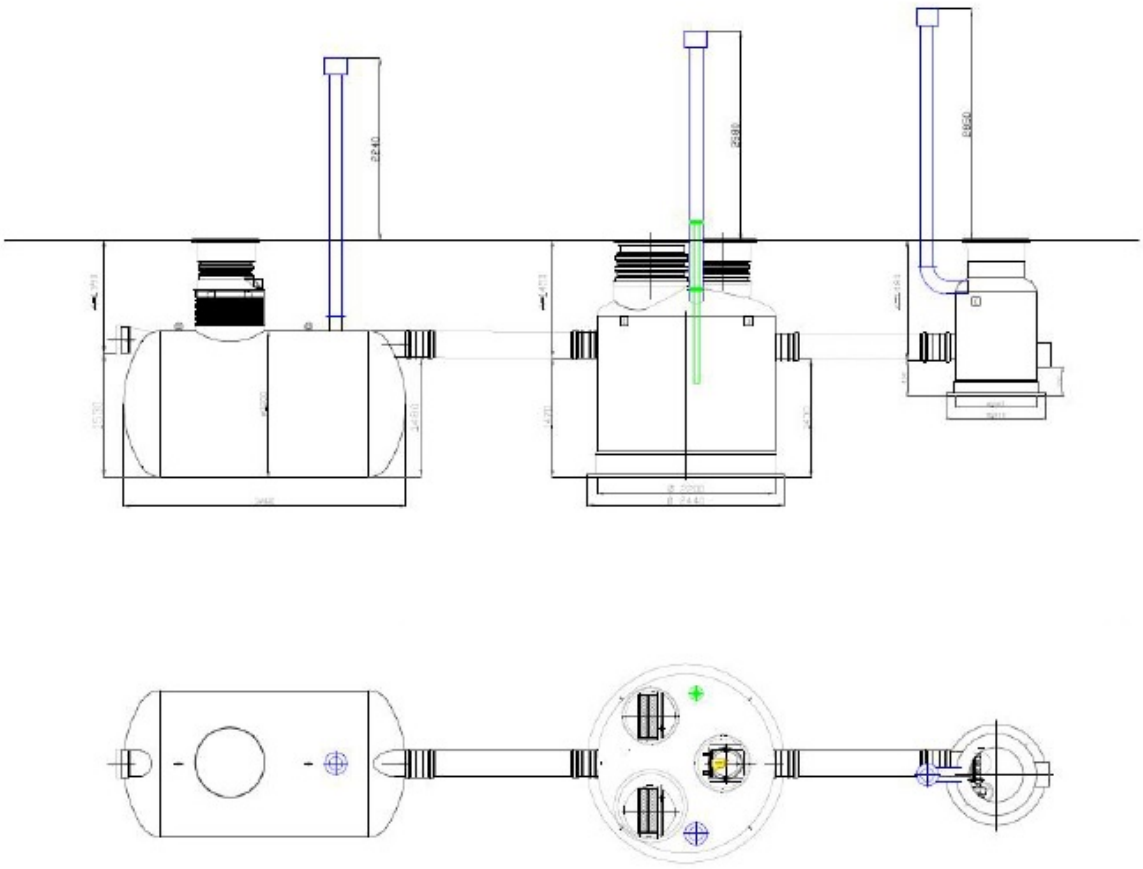
- Normally closed valves must only be opened under supervision.
- All tanks containing hydrocarbons (oily water, sludge, lubricating oil, fuel, etc.) will have an equivalent drainage system. The nearby tanks will use the same drainage channel. If funnels are used after the drain valves (in rows of small tanks, for example) they will be connected with a pipe to the common drainage channel of the tank.
- Drainage channels will be constructed with walls approximately 0.5 meters high to keep pure rainwater and oily waters separate. Rain that falls directly into the drainage channel (in smaller amounts) will be brought to the oily water collector. The minimum area of the bottom of the channel will be 800 x 800 mm to maintain valves and the channel. The drain channel valve will be equipped with an extension arm for easy operation.
- All drain lines will normally be closed to prevent oil dripping out of the area in case the tank spills.
- Pipelines will be separated from the drain channel of the tank and those from the rainwater channel to prevent direct spillage from the tank to the rainwater system.

The oily water management system will be responsible for collecting the oily waters and sludge produced in the plant to be stored in a tank for future disposal and transportation. The sludge will be

delivered to a company that has environmental permission for its final treatment and transportation outside the plant.
There will be water oil separator systems to drain water that might have contact with the oils of the equipment.

Figure 10.12 shows the treatment system for the water potentially contaminated with oil. The rain water pass through the sand trap where the particles settle out. When they come out of the sand trap the water is carried to the oil trap where the content of the oil is removed with the help of a coalescers, which separates the oil from the water, the system also includes a container of sampling where samples of the treated water can be taken.

Figure 10.12 – Water-Oil Separator



Source: Wärtsilä 2016

During the operation of the plant, rainwater potentially contaminated with oil will pass through the oil trap to prevent contamination.

In general, contaminated cleaning water from the following areas will also be treated:

1. Powerhouse;
2. Switch control;
3. Turbines;
4. Heat recovery boilers;
5. Stack area;
6. Boiler washing water;
7. Heat recovery system;
8. Compressed air building;
9. External tanks.

The parameters to be measured will be oils and grease and hydrocarbons.

Location of the Environmental Measure

South-west corner of the site of the Thermal Power Station.

Estimated Amount of Environmental Measure

Table 10.40 – Estimated Cost of Environmental Measure - Water-Oil Treatment System

Description	Quantity	Unit	Unit Price	Term (months)	Total
Oil treatment system	1.00	s.g.	$16,000.00	1.00	$ 16,000.00
Monitoring	6.00	c/u	$80.00	1.00	$ 480.00
				TOTAL	**$ 16,480.00**

Source: Elaboration by Consulting Team

10.2.26 Sedimentation / Rain Water Control Pond

Type of measure: The measure is considered as Preventive

Description of measure

To reduce the impact from the generation of increase of rainwater flows in the project, it is necessary to build a detention pond to store the additional volume and discharge only the rain water in the conditions without project.

The calculated flow rate to the ground without project generated by the maximum intensity of rain, 0.17 mm/min, for a return period of 100 years is 179 l/s. The duration of storm used is 24 hours. It is used for the design storm return period of 100 years, according to regulations of the United States, at the request of the holder of the Project.

Within the project area, it generates a total flow of 210 L/s with project. The difference in flow rates between conditions with and without the project, is 0,033 m3/sec for the area of the substation, and 0.16 m3/sec for the rest of the field. The maximum daily rainfall data used in this study correspond to the station Acajutla, and are from the 1971-2011 period (41 years). There is no more recent data; however, the analyzed period includes catastrophic weather events, such as IDA (2009), AGHATA (2010) and 12E (2011).

Two detention ponds consisting of a pond and a pumping system are proposed, since the point of discharge is at an upper level, in the CEPA drainage channel, on the Boulevard Coronel Oscar Osorio.

The retention pond for the rest of the land without the electrical substation will have minimum dimensions of 24 x 60 meters in the base and 1.8 meters in height, having a capacity of 2,544.48 m3. The emptying time of the tank will be double filling, in order to meet the criterion of zero hydrological impact.

The retention pond for the substation, will have dimensions of 15 x 10 meters of base and 1.8 meters of height, with capacity for 267.84m3.

The recommended pumping equipment is of submersible type, since it will be submerged inside the pond, Due to the low flow rate and the small hydraulic load that must overcome, a required power of 1.1 HP has been estimated, data to be confirmed in the final design phase. The water will be evacuated in 48 hours.

A solid trap will be installed in the entrance of the rainwater to the ponds, in order to prevent large solids from damaging the pump, it is recommended to use a submersible pump for wastewater, since these have the capacity to handle solid particles up to 2 inches in diameter.

The ponds will be periodically inspected to verify that there are no obstructions or excessive sedimentation in the pond. The inspection should be daily in the rainy season, and should be cleaned or removed and sediments when necessary.

The final stormwater management system will consider "low impact development" (LID) techniques such as:

- Reduction of impermeable areas;

- Permeable paving
- currents and bioretention
- Landscaped vegetation

The discharge of the water after the pond will be to the channel of CEPA.

Location of the Environmental Measure

Before discharge in the CEPA Channel at the south of the property and the other pond at the south of the substation.

Estimated Amount of Environmental Measure

Table 10.41 – Estimated Amount of Environmental Measure - Rain Water Control Pond

Description	Quantity	Unit	Unit Price	Term (months)	Total
Pond fot Power House and rest of the property	1.00	total	$10,000.00	1.00	$ 10,000.00
Pond for substation	1.00	total	$5,000.00	1.00	$ 5,000.00
				TOTAL	**$ 15,000.00**

Source: Elaboration by Consulting Team

10.2.27 Fire Protection System

Type of measure: Prevention.

Description of measure

To protect people, employees and the general population by possible events, especially in the handling of hazardous materials, such as LNG and other materials that will used in the project in the phase of operation.

Fire fighting equipment will be detailed later, as specified in the design of the firefighting system.

Location of the environmental measure

Thermal Power Plant in General.

Estimated Amount of Environmental Measure

(See table 10.42)

Table 10.42 – Estimated Amount of Environmental Measure - Fire Protection System					
Description	**Quantity**	**Unit**	**Unit Price**	**Term (months)**	**Total**
Portable fire extinguisher 5Kg, CO2	11	each	$35.00	1.00	$ 385.00
Portable fire extinguisher 20Kg, CO2	2	each	$90.00	1.00	$ 180.00
Portable fire extinguisher 12Kg, ABC	52	each	$60.00	1.00	$ 3,120.00
Portable fire extinguisher 6Kg, ABC	10	each	$35.00	1.00	$ 350.00
25 m hose	4	each	$300.00	1.00	$ 1,200.00
Blanket against fire	1	each	$60.00	1.00	$ 60.00
External hydrants	12	each	$1,850.00	1.00	$ 22,200.00
External hose enclosure	12	each	$450.00	1.00	$ 5,400.00
Valves for hydrant	12	each	$1,200.00	1.00	$ 14,400.00
Self-supporting hose enclosure	12	each	$500.00	1.00	$ 6,000.00
Foam mobile unit	6	each	$11,000.00	1.00	$ 66,000.00
				TOTAL	**$ 119,295.00**

Note: water tank, pipes and sprinkler systems are not included.

Source: Wärtsila 2016

10.2.28 Leak Detection System

Type of Measure: Prevention.

Description of measure

Installation of fixed equipment for detection of vapors

Gas detectors shall be installed within the facilities of the Thermal Power Plant, as established in Article 23, literal k) of the Regulation for the Application of the Law Regulating the Deposit, Transport and Distribution of Petroleum Products. These detectors will be of the intelligent, addressable type and with Infra Red or Ultra Violet technology. The detectors send information to the control room permanently. The equipment that is detailed will be installed:

- 8 Around the Powerhouse
- 4 in CEPA dock;
- 4 on main land.

In total, 16 fixed vapor detectors will be installed.

The detectors send information to the control room permanently, and are reviewed and calibrated every six months.

Acquisition of portable equipment for detection of vapors

Another mechanism to detect LNG leaks will be by constant monitoring of pressure in tanks and pipes, which, upon detecting an uncontrolled pressure drop, will automatically close the affected equipment-section. In addition, periodic inspections will be carried out with portable explosive gas detection instruments and oxygen meters.

The acquisition of four explosive gas detectors and four oxygen meters will be made.

Location of the Environmental Measure

Thermal Power Plant in general.

Estimated Amount of Environmental Measure

Table 10.43 – Estimated Amount of Environmental Measure - Leak Detection System

Description	Quantity	Unit	Unit Price	Term (months)	Total
Detection system	16.00	s.g	$500.00	1.00	$ 8,000.00
Explosive gas detectors and oxygen meter	4.00	each	$2,000.00	1.00	$ 8,000.00
				TOTAL	**$ 16,000.00**

Source: Elaboration by Consulting Team

10.2.29 Well Flow Monitoring Equipment and Monitoring Wells

Type of measure: Prevention

Description of measure

Objetive

Check the water flows extracted from the wells to be drilled to supply water to the plant.

Description

Installation of three water meters with flange of 2" and multi-jet standard pressure. To ensure the proper functioning of the macrometers installed, the maintenance described below will be performed.

- Preventive maintenance consists of suspending the supply, disassembling the meter and checking its parts to locate wear or burns that require its change. Proceed to adjust all its parts and if necessary calibrate to ensure its accuracy. Still, it is better to change the piece of measurement to another one that has been calibrated previously in the workshop, to guarantee its good functioning;

- The meters should be read at a frequency that allows to be aware of any irregularities such as backsliding or stoppages which may represent problems for the water supply. Every 1000 m3 is a figure that can serve as a guide and if the daily consumption is higher, then, reading every day will be recommended;
- The meter must be repaired, usually "in situ", it is immediately detected that it is failing or in bad condition.

Depending on the admissible flow registered, the following shall be done:

a. Maintenance must be done every two years when the meter registers 50% of the permissible flow per month. That is, we have Qn = Nominal flow rate, Qa = Permissible flow rate = Qn / 3

$$Q_t = Caudal\ total\ mes = \frac{Q_n}{3} \times 24 \times 30$$

When the total monthly consumption is half Qt or less, preventive maintenance can be done every two years.

b. When the total monthly consumption is between 50% and 75% of Qt, maintenance should be done every six months.
c. When it is above 75% it should be maintained every two months and presumably before, since at that rate it is expected to be damaged frequently. Consider placing another meter with a higher rated capacity. If the meter is frequently damaged, it is necessary to replace it with a higher nominal capacity.

The water quality of the well will also be monitored, in the well and in the monitoring wells. Parameters to be monitored include static level, temperature, conductivity and solids, as well as contaminants such as greases and oils (to determine hydrocarbons). As part of the salt intrusion control, the well will be monitored every six months for the following parameters: Calcium, magnesium, potassium, sodium, phosphates, sulfides and chlorides.

Monitoring Wells

In order to perform a continuous monitoring and verify that there is no risk of saline intrusion in the aquifer, it is proposed to construct two monitoring wells. The characteristics of each monitoring well to be drilled are as follows:

- Overall depth: 100 meters.
- Perforation Diameter: 10 inches.
- Coating Diameter: 6 inches
- Probable Static Level: 25 to 30 meters.

In the wells will be installed piezometric tubes for the monitoring of levels.
The chemical change in water will be reflected by an increase in the value of Electrical Conductivity, Total Dissolved Solids and Temperature.

It is possible to maintain control of these basic parameters by the installation of equipment with a continuous logging equipment known as Data Logger (**Figure 10.13**).

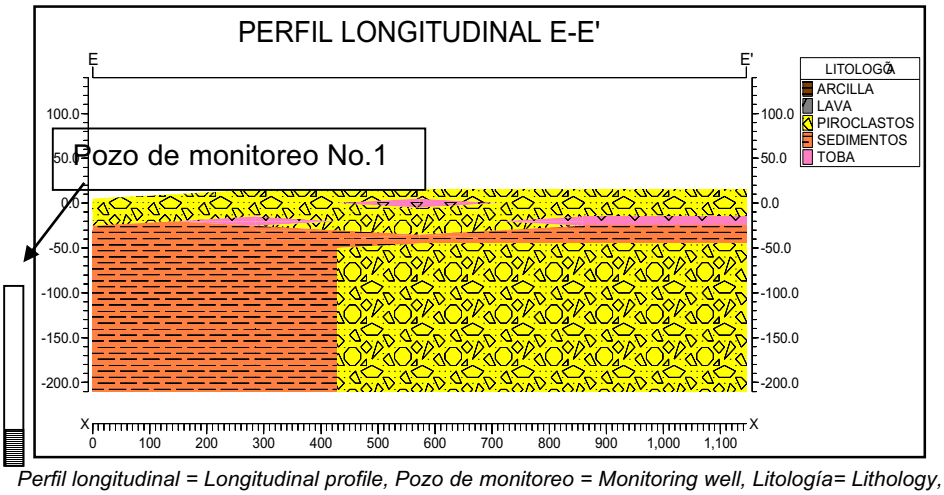
Figure 10. 13– Data Logger

Source: http://www.solinst.com/products/dataloggers-and-telemetry/3001-levelogger-series/levelogger-junior-edge/datasheet.php

In any case, due to the increase in the volume of exploitation in the area, it will be beneficial for all to maintain a monitoring of the basic physico-chemical parameters of the groundwater of the aquifer used.

The aquifer that should be monitored are the alluvial sediments that can be observed in the Profile E-E ' (Figure 10.14).

Figure 10.14 – Longitudinal profile E-E 'Location of monitoring well No.1



Perfil longitudinal = Longitudinal profile, Pozo de monitoreo = Monitoring well, Litología= Lithology, Arcilla= clay, lava=lava , piroclastios = pyroclstic, sedimentos=sediments, toba= tuff

Source: Hydrogeological Study of the Project

In this case, a piezometer nest is not required because the aquifer to be monitored is only one.

The electrical conductivity of seawater is very high compared to fresh water, it ranges from 50,000 µS / cm to 60,000 µS / cm. An increase in the electrical conductivity of water extracted from a well is not necessarily related to saline intrusion; however, in the case of coastal aquifers it is most likely.

The total dissolved solids of the seawater present a value close to 35,000 mg / L, evidently an increase of this parameter due to saline intrusion would be very easy to detect with a continuous monitoring.

The temperature in the groundwater will increase if the flows come from a greater depth. If there is an increase in the electrical conductivity of the water and an increase of the total dissolved solids, but if this variation is accompanied by an increase in the temperature of the extracted water; then, probably the explanation is that a deeper water flow has been induced by means of pumping and not necessarily an intrusion of sea water.

Therefore, it is evident that a constant monitoring of these basic parameters is required, any anomaly will be detected promptly and will facilitate the attenuation of the harmful effects of the phenomenon. On the other hand, as is to be expected, variations in water quality are very important for the evaluation of saline intrusion, there are ionic relations that serve to detect the phenomenon, and that can be used for assessment.

The main ones are the following:

- Chloride / Bicarbonate Ratio: rCl / rHCO3: In sea water, its values range from 20 to 50, while in fresh waters varies from 0.1 to 5.0. Therefore, monitoring of the chloride and bicarbonate ions must be carried.
- Sulphates / Chlorides ratio: rSO42- / rCl-: It is of great interest to identify the process of marine intrusion since it has a characteristic value (0.1) in sea water. An approximation of the values of this relation in the water of the aquifer can be an indication of contamination by sea water.
- Magnesium / Calcium Ratio: rMg2 + / rCa2 +: In sea water reaches values around 5, while in fresh water it is 0.3 to 1.5.

Therefore, it is considered basic that in the Project wells are monitored the following ions: Chlorides, Bicarbonates, Sulphates, Magnesium and Calcium.

The frequency of sampling should be at least once a month, so that any anomaly that may exist in the quality of the water extracted in the production Wells can be identified.

It is important to define the objectives of monitoring, basically it is necessary to know if the exploitation of wells in the area is producing the Saline Intrusion phenomenon. The control of marine intrusion, will be beneficial not only for the Project, but for the different uses in that area. Aquifer sector where there is several wells.

Location of the Measure

Figure 10-15 details the location of the extraction well and monitoring wells.

Estimated Amount of Environmental Measure

Table 10.44 – Estimated Amount of Environmental Measure - Well Flow Equipment Monitoring

Description	Quantity	Unit	Unit Price	Term (months)	Total
Installation of flow macrometers	2.00	each	$ 650.00	1.00	$ 1,300.00
Analysis to determine saline intrusion	1.00	each	$ 75.00	4.00	$ 300.00
Placement of piezometric tubes and monitoring	3.00	each	$ 100.00	5.00	$ 1,500.00
TOTAL					$ 3,100.00

Source: Elaboration by Consulting Team

10.2.30 Disease Vector Minimization

Type of measure: Prevention

Description of measure

It is intended to prevent the proliferation of disease vectors. Efforts will be made to minimize / eliminate stagnant water areas and train employees to minimize vector sites.

Location of Measure

All lands of the Project

Estimated amount of the environmental measure

Table 10.45 – Estimated Amount of Environmental Measure - Leak Detection System Measure

Description	Quantity	Unit	Unit price	Term (months)	Total
Employee training, a talk every three months	1	s.g	$200.00	12.00	$ 2,400.00
				TOTAL	**$ 2,400.00**

Source: Elaboration by Consulting Team

10.2.31 Minimize the Impact on Marine Habitat

Type of measure: Prevention.

Description of measure

To reduce the impact on the disturbance to the marine habitat, the measures described below will be executed:

- When possible, use equipment from land or water (over the temporary trestle or from a barge) to minimize possible disturbances of the coast and seabed.
- Do not use ground anchored barges during construction work.
- The project environmental specialist will observe the work to determine the need for mitigation and confirm that the measures implemented are working as expected.
- Site inspection to verify that there are no endangered species at the temporary trestle location prior to construction to avoid work on sites with significant marine habitat.

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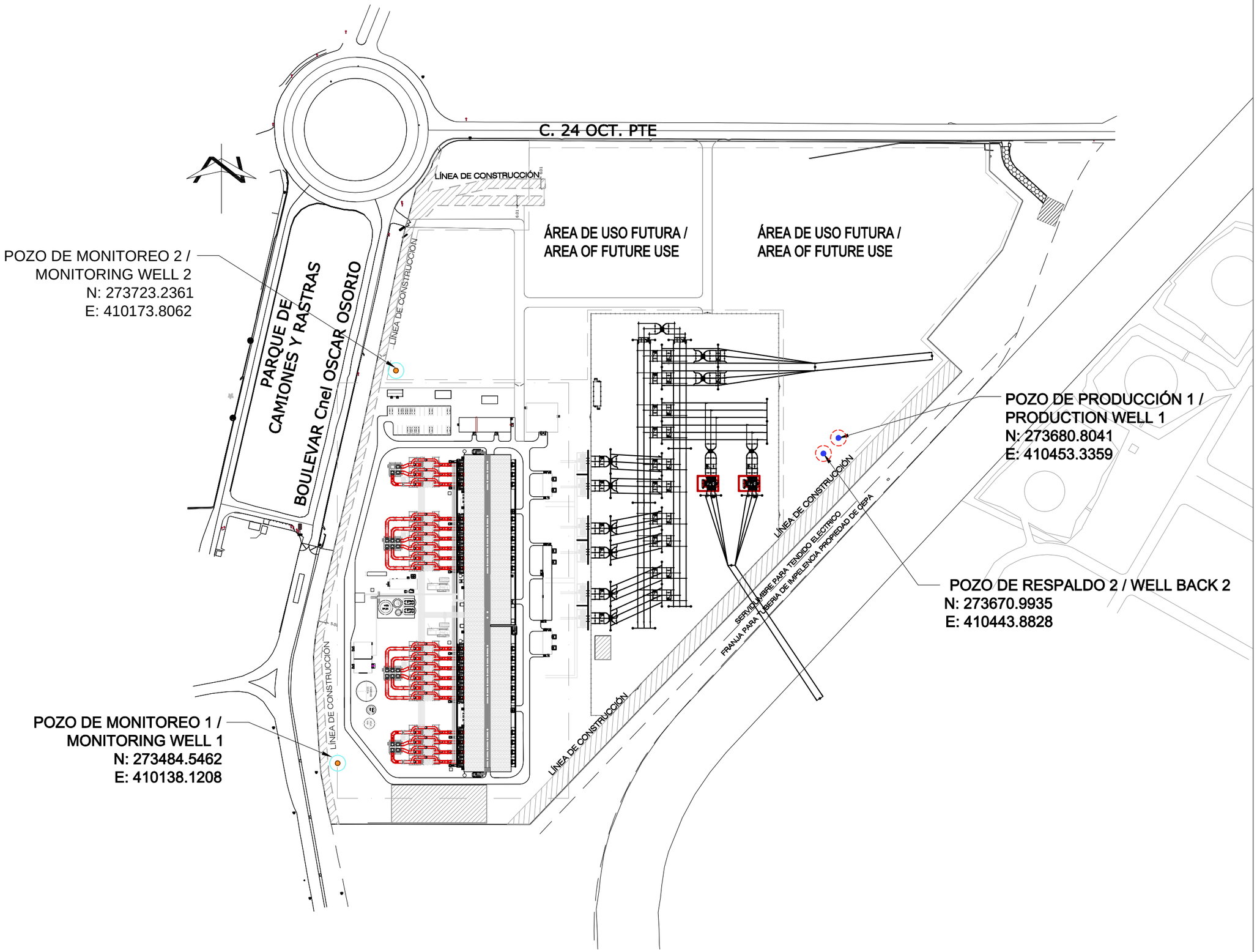
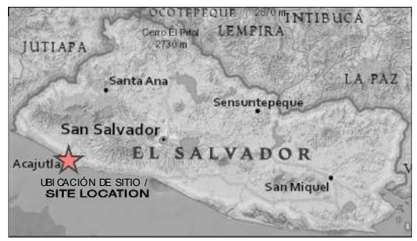
UBICACIÓN DE POZOS DE EXTRACCIÓN Y POZOS DE MONITOREO / LOCATION OF EXTRACTION WELLS AND WELLS OF MONITORING

FIGURA 10.15 / FIGURE 10.15





0 10 20 30 40 50m

N W E S

FUENTE / SOURCE :
PLANOS WARTSILA Y ECO / WARTSILA SITE PLAN AND ECO

MAPA CREADO POR / MAP CREATED BY: ECO INGENIEROS
MAPA REVISADO POR / MAP CHECKED BY: LF
PROYECCIÓN DE MAPA / MAP PROJECTION :
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PROYECTO / PROJECT: 14-9114
ESTADO / STATUS : FINAL / FINAL
FECHA / DATE: 12/03/2016

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Location of the Environmental Measure

Temporary trestle and Maritime Terminal construction site.

Estimated Amount of Environmental Measure

Table 10.46 – Estimated Amount of Environmental Measure - Minimize the Impact on Marine Habitat					
Description	**Quantity**	**Unit**	**Unit Price**	**Term (months)**	**Total**
Prepare a procedure and training for key workers	1.00	s.g	$1,000.00	1.00	$ 1,000.00
				TOTAL	**$ 1,000.00**

Source: Elaboration by Consulting Team

10.2.32 Detailed Risk Assessment and Contingency Plan

Type of measure: Prevention.

Description of Measure

Objetive

Prevent damage to people, employees in general for possible events occur.

Description

Carry out a detailed risk assessment as part of the detailed design work and the development of the Major Risk Contingency and Risk Planning Plan. Further details are given in Appendix 9D.

Location of the Environmental Measure

Maritime Terminal and Thermal Power Station.

Estimated Amount of Environmental Measure

Table 10.47 – Estimated Amount of Environmental Measure - Leak Detection System Measure					
Description	**Quantity**	**Unit**	**Unit Price**	**Term (months)**	**Total**
Risk assessment and contingency plan, including training and drills	1.00	s.g	$100,000.00	1.00	$ 100,000.00
				TOTAL	**$ 100,000.00**

Source: Elaboration by Consulting Team

10.2.33 Measures for disposal site for dredged material

Type of measure: Prevention.

Description of Measure

The measure is to minimize environmental and social effects in final dredging disposal site. The area and discharge velocity will be used to control the deposition area and height of the sediment layer. The dredger would reduce its speed when approaching the specified central point, then it would remain firm on the designated area or maintain a slow course within the radius of 1.5 nautical miles. The additional 0.5 nautical mile damping provides a re-suspension zone. No significant change is expected in the water depths since the site has a depth of at least 30 m.

Prior to the start of the work, the study of benthos and videotaping in six points at the edge and at the centre of the dredging zone will be performed.

As monitoring, daily turbidity, readings will be done during the expected 18 days of material deposition at the same six monitoring points.

Location of the Environmental Measure

Dredging material deposition site, Figure 7.10.

Estimated Amount of Environmental Measure

Table 10.48 – Estimated Amount of Environmental Measure - Leak Detection System Measure

Description	Quantity	Unit	Unit Price	Term (months)	Total
Turbidity Monitoring	6.00	points	$1,150.00	1.00	$ 6,900.00
				TOTAL	**$ 6,900.00**

Source: Elaboration by Consulting Team

10.2.34 Environmental Measures Plan

On the next page, Figure 10.16 presents the plan of environmental measures at the construction stage.

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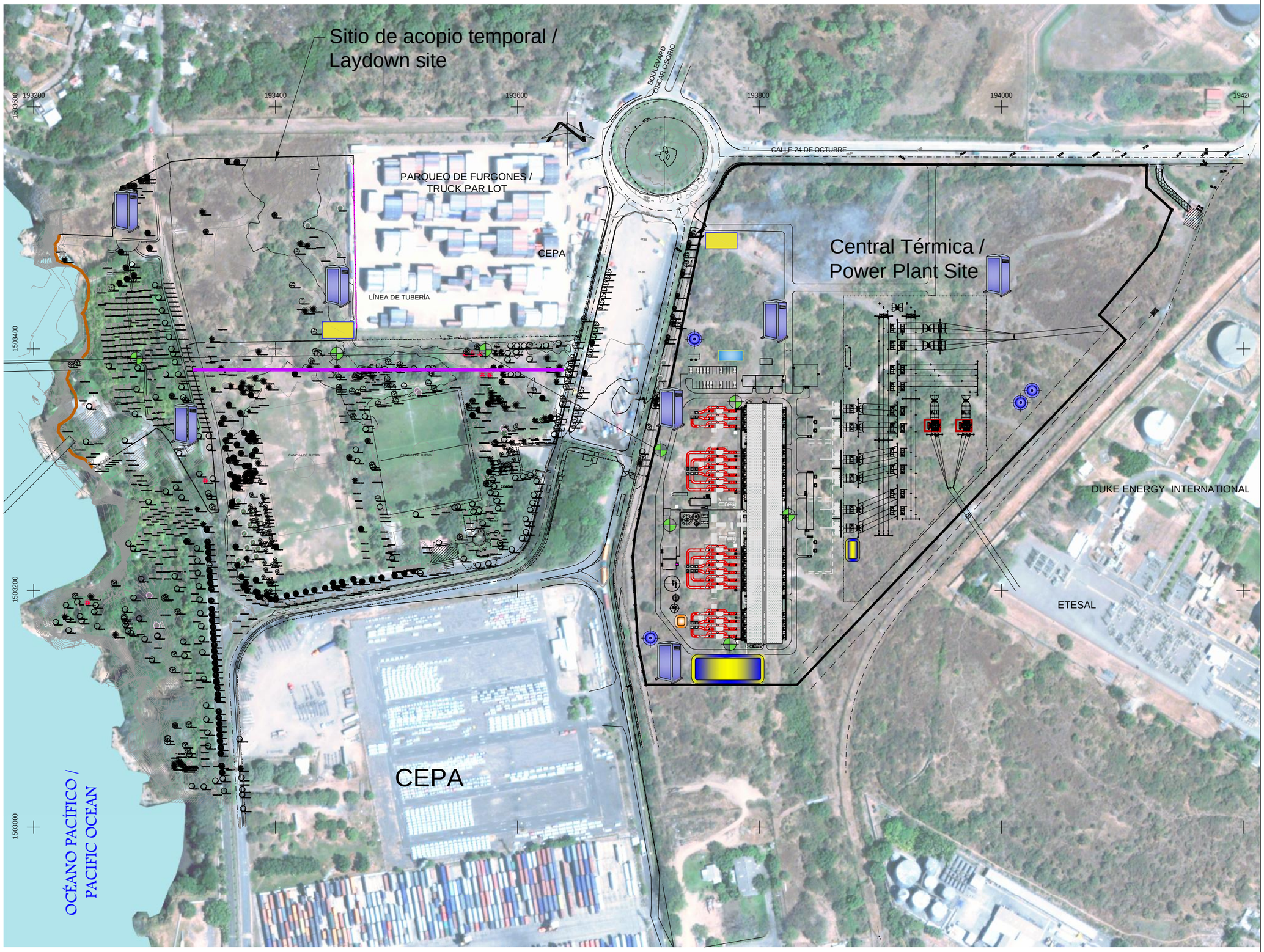
LNG TO POWER PROJECT

MEDIDAS AMBIENTALES EN CONSTRUCCIÓN / ENVIRONMENTAL MEASURES IN CONSTRUCTION

FIGURA 10.16 / FIGURE 10.16



SIMBOLOGÍA / SYMBOLS	UBICACIÓN DE MEDIDAS / MEASURES OF LOCATION	CONTENIDO DE MEDIDAS / CONTENT OF MEASURES
	MEDIDA 5 / MEASURE 5	MANEJO Y ALMACENAMIENTO DE MATERIALES PELIGROSOS / HANDLING AND STORAGE OF HAZARDOUS MATERIALS
	MEDIDA 6 / MEASURE 6	TRATAMIENTO DE AGUAS RESIDUALES DOMESTICAS / DOMESTIC WASTE WATER TREATMENT
	MEDIDA 12 / MEASURE 12	BARRERA EN ZONA DE PLAYA / FENCE ON SHORELINE
	MEDIDA 22 / MEASURE 22	BARRERA DE SEGURIDAD DE TUBERÍA / BARRIER FOR SAFETY
	MEDIDA 24 / MEASURE 24	CONSTRUCCIÓN DE PLANTA DE TRATAMIENTO DE AGUAS RESIDUALES / CONSTRUCTION OF WASTEWATER TREATMENT PLANT
	MEDIDA 25 / MEASURE 25	SEPARADOR DE AGUA - ACEITE / WATER - OIL SEPARATOR
	MEDIDA 26 / MEASURE 26	TANQUE SEDIMENTADOR/AMORTIGUADOR DE AGUA / SEDIMENTATION/BUFFER TANK FOR RAINWATER
	MEDIDA 28 / MEASURE 28	SISTEMA DE DETECCIÓN DE FUGAS / PREVENTATIVE LEAK DETECTION SYSTEM
	MEDIDA 29 / MEASURE 29	EQUIPO DE MONITOREO DEL CAUDAL DEL POZO / MONITORING EQUIPMENT FOR THE WATER WELL AND MONITORING WELLS

0 10 20 30 40 50m

N W E S

FUENTE / SOURCE :
PLANOS WARTSILA / WARTSILA SITE PLAN

MAPA CREADO POR / MAP CREATED BY: ECO INGENIEROS
MAPA REVISADO POR / MAP CHECKED BY: LF
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PROYECTO / PROJECT: 14-9114
ESTADO / STATUS : FINAL / FINAL
FECHA / DATE: 12/03/2016

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10.2.35 Summary of the Environmental Management Program during the Construction Phase

The Environmental Management Program (EMP) is to prevent, mitigate and compensate for the negative impacts that the Project activities will generate on the environment. The Environmental Management Program basically consists of:

Environmental Management Plan
A summary table containing all the measures proposed above is presented, with the respective actions required for each one, including implementation costs.

Monitoring Program
In Table 10.49, provides an overview of identified impacts, both positive and negative, proposed mitigation measures for each impact and displays the Environmental monitoring required for the construction phase.

Schedule for the implementation of measures and investments.
The implementation of the measures has been programmed, according to the development of the Project.

The summary of the Environmental Management Plan, monitoring plan and timetable for the application of environmental measures, for the CONSTRUCTION PHASE are included in tables 10.49, 10.50 and 10.51. The environmental bond has been quantified for an investment cost of **NINE HUNDRED FORTY-ONE THOUSAND SEVEN HUNDRED SIXTY-FOUR 88/100 DOLLARS** (**$941,764.88).**

Table 10.49 – Environmental Management Program, Construction Phase

Execution Phase	Project Activity	Description of Generated Environmental Impact	Environmental Measure (Prevention, Attenuation, Compensation)	Description of Proposed Measure	Location of the Environmental Measure	Responsible for its execution	Calculated Amount of Environmental Measure	Time of execution	Expected result
Site Preparation, Construction and Closing	• Operation of stationary generators • Operation of the mobile motorized equipment • Cutting and logging • Excavation work • General construction activities • Construction related to traffic	• Exposure of workers and the public to the emission of air pollutants • GHG emissions	**Attenuation** **1. Reduction of air emissions**	Develop a Maintenance Plan that considers: • Maintenance program, • Control / monitoring system • Location of stationary generators 50 m from the northern boundary of the site • Anti-shutdown protocol • Use of buses to transport workers from outside Acajutla to the site from the main cities	Project site area and transport and haul routes	EDP	$2,000.00	During construction	No significant impact on air quality and the reduction of emissions of greenhouse gases from the transport of workers
Site Preparation, Construction and Closing	• Clearance • Excavation works • General construction activities • Traffic related to construction	• Migration of dust emissions to off-site receptors	**Prevention** **2. Dust management plan**	Dust Management Plan including: • Irrigation of water in internal streets of the project during dry season • Site exit control (wheel washing, surface hardening) • Stabilize storage areas • Speed limits on internal roads • Truck covers	Project site, temporary storage site, main transport routes and material haulage	EDP	$54,012.00	During construction	Prevent short-term dust increase in the vicinity of the site
Site Preparation, Construction and Closing	• Construction of piles (on land) • Earthworks • Construction, use of equipment • Concrete plant	• Disturbing noises for surrounding communities and residents	**Attenuation** **3. Noise management during construction**	Develop a Noise Management Plan that considers: • Type, number and location of the piles; • Use of low noise techniques for piles, if feasible (ex: vibratory piles, pressure piles) • Schedules for excavation of piles and operation of the concrete plant. • Schedule for use of primary routes and for hauling of materials	Project Site, Temporary Collection Site, and route of construction materials	EDP	$1,000.00	Duration of construction activities, in particular pile driving.	Short-term annoying noises at a project site radius during daylight hours.
Site Preparation, Construction and Closing	• Cut and logging • Earthworks • Construction activities in general (on land)	• Loss of fertile soil/soil layers • Possible effects on flora and marine fauna for sediments entering the marine waters as a result of erosion of materials on land • Offsite flooding as a result of peak events for running surface waters	**Attenuation** **4. Soil and rainwater management during construction**	Apply the provisions for the management of earthworks and rainwater in "Instruction for quality and installation, earthworks, Power Plants" from Wärtilä, including: • Trenching and storage of organic soil separated from the subsoil • Use of berms and fencing to control erosion and sediment runoff • fences to prevent entry of machinery in sensitive areas. • Protect or stabilize exposed material (re-vegetation, geo-membranes, concrete, etc.) • Protect corners of ditches and curves with rocks or breakwater - installation of energy dissipation devices in outputs and download locations • settling ponds / or other system to remove the sediments of water before discharge and ponds to control • Ponds To control the discharge of rain water.	General Project Site, Laydown area, and shoreline areas that could be susceptible to erosion	EDP	$75,800.00	Before and during the duration of construction activities, including activities in the vicinity of the coast	Use of organic soil from the site's trace, removed for off-site use. Release of marine sediment for a short period, without significant effects on marine flora and fauna. There are no changes in the event of maximum flood

Table 10.49 – Environmental Management Program, Construction Phase

Execution Phase	Project Activity	Description of Generated Environmental Impact	Environmental Measure (Prevention, Attenuation, Compensation)	Description of Proposed Measure	Location of the Environmental Measure	Responsible for its execution	Calculated Amount of Environmental Measure	Time of execution	Expected result
Site Preparation, Construction and Closing	Storage, handling, use and disposal of hazardous raw materials and hazardous wastes (on the project site and temporary storage area)	Accidental release of hazardous materials at the site with potential for: • pollution of the environment at the site (soil, surface and groundwater) • exposure of workers to toxic or irritant materials	**Prevention** **5. Handling and Storage of Hazardous Materials**	Use of the Best Practices of the International Industry for the handling, storage, use of hazardous materials, including: • Training to personal and protective equipment available • Overfilling and spill protection • Labeling and Inventory Control • Use of secondary containment • Incompatible materials stored in separate places • Spill response and cleaning of material • Fire extinguishers available	Laydown area and Construction Site	EDP	$12,200.00	During construction	Low risk of significant contamination of soil, ground or surface water as a result of construction
Site Preparation, Construction and Closing	Storage, handling, use and disposal of hazardous raw materials (onshore and offshore)	• Pollution of the environment through the inadequate disposal of human waste	**Prevention** **6. Sewage waste water treatment**	• Portable toilets with integrated tanks will be provided for workers • Material collected will be transported by truck for off-site treatment and disposal at an authorized facility	Construction Site and Laydown area.	EDP	$47,180.00	During construction	There is no contamination of human waste at the project site. Discharge of effluents to the off-site waste treatment plant.
Site Preparation, Construction and Closing	Storage, handling, use and disposal of raw materials, and hazardous waste (offshore)	• Pollution of marine waters or sediments by the accidental release of hazardous materials during construction activities • Possible contamination of the human food chain	**Prevention** ***7.* Hazardous materials in construction of Maritime Terminal**	In addition to the general procedures for the storage and handling of hazardous materials defined in other sections, the following practices shall be used: • Storage of hazardous materials, including fuels and lubricants, in confined areas. • Spill equipment will be available for immediate deployment in case of a spill (absorbent booms, floating oil containment barriers, skimmers) • Workers will be trained in the prevention of marine spills and to provide response and cleaning during construction activities	Temporary trestle, pipeline, and Maritime Terminal area	EDP	$11,520.00	Duration during construction of temporary dock, sea terminal, and pipeline	No significant environmental pollution as a result of sea spills is anticipated
Site Preparation, Construction and Closing	• drilling of wells (onshore)	• Unsealed holes can allow the migration of contaminating material into groundwater	**Prevention** **8. Closing of perforations in soil**	Capping or sealing open holes with bentonite clay or other suitable material	Area where drilling may be required (powerhouse)	EDP	$1,000.00	Geotechnical exploration	There are no new pathways created for the migration of material to groundwater
Site Preparation, Construction and Closing	Cleaning of pipelines	• Contamination of the environment by the release of water from hydrostatic test and pipelines cleaning	**Prevention** **9. Discharge of test water**	• The water used for pressure test will be test to confirm the absence of contamination. Water free from contamination will be released to a local drain. If it is contaminated above the applicable criteria, the water will be treated before discharge. • Water for cleaning will be collected for proper disposal as needed.	Site for the discharge of water after the tests.	EDP	$3,000.00	Upon completion of hydrostatic testing of ships and pipelines	No significant contamination of wash effluent release / hydrostatic tests
Site Preparation, Construction and Closing	Cut and logging	• Elimination of vegetation resulting in the displacement of fauna to inadequate areas, which could cause mortality	**Attenuation** **10. Relocation of fauna**	• Wildlife Relocation Program: before commencing works, relocate wildlife (ex: snakes) to an appropriate habitat with the support of an NGO • Keeping cage and training for construction workers from respecting and protecting wildlife during construction	The project site and Laydown Area	EDP	$6,200.00	Immediately prior to cleaning, and during logging activity	To reduce the mortality of fauna of great size. Reduce the migration of fauna in nearby areas not suitable

Ing. Alejandro Alle, Apoderado Legal, **Energía del Pacífico Ltda. de C.V.**

Table 10.49 – Environmental Management Program, Construction Phase

Execution Phase	Project Activity	Description of Generated Environmental Impact	Environmental Measure (Prevention, Attenuation, Compensation)	Description of Proposed Measure	Location of the Environmental Measure	Responsible for its execution	Calculated Amount of Environmental Measure	Time of execution	Expected result
Site Preparation, Construction and Closing	Cut and logging	• Loss of habitat and increased habitat fragmentation	**Compensation** **11. Reforestation and support to FIAES**	Restoration of habitat, planting of 20,782 trees: • Plantation of 1,781 trees in the project property • Planting of 18,114 in properties of the municipality of Acajutla •The payment of $ 11,889.93 to FIAES for use in projects for improvement and protection of the environment in El Salvador	• Project site • Properties of the municipality of Acajutla	EDP	$123,102.98	At the end of construction	The tree planting program will not result in the loss of tree numbers. Restoration works carried out as part of the FIAES program will compensate for the loss of habitat in the area
Site Preparation, Construction and Closing	• Cut and logging • Construction general activities	• Disturbance of shoreline and beach areas from storage of material, and passage of heavy equipment	**Prevention** **12. Barrier in beach area**	Install fences at the top of the cliff and along the road to the temporary trestle, to demarcate areas off-limits and no disturbance.	Pipeline corridor and Laydown Area.	EDP	$710.00	Prior to the start of cutting and logging and , and during the duration of construction	Affection to the cliff and the beach by the construction of the temporary dock and the access road to it.
Site Preparation, Construction and Closing	Storage, handling, use and disposal of hazardous raw materials, and common and / or hazardous waste	• inadequate storage and disposal of food waste attractive for wildlife	**Prevention** **13. Prevention of interaction with fauna**	• Food waste will be stored in wildlife-proof containers that are emptied and cleaned regularly • All waste will be disposed outside the properly	Project Site, Laydown Area, maritime terminal, pipeline bondage, and temporary trestle.	EDP	$2,400.00	Duration of construction activities	There are no important attractants for wildlife related to the storage and handling of food and waste
Site Preparation, Construction and Closing	Driving of piles (offshore)	Noise in the water from the pile driving can: • be detrimental to oyster divers (and recreational divers) • Have lethal and non-lethal effects on marine mammals, turtles and other marine wildlife	**Attenuation** **14. Noise reduction during pilotage in sea**	Develop a management plan for piloting, consistent with the Joint Nature Conservation Committee (JNCC) protocol to minimize the risk of injury to marine mammals and turtles due to pile-driving noise, including the following considerations • Identify and communicate a safety zone for fishermen and divers • If feasible, consider using low noise techniques to drill. • Search for divers, turtles and marine mammals in the mitigation zone (500 m radius of piles), before drilling • Delay activities, if divers, sea turtles or mammals were detected within the mitigation zone • Soft start of drilling rig and restart protocol after recess • Record keeping and reporting	In an area of 500m outside the activities of piloting, temporary trestle, and facilities of the maritime terminal	EDP	$5,100.00	Plan prior to the commencement of drilling and its implementation during the drilling activities of piles	Non-significant mortality and minimal disruption to marine mammals or other wildlife species. Interruption to oyster catchers s and possibly other divers
Site Preparation, Construction and Closing	Site Preparation, Construction and Closing General construction activities (offshore)	• Artificial lighting necessary for construction can affect the behaviour of marine fauna, including turtles	**Attenuation** **15. Lighting Plan for Maritime Terminal and Temporary Trestle**	Apply Lighting Management Plan: • Reduce lighting in non-essential areas, particularly during critical periods of life-cycle (ex: nesting of turtles) • Use of guards to direct lights to areas requiring lighting • Avoid direct light in water • Low light mounting where possible • Use of long wavelength lights (ex: amber) that make light less intense for nocturnal animals.	Maritime Terminal and temporary dock	EDP	$1,000.00	Duration of offshore construction activities	Reduce lighting that can disturb marine fauna behavior

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Execution Phase	Project Activity	Description of Generated Environmental Impact	Environmental Measure (Prevention, Attenuation, Compensation)	Description of Proposed Measure	Location of the Environmental Measure	Responsible for its execution	Calculated Amount of Environmental Measure	Time of execution	Expected result
Site Preparation, Construction and Closing	Dredging of marine sediment	• Dredging will increase the amount of suspended sediment in the water column, as well as turbidity	**Prevention** **16. Measures to Reduce Turbidity and Oyster Biomonitoring**	Stop or temporarily reduce dredging activities if excess turbidity limits are detected during monitoring. At the same time to perform biomonitoring of oysters.	Points M1 and M23 as well as oyster zone	EDP	$6,960.00	Establish prior to the start of dredging activities and maintain while dredging activities continue, daily	Temporal and localized with less impact to aquatic flora and fauna
Site Preparation, Construction and Closing	• Cutting and logging • Earthworks • General construction activities	•Risk of safety to the public by general construction activities, including the use of heavy machinery •Construction activities can cause disruption and inconvenience to local residents or businesses (complaints)	**Prevention** **17. Environmental and Social Management Plan**	Establish a community liaison program to be served by two relationship officers, whose responsibilities include: • Maintain the presence of an off-site community liaison office • Implement a communication plan that includes meetings, materials, interviews, including information / educational material for the municipality, schools and community. • Make the community aware of the existence of the Complaint Mechanism. To register and to solve the complaints that are presented by the stakeholders	Around communities, schools, municipality	EDP	$84,150.00	Establish before the start of construction and maintenance during construction	Broad knowledge of the project and the risks of the general public Low risk of unauthorized entry or public safety risk Respond to all valid complaints and complaints filed in the office
Site Preparation, Construction and Closing	General Construction Activities - offshore	• Safety risk for the public (seafarers and fishermen) operating in the vicinity of the temporary trestle, pipeline, and ships necessary for the construction of the facilities	**Prevention** **18. Open sea safety**	Coordination with CEPA and the Port Maritime Authority (AMP), to develop a safety plan, including considerations for: • Formalize the 300m exclusion zone around the project site, with the MPA in agreement with CEPA. This exclusion zone applies to all ships including commercial port traffic. • An additional security zone with a radius of at least 500m, applicable for non-CEPA controlled vessels. • Mark the limit of the security perimeter. • Security Patrols / Reinforcement • Communication with / and education of local fishermen and other active navigators in the area	Project site in the sea	EDP	$5,500.00	Before the start of construction and during offshore construction activities	Low risk of significant safety incidents for navigators and fishermen
Site Preparation, Construction and Closing	Traffic related to construction	Project traffic on public roads can: • Create risk for public safety (collisions and accidents) • Cause traffic jams	**Prevention** **19. Traffic Plan**	Traffic Management Plan includes: • The use of collective transport for workers (buses) to reduce vehicle movements • Specification of designated haul routes • No heavy vehicles on local roads • Drivers will receive training on the Traffic Management Plan. • Inform closures or blockages and plan it in hours of little activity • appropriate traffic controller signals • Consultation with the municipality, local communities, and local schools on the traffic plan and traffic hazards	Project site, transport routes roads	EDP	$1,820.00	Duration of construction	There is no significant increase in the risk to the public safety of traffic related to the project less congestion of the main access road to the site

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Table 10.49 – Environmental Management Program, Construction Phase

Execution Phase	Project Activity	Description of Generated Environmental Impact	Environmental Measure (Prevention, Attenuation, Compensation)	Description of Proposed Measure	Location of the Environmental Measure	Responsible for its execution	Calculated Amount of Environmental Measure	Time of execution	Expected result
Site Preparation, Construction and Closing	Management of the construction workforce	•The influx of job seekers and the growing demand for social services and the possible disruption of peace and community security • Security and safety hazard, by the group of people who seek employment in the facilities	**Prevention/ attenuation** **20. Employment of local workers**	• Hire a local hiring officer to support EDP and contractors with the identification of qualified and unskilled local workers • Expand the off-site office in Acajutla for use by EDP and contractors as a local contracting center • Publish that the contracting will focus on local staff and that there will be no contracting at the doors of the facilities	• The entrance of the site • commercial area Acajutla • Project Office	EDP	$25,500.00	Before and during construction	Net profit expected from the local economy through the hiring and use of local service providers An influx of job seekers is expected, but with minimal changes to the local population base, demand for local services, peace and safety
Site Preparation, Construction and Closing	General construction activities	• Security problems due to the development of food stalls and informal merchants, near the entrance of the facilities.	**Prevention** **21. Prevention of informal stores near the site**	In addition to providing on-site cafeteria facilities, provide: • Communication to workers to discourage informal food • Signs prohibiting informal sales on the property's outdoor fence • Coordinate with the municipality to remove informal stores	Entrance to site	EDP	$ 700.00	Duration of construction	Reduce the incentive for informal traders to be located near entry to facilities
Site Preparation, Construction and Closing	• Cutting and logging • Earthworks • Pile driving • General Construction Activities - on land • Hydrostatic test	• Construction activities may pose a danger to the safety of CEPA workers and the public in the use of CEPA sports fields.	**Prevention / attenation** **22. Pipeline Safety Barrier**	Provide a security barrier to ensure public safety.	• Temporary Laydown Area • Piping route	EDP	$8,822.00	During construction and testing activities in pipeline corridor	Prevention of access by CEPA and public workers to active construction areas
Site Preparation, Construction and Closing	• General offshore construction activity • Physical presence of the temporary pier and maritime terminal	Construction activities and, finally, the presence of the temporary trestle, and the maritime terminal, will produce: • Restrict fishing areas for "oyster-catcher" and "tuberos" fishermen, • Forcing fishermen leaving the artisan pier to travel longer distances when traveling to / from the south	**Compensation** **23. Compensation for fishermen**	To compensate members of fishermen's cooperatives affected by longer distances of travel: • Installation of a new winch at the artisanal dock • Installation of 15 "Fish Aggregator Devices" (FAD) To compensate the fishermen "Oyster catchers" • Installing artificial reefs To compensate 57 fishermen known as "tuberos" and "Oyster-catchers", allow to choose among: • Participate in the construction of a boat, completing with safety training (product handling), and reception of basic fishing equipment, or, • Receive training in an alternative line of work with the objective of leaving the fishing industry.	• FAD- Northwest Artisanal dock • Artificial Reefs- North of the Artisanal dock • Winche- Artisanal dock • Equipment and Training - To be defined (Artisanal dock)	EDP	$55,650.90	Complete installation of FAD, Reefs and winches, and start the training of oyster-catchers and tuberos, before the start of construction	The cost and longer navigation time for cooperatives will be compensated for improvements in the winch of the artisan pier, and the installation of the FADs. The livelihoods of local oysters will be enhanced by the development of the artificial reef. The livelihoods of the local pipelines will be compensated by equipment / training Improving the safety of fishermen
Site Preparation, Construction and Closing	Operations stage Wastewater Management	• Sewage generation	**Prevention** **24. Construction of wastewater treatment systems**	Installation of waste water treatment plant in the Thermal Power Plant and the Maritime Terminal (FSRU / FSU)	Power Plant: South-west of the property (See figure of location of environmental measures) Maritime Terminal: FSU and FSRU	EDP	$126,262.00	Installation during the construction phase	All process water and treated wastewater must comply with applicable standards

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Table 10.49 – Environmental Management Program, Construction Phase

Execution Phase	Project Activity	Description of Generated Environmental Impact	Environmental Measure (Prevention, Attenuation, Compensation)	Description of Proposed Measure	Location of the Environmental Measure	Responsible for its execution	Calculated Amount of Environmental Measure	Time of execution	Expected result
Site Preparation, Construction and Closing	Operations stage Increased surface runoff	• Generation of drainage of surface waters potentially contaminated by oils and grease	**Prevention** **25. Oily Water Treatment System**	Installation of a waste water treatment system to treat potentially contaminated water with oils from surface drainage	West of the property (See figure of location of environmental measures)	EDP	$16,480.00	Installation during the construction stage	All treated water must comply with applicable standards
Site Preparation, Construction and Closing	Physical presence of the facilities	• Off-site flooding as a result of increased flow of surface water	**Prevetion** **26. Sedimentation / rainwater control pond**	Construction of two sedimentation ponds, one for the substation and one for the rest of the property. The final stormwater management system will consider LID Low Impact Development techniques such as: • Reduction of impermeable areas, permeable paving, ditches and bio-retention, and with landscaping vegetation. • Send the rest of the surface water flow of the permanent stormwater management system.	Sedimentation ponds will be located south of the Project Site	EDP	$15,000.00	Before starting operations	It was not expected to have a significant change in flood potential downstream of the site, by an increase in the maximum flow.
Site Preparation, Construction and Closing	Operation stage - general operating activities	• Operations stage Firefighting equipment	**Prevention** **27. Fire protection system**	• Installation of fire extinguishing equipment: fire extinguishers, hydrants, hoses, valves, mobile foam units, etc. • Provide training in fire extinguishing and drills	General facilities including Thermal Power Station and Marine Terminal	EDP	$119,295.00	Installation and training to be completed before the start of operations	International Good Practices of the Firefighting Industry
Site Preparation, Construction and Closing	Operation stage - general operating activities	• Accidental release or leakage of natural gas	**Prevention** **28. Leak Detection System**	Leak detection equipment at the Thermal Power Plant (fixed), pipelines and CEPA Port, as well as portable gas meters for detecting leaks in the visual inspections of the facilities	NG, FSU, FSRU pipeline	EDP	$16,000.00	Buying meters before starting operations	Periodic inspections will help identify leaks
Site Preparation, Construction and Closing	Operation stage – Well Operation	• Groundwater use	**Prevention** **29. Well flow monitoring equipment and monitoring wells**	Installation of flow control equipment, and measure levels and parameters in monitoring wells.	Wells	EDP	$3,100.00	Installation before begining operations	The extraction of water must not exceed the limit established in the permit
Site Preparation, Construction and Closing	General construction activities - offshore	• Risk to the public and workers	**Prevention** **30. Disease Vectors Minimization**	Minimize / remove areas with water stagnation, and provide training to employees to minimize vector sites	Thermal Power Plant and Temporary Collecting Site	EDP	$2,400.00	During construction activities	Elimination of mosquito breeding habitats
Site Preparation, Construction and Closing	General construction activities - offshore	• Removal and disturbance of marine habitat	**Prevention** **31. Minimize the impact on marine habitat**	•Wherever possible, operate equipment on land or at sea (from a barge or temporary dock), in a manner that minimizes potential disturbances to the coastline and seabed; • Avoid running aground barges used during construction work •A Qualified Environmental Monitor will monitor the work to determine the need for mitigation and confirm that the measures implemented are working as expected. • Inspection of endangered species at the location of the temporary dock, prior to construction to avoid areas with significant marine habitats.	Offshore construction sites	EDP	$1,000.00	During construction activities	Minimized disturbance to marine habitats

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Execution Phase	Project Activity	Description of Generated Environmental Impact	Environmental Measure (Prevention, Attenuation, Compensation)	Description of Proposed Measure	Location of the Environmental Measure	Responsible for its execution	Calculated Amount of Environmental Measure	Time of execution	Expected result
Site Preparation, Construction and Closing	LNG delivery, LNG storage, management and regasification	• Risk to the public and nearby industrial activities due to a catastrophic event (major LNG / NG spills, large fires, explosion)	**Prevention** **32. Detailed risk assessment and contingency plan**	Perform a detailed risk assessment as part of the final detailed design work. • Development of a Major Threat Risk Management Plan and Contingency Plan. • Training and drills	FSRU/FSU	EDP	$100,000.00	Prior to begin activities	Risks to public safety within Standards and Good International Practices for the Industry
Site Preparation, Construction and Closing	Seabed dredging for marine terminal installation	• Generation of sediments in the water and accumulation of sediments in the seabed	**Prevention** **33. Measures for disposal site for dredged material**	Reduce dredge speed and turbidity Measures in water	Dredging material final disposal site	EDP	$6,900.00	During dredging	Minimize disturbance of the seabed
						TOTAL	**$941,764.88**		

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Table 10.50 – Monitoring Program, Construction Stage

Stage of Execution	Environmental Measure	Parameters to Consider	Place or Monitoring Point	Frequency of Monitoring	Method to Use	Responsible for Monitoring	Interpretation of results	Feedback	Reference in Impact Description Text
Site Preparation, Construction and Closing	**Attenuation** **1. Reduction of Gas Emissions**	Maintenance record	Project construction office	Monthly	Review the record	EDP	Verify that maintenance is performed in accordance with the plan	Improve maintenance according to program	Page 10-4
Site Preparation, Construction and Closing	**Prevention** **2. Dust Management Plan**	Excess of dust emissions	All active construction areas where there is uncovered land	Daily / Weekly	Weekly visual check for excessive dust emissions by site environmental monitoring Weekly inspection of dust mitigation measures	EDP	Confirm that dust controls are effective to prevent significant off-site migration of dust by air or vehicles	If excessive dust migration is carried out, the activity that causes it should be stopped and appropriate control measures applied at the site or until the weather changes (rain or wind reduction)	Page 10-5
Site Preparation, Construction and Closing	**Attenuation** **3. Noise management during construction**	Disturbing noise	Nearby residential areas	Non-applicable	Complaints from interested parties	EDP	All noise complaints should be investigated to identify the root cause	Introduce control measures to deal with noise nuisance complaints and follow up communication with the complainant	Page 10-7
Site Preparation, Construction and Closing	**Attenuation** **4. Ground and rainwater management under construction**	Physical soil conditions	Areas subject to earthworks and excavations	Weekly	Weekly inspection of exposed soils and drainage channels for excess erosion and sedimentation	EDP	Confirm that sediment controls are effective to avoid significant erosion / sedimentation	If there is excessive erosion introduce additional stabilization measures for control	Page 10-8
		Flood	Sites for discharge of rain water and channel of CEPA in point of discharge	Weekly during the rainy season - monthly during the dry season	Visual inspection of the stormwater management system to verify capacity and integrity, and any evidence or risk of flooding and erosion	EDP	Check for erosion, signs of flooding, damage to gutter	Take corrective actions by improving the pipeline infrastructure or retention pond	Page 10-8
Site Preparation, Construction and Closing	**Attenuation** **5. Management and Storage of Hazardous Materials**	Adequate handling: storage in fenced area, MSDS available, establishment secondary containment.	Hazardous Materials Storage Site	Monthly	Inspection of the site and photographic record	EDP	All hazardous materials must be stored according to their characteristics	Correct storage of materials and reinforcement of training to the person in charge of the area	Page 10-11
Site Preparation, Construction and Closing	**Prevention** **6. Domestic wastewater treatment**	Presence and use of portable toilets	In front of work place	Monthly	Visual inspection, rental registration, cleaning record	EDP	Compare number of toilets with registration of workers, there must be one per 25 workers. Toilets must be in good condition and cleaned periodically	Hire more portable toilets and request their cleaning and maintenance	Page 10-15
Site Preparation, Construction and Closing	**Prevention** **7. Hazardous materials in construction of Maritime Terminal and temporary dock**	Training and accident records, spill equipment and biodegradable oil	In construction site	Every six months	Staff interviews, purchase and photo record	Holder	Prevent damage to personnel, infrastructure and the environment	Update of training topics and purchase of equipment needed	Page 10-17

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Table 10.50 – Monitoring Program, Construction Stage

Stage of Execution	Environmental Measure	Parameters to Consider	Place or Monitoring Point	Frequency of Monitoring	Method to Use	Responsible for Monitoring	Interpretation of results	Feedback	Reference in Impact Description Text
Site Preparation, Construction and Closing	**Prevention 8. Closing of perforations in soil**	Presence of open holes in the property	Tank construction site and powerhouse	Finishing construction of foundations	Inspection of the site and photographic record	EDP	Check that all open holes in the ground are closed	Close the open holes in the soil	page 10-18
Site Preparation, Construction and Closing	**Prevention 9. Test water discharge**	Sampling water test water	Before discharge point	Before discharge, at the end of construction	Sampling with local equipment: suspended sediment, oil and fats	EDP	Check that the parameters are according to the regulations	Treat the water before it is discharged	Page 10-19
Site Preparation, Construction and Closing	**Attenuation 10. Relocation of fauna**	Presence of fauna on site	Project property, spread areas, and piping corridor	Once, before starting the eviction of the property	Inspection of the site and photographic record	EDP	Verify that there is no established fauna present on the site	Apply the relocation program	Page 10-19
Site Preparation, Construction and Closing	**Compensation 11. Reforestation and Support (FIAES)**	Number of species planted, record of payments to FONAES	Green areas in the Project site	Weekly	Inspection of the site and photographic record	EDP	Verify planting establishment	Care and maintenance or replanting of damaged species	Page 10-21
Site Preparation, Construction and Closing	**Prevention 12. Barrier in beach area**	Presence of fence	Coastal area on the ground for the pipeline	Monthly	Inspection of the site and photographic record	EDP	The fence must be installed	Install the fence if it is not installed correctly or is damaged	page 10-29
Site Preparation, Construction and Closing	**Prevention 13.Prevention of interaction with fauna**	Deposits for solid waste	In front of work place and inside the facilities	Weekly	Visual inspection	EDP	Verify the installation of containers and their proper use	Ensure eviction and proper disposal	Page 10-30
Site Preparation, Construction and Closing	**Attenuation 14. Noise reduction during sea piloting**	Recording Observations	Area of 500m pilot noise around the dock and safety zone in CEPA Port (fig.10.18)	Weekly during piloting activities	Daily records of observations including species, location, time, status of piles	EDP	Implement management measures that apply when marine mammals are present	Reinforce monitoring and proposed measures	Page 10-32
		Pile driving	Rocky seabed.	Monthly during construction	Inspection of the site and photographic record	EDP	The area of work must be cleared of fauna	removal of fauna that has not been removed prior to the activities	Page 10-32
Site Preparation, Construction and Closing	**Attenuation 15.Lighting Plan of Maritime Terminal and Temporary dock**	Lighting on the jetty	Jetty	Monthly during construction	Inspection of the site and photographic record	EDP	Lighting should not be directed to sea water	Correct the direction of lightning	Page 10-35
Site Preparation, Construction and Closing	**Prevention 16.Measures to Reduce Turbidity and Oyster Biomonitoring**	Turbidity in water and metals in oysters	Construction dock area outside the curtains and oyster banks	turbidity, Weekly and biomonitoring in oysters every two months	Work material and analysis in laboratory	EDP	Turbidity must meet 75NTU average 30 days and 100NTU average 7 days; Metals in oysters should not be above the baseline (first Measure before works)	Improve measures for sedimentation control	Page 10-36
Site Preparation, Construction and Closing	**Prevention 17.Environmental and Social Management Plan**	Verify the information of the population about the project and conflicts that arise	Record of meetings and complaints	MOnthly	Review complaints and their resolution	EDP	Verify that project information and conflict resolution have been provided	Improve the media and the attention to complaints	page 10-38

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Table 10.50 – Monitoring Program, Construction Stage

Stage of Execution	Environmental Measure	Parameters to Consider	Place or Monitoring Point	Frequency of Monitoring	Method to Use	Responsible for Monitoring	Interpretation of results	Feedback	Reference in Impact Description Text
Site Preparation, Construction and Closing	**Prevention** **1. Safety in the open sea**	Incidents and accidents	Near dock construction	Monthly	Review accident statistics and the cause of accidents	EDP	Review the cause of accidents	Install measures to prevent accidents and improve coordination	Page 10-40
Site Preparation, Construction and Closing	**Prevention** **2. Traffic plan**	Claims from population	Communications office	Monthly	Check for any community complaints or traffic-related accidents.	EDP	Review the cause of the complaint or accident	Improve training for personnel in charge of transporting materials or equipment	Page 10-41
Site Preparation, Construction and Closing	**Prevention/ attenuation** **3. Local workers employment**	Number of people from the community hired for the project	Communications office	Monthly	Review of Statistics of the people hired for the project	EDP	Compare current hiring with the target of 100% unskilled local area workers	Improve the mechanism for hiring staff to incorporate more people from Acajutla	Page 10-42
Site Preparation, Construction and Closing	**Prevention** **4. Prevention of informal stores around the site**	Informal stores around the project site	Within the perimeter of the area of the project	Monthly	Site inspection and photographic record	EDP	Stores should not be installed	Improve measures with workers	Page 10-43
Site Preparation, Construction and Closing	**Prevention / attenuation** **5. Pipe safety barrier**	Presence of barrier	Coast in the corridor for the pipe	Monthly	Site inspection and photographic record	EDP	The barrier must be installed	Install the barrier, if it is not installed correctly or missing parts	Page 10-44
Site Preparation, Construction and Closing	**Compensation** **6. Compensation to fishermen**	Installation of winch, in the artisanal dock, artificial reefs and FDAs	Artisanal dock	6 months and 1 year after completion of installation	Site inspection and photographic record Interview to verify the effectiveness of the FAD	EDP	The winch must be installed. FAD and reefs must be installed	Install equipment	Page 10-44
Site Preparation, Construction and Closing	**Prevention** **7. Construction of wastewater treatment systems**	Compensation program for independent fishermen	NA	Before starting the program to establish the baseline, then 6 months, 1 year and 2 years after completion of the compensation program	Interview each independent fisherman on the status of his livelihood	EDP	Compare the baseline values	Provide corrective assistance for all fishermen whose livelihoods worsen as a result of the project	Page 10-46
Site Preparation, Construction and Closing		Water quality Analysis: BOD5, COD, pH, Oils and Fats Sedimentable solids Total Suspended Solids, Total Coliforms (CT)	Treatment plant effluent outlet point	Quarterly (4 times a year)	Individual samples subjected to laboratory NSO standards.	EDP	NSO 13.49.01:09, BOD5, 60 mg/L COD 60 mg/l, pH, fat and oils 20 mg/L, solid sedimentary 1 mg/L total suspended solids, 60 mg/L, Temperature 20-35°C, chlorides (report, there is no standard), flow (point "a" or "b")	If the monitoring detects contamination related to the project, corrective measures must be taken to avoid further contamination	Page 10-4
Site Preparation, Construction and Closing	**Prevention** **8. Water-oil separator**	Sampling of water quality: oil and fats and hydrocarbons	Before discharge in CEPA channel	Quarterly (4 times a year)	Individual samples for laboratory analysis	EDP	Comparison of the applicable surface water quality criteria: fats and Oils 20 mg / L, there should be no presence of hydrocarbons	If the monitoring detects contamination related to the project, corrective measures must be taken to avoid further contamination	Page 10-52

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Table 10.50 – Monitoring Program, Construction Stage

Stage of Execution	Environmental Measure	Parameters to Consider	Place or Monitoring Point	Frequency of Monitoring	Method to Use	Responsible for Monitoring	Interpretation of results	Feedback	Reference in Impact Description Text
Site Preparation, Construction and Closing	**Prevention** **9. Sedimentary tank / rain damper**	Flood	Characteristics of surface water management	Weekly during the rainy season - monthly during the dry season	Visual inspection of the storm water management system to verify capacity and integrity, and any evidence or risk of flooding and erosion	EDP	Comparison with system design specifications	If inspections indicate a risk of flooding or erosion take corrective actions	Page 10-55
Site Preparation, Construction and Closing	**Prevention** **10. Fire protection system**	Installation of all equipment and operation test	Tank yards, cargo rack and bottling plant	Biannual	Equipment operations report	EDP	The equipment must operate according to the specifications thereof	Replacement of defective equipment	Page 10-57
Site Preparation, Construction and Closing	**Prevention** **11. Leak detection system**	Installation of all equipment and operation test	Tank yards, cargo rack and bottling plant	Biannual	Equipment operations report	EDP	The equipment must operate according to the specifications thereof	Replacement of defective equipment	Page 10-58
Site Preparation, Construction and Closing	**Prevention** **12. Well flow monitoring equipment and well monitoring**	Flow rate of extraction and piezometric levels and parameters which are indicative of saline intrusion	Monitoring wells groundwater up and down the gradient of the well and the well project	Quarterly (4 times a year)	Individual samples submitted for laboratory analysis	EDP	Comparison to baseline conditions	If monitoring detects contamination related to the project, corrective measures must be taken to avoid further contamination and to seek for the necessary corrective measures	Page 10-59
Site Preparation, Construction and Closing	**Prevention** **13. Disease vector minimization**	The presence of mosquito larvae	Areas of deposition areas of stagnant water (for example, a storm water pond) site in general	2 times a week (can be reduced in the dry season)	Visual inspection	EDP	Presence of breeding habitat, presence of larvae in water	Eliminate reproduction habitat whenever possible. Otherwise, if larvae persist, treat with larvicide	Page 10-64
Site Preparation, Construction and Closing	**Prevention** **14. Minimize affectation to marine habitat**	Establishment of plan	Maritime Terminal and Temporary Dock	During construction at sea	Inspection	EDP	Verify affectation of marine habitat	Establish procedures or improvements to theses or reinforce established procedures that apply correctly thereof	Page 10-64
Site Preparation, Construction and Closing	**Prevention** **15. Detailed risk assessment and contingency plan**	Establishment of plan	Central Power Plant Site in general	1 time prior to the start of operations stage	Verify that the plan has been established, coordinate with authorities, and train employees	EDP	This plan should contain all the aspects established in Chapter 9	Complete or justify what is needed	Page 10-67
Site Preparation, Construction and Closing	**Prevention** **16. Measures for disposal site of dredging material**	Turbidity	Dredging material disposal site, initial sampling points	Daily during the 18 days of dredging	Using turbidimeter equipment on site	EDP	Turbidity must meet 75NTU average 30 days and 100NTU average 7 days	Reduce discharge speed until reaching the set parameter	Page 10-68

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Table 10.51 – Execution Schedule of the Environmental Management Program, Construction Stage

Execution stage	Environmental measure	2017												MONTHS / COST YEAR 1	2018												MONTHS / COST YEAR 2	2019												2020				MONTHS / COST YEAR 3 (2019+2020)	Calculated Amount of Environmental Measure
		J	F	M	A	M	J	J	A	S	O	N	D		J	F	M	A	M	J	J	A	S	O	N	D		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A		
Construction	**Attenuation**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	**$ 2,000.00**
	1. Reduction of Gas Emissions													$ 444.44													$ 666.67																$ 888.89	
Site Preparation, Construction, Closing	**Prevention**											1	1	2	1	1	1	1							1	1	6	1	1	1	1							1	1	1	1	1	1	10	**$ 54,012.00**
	2. Dust Management Plan													$ 6,001.33													$ 18,004.00																$ 30,006.67	
Site Preparation, Construction, Closing	**Attenuation**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	**$ 1,000.00**
	3. Noise management during construction													$ 222.22													$ 333.33																$ 444.44	
Site Preparation, Construction, Closing	**Attenuation**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1													4	**$ 75,800.00**
	4. Soil and rainwater management under construction													$ 25,266.67													$ 37,900.00																$ 12,633.33	
Site Preparation, Construction, Closing	**Prevention**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	**$ 12,200.00**
	5. Handling and Storage of Hazardous Materials													$ 2,711.11													$ 4,066.67																$ 5,422.22	
Site Preparation, Construction, Closing	**Prevention**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	**$ 47,180.00**
	6. Domestic wastewater treatment													$ 10,484.44													$ 15,726.67																$ 20,968.89	
Site Preparation, Construction, Closing	**Prevention**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1								9	**$ 11,520.00**
	7. Hazardous materials in construction of Maritime Terminal and temporary dock													$ 3,177.93													$ 4,766.90																$ 3,575.17	
Construction, Closing	**Prevention**													0										1	1	1	3																	0	**$ 1,000.00**
	8. Closing of perforations in soil													$ -													$ 1,000.00																$ -	
Site Preparation, Construction, Closing	**Prevention**													0													0													1	1	1		3	**$ 3,000.00**
	9. Test water discharge													$ -													$ -																$ 3,000.00	
Site Preparation, Construction, Closing	**Attenuation**					1	1	1						3				1	1	1							3																	0	**$ 6,200.00**
	10. Relocation of fauna													$ 3,100.00													$ 3,100.00																$ -	
Site Preparation, Construction, Closing	**Compensation**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	**$ 123,102.98**
	11. Reforestation and Support to (FIAES)													$ 27,356.22													$ 41,034.33																$ 54,712.44	
Site Preparation, Construction, Closing	**Prevention**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1								9	**$ 710.00**
	12. Barrier in beach area													$ 195.86													$ 293.79																$ 220.34	
Site Preparation, Construction, Closing	**Prevention**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	**$ 2,400.00**
	13. Prevention of interaction with fauna													$ 533.33													$ 800.00																$ 1,066.67	
Site Preparation, Construction, Closing	**Attenuation**					1	1	1	1	1	1			6													0																	0	**$ 5,100.00**
	14. Noise reduction during sea piloting													$ 5,100.00													$ -																$ -	
Site Preparation, Construction, Closing	**Attenuation**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1								9	**$ 1,000.00**
	15. Lighting Plan for Maritime Terminal and Temporary dock													$ 275.86													$ 413.79																$ 310.34	
Site Preparation, Construction, Closing	**Prevention**							1	1					2													0																	0	**$ 6,960.00**
	16. Measures to Reduce Turbidity and Oyster Biomonitoring													$ 6,960.00													$ -																$ -	
Site Preparation, Construction, Closing	**Prevention**				1	1	1	1	1	1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	**$ 84,150.00**
	17. Environmental and Social Management Plan													$ 20,468.92													$ 27,291.89																$ 36,389.19	

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Table 10.51 – Execution Schedule of the Environmental Management Program, Construction Stage

Execution stage	Environmental measure	2017												MONTHS / COST YEAR 1	2018												MONTHS / COST YEAR 2	2019												2020				MONTHS / COST YEAR 3 (2019+2020)	Calculated Amount of Environmental Measure
		J	F	M	A	M	J	J	A	S	O	N	D		J	F	M	A	M	J	J	A	S	O	N	D		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A		
Site Preparation, Construction, Closing	**Prevention**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1								9	
	18. Safety in the open sea													$ 1,517.24													$ 2,275.86																$ 1,706.90	**$ 5,500.00**
Site Preparation, Construction, Closing	**Prevention**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	
	19. Traffic Plan													$ 404.44													$ 606.67																$ 808.89	**$ 1,820.00**
Site Preparation, Construction, Closing	**Prevention / attenuation**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	
	20. Employment of Local Workers													$ 5,666.67													$ 8,500.00																$ 11,333.33	**$ 25,500.00**
Preparación de Sitio, Construcción, Cierre	**Prevention**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	
	21. Prevention of informal stores around the site													$ 155.56													$ 233.33																$ 311.11	**$ 700.00**
Site Preparation, Construction, Closing	**Prevention / attenuation**													0	1	1	1	1	1	1							6																0	
	22. Pipe Safety Barrier													$ -													$ 8,822.00																$ -	**$ 8,822.00**
Site Preparation,	**Compensation**		1	1	1	1	1	1						6													0																0	
	23. Compensation to Fishermen													$ 55,650.90													$ -																$ -	**$ 55,650.90**
Construction, Closing	**Preventive**													0													0								1	1	1							3	
	24. Construction of sewage treatment systems													$ -													$ -																$ 126,262.00	**$ 126,262.00**
Construction, Closing	**Preventive**													0													0						1	1	1									3	
	25. Water-oil separator													$ -													$ -																$ 16,480.00	**$ 16,480.00**
Site Preparation, Construction, Closing	**Prevention**					1	1	1						3													0																0	
	26. Settling tank / rain damper													$ 15,000.00													$ -																$ -	**$ 15,000.00**
Construction, Closing	**Preventive**													0													0																6	
	27. Fire Protection System													$ -													$ -																$ 119,295.00	**$ 119,295.00**
Construction, Closing	**Preventive**													0													0																3	
	28. Leak Detection System													$ -													$ -																$ 16,000.00	**$ 16,000.00**
Site Preparation, Construction, Closing	**Preventive**					1	1	1						0													0																3	
	29. Wellflow monitoring equipment and monitoring wells													$ 3,100.00													$ -																$ -	**$ 3,100.00**
Site Preparation, Construction, Closing	**Preventive**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	
	30. Minimization of Disease Vectors													$ 533.33													$ 800.00																$ 1,066.67	**$ 2,400.00**
Site Preparation, Construction, Closing	**Preventive**					1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1								9	
	31. Minimize the impact on marine habitat													$ 275.86													$ 413.79																$ 310.34	**$ 1,000.00**
Site Preparation, Construction, Closing	**Preventive**								1	1	1	1		0	1	1	1	1									12																0	
	32. Detailed risk assessment and contingency plan													$ 50,000.00 -													$ 50,000.00																$ -	**$ 100,000.00**
Site Preparation, Construction, Closing	**Preventive**								1	1				2													0																0	
	33. Measures for disposal site of dredging material													$ 6,900.00													$ -																$ -	**$ 6,900.00**
TOTAL PER YEAR AND TOTAL PMA														**$ 251,502.35**													**$ 227,049.69**																**$ 463,212.84**	**$ 941,764.88**

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10.3 Description of Environmental Measures for Operation Phase

10.3.1 Emissions Monitoring

Type of measure: Preventive

Description of the Measure

Air emissions of combustion gases will be measured after the start-up of the engines. Sampling will be carried out by an independent laboratory selected by EDP and authorized by MARN. MARN staff will be invited to witness its execution.

Methods of measurement shall be US EPA[2] reference methods. The air emissions program is summarized in Table 10.52 below.

Table 10.52 – Stack Emission Monitoring Summary	
Sampling Site:	4-engine stacks, selected at random.
Frequency:	Annual, during three years; Note: After the first three years, during the life of the Project if the results comply with the normative, the monitoring will be done every two or three years, not annually.
Parameters to be determined:	NOx; PTS; O2; CO; CO2; Gas flow, composition, production (MW)
Methods to use	NOx: US EPA Method 7, o 7C, o 7E
	PTS: US EPA Method 17
	O2: US EPA Method 3A o 3B
	CO: US EPA Method 10
	Gas flux: US EPA Method 2
	Gas Humidity: US EPA Method 4
	Fuel consumption: Load measurement.
	CO2 emissions will be calculated based on the fuel analysis and the measured O2
Number of tests:	3 consecutive for each parameter
Duration of sampling:	≥1 hour at ≥90% Maximum continuous load
Standard to be met:	World Bank Guidelines, 2007

Source: Elaboration by Consulting Team

The environment air quality will be measured after the start-up of the equipment. Sampling will be carried out by a laboratory selected by EDP. MARN staff will be invited to witness its execution.

Methods of measurement shall be US EPA[2] reference methods and ASTM methods. The air emissions program is summarized in Table 10.53.

For environment, air is detailed as follows:

Table 10.53 – Summary of Environment Air Quality Program (atmospheric emissions)	
Sampling Site:	A point in the critical area determined in the dispersion model.
Frequency:	Continuous monitoring for twenty days
Parameters to be determined:	NO_x, during the text period the heat rate, fuel consumption, and production (MW) will be measure.
Methods to Use:	Continuous measurement with electrochemical analyzer equipment similar to that used for the base line
Number of tests:	Continuous
Sampling time:	continuous
Standard to be met	NSO 13.11.01:01, Table 1 Nitrogen dioxide: 150 µg/Nm^3, for 24 hours.

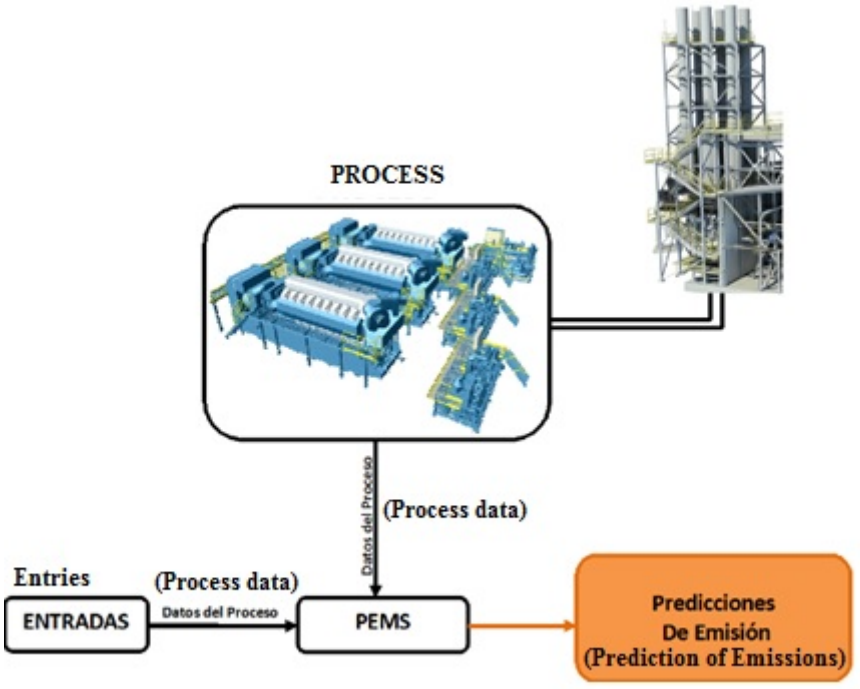
Source: Elaboration by Consulting team

The results will be commented with the meteorological data obtained from the meteorological station to be installed.

Emission prediction monitoring system
Since NOx is the main pollutant produced in the combustion of natural gas, the NOx gas detector allows the reading of the NOx levels in the chimney in real time, so when detecting non-standard levels during the tests will proceed with the system shutdown.

In addition, an EMISSION PREDICTION MONITORING (PEM) SYSTEM will be installed. These systems calculate emissions using models that use real data of different parameters, use robust instrumentation and can be verified by reference measurements. These systems have been tested in the United States and are used in more than one hundred facilities worldwide to report emissions. The USEPA No. 16 standard gives the requirements for these equipment. See Figure 10.17.

Figure 10.17 – Emission Prediction Monitoring System Operation Scheme



Source: Wärtsilä, 2014

Meteorology

A permanent weather station will be operated and maintained to the purpose of:

a) Facilitate the interpretation of monitoring data of NO_2;
b) evaluating air quality events (for example, possible odor observations);
c) construct a local database for a more precise application of dispersion models.

A meteorological station will be installed to record the following parameters:

- Wind direction (degrees, from the north = 0, from the east = 90);
- Wind speed (m/s);
- Relative humidity (%, calculated dew point ^{o}C);
- Temperature (^{o}C);
- Rain (total mm, mm/h);
- Solar radiation (W/m^2).

The wind sensors shall be located to comply with the following guidelines [2]:

- The standard height is 9-10 m on uneven flat ground;
- Keep a distance ≥10 times the height of the nearest buildings or trees;
- If the sensor was installed on a building, do it on a mast of ≥ 6 m above the highest part of the building; and
- If the sensor is installed on a tower (ex: chimneys) on a horizontal support of a length equal to twice the diameter of the tower, and install this extension where the wind comes most of the time.

A summary of the local meteorological data will be included in the annual reports that EDP submits to MARN, where the results of the air quality measurements will be reported. This summary shall include for each sampling period the number of hours in which the passive monitoring station was in the leeward of the Thermal Power Station (± 11.25 degrees), and the average wind speed. That is, if the monitor is located exactly to the west of the Thermal Power Station (270 degrees) it would count the time in which the direction of the wind was in the interval (78.75 to 101.25 degrees). The production of this meteorological summary will be facilitated with the use of software or a spreadsheet to classify wind directions, with respect to the orientation of each of the air quality monitoring stations. (See Table 10.54)

Table 10.54 – Meteorology	
Sampling site:	EDP Communications Office.
Frequency:	Continuous, schedule data file.
Parameters to determine:	Wind direction and wind speed, solar radiation, temperature, humidity.
Methods to be used.	NOAA guidelines for meteorological stations. (NOAA, guidelines for meteorological station reconnaissance and meteorological sensors height measurements, April 2008).
Number of tests:	Continuous
Duration of sampling:	Continuous

Source: Elaboration by Consulting Team

The data obtained from the weather station to install will be used to check on future data, since it does not have sufficient information during a time that lasts the sampling in chimneys, or 24 hour on ambient

[2] Source: NOAA, Guidelines for Meteorological Station Reconnaissance and Meteorological Sensor Height Measurements, Abril 2008.

air. Note the atmospheric data during the tests of emission and emission levels, to comment on the results obtained.

Location of the Environmental Measure

Stacks and Communications Office.

Estimated Amount of Environmental Measure

Table 10.55 – Estimated Amount of Environmental Measure - Emissions Monitoring					
Activity	**Quantity**	**Unit**	**Unit Price**	**Term (months)**	**Total**
Stack monitoring	12.00	c/u	$2,000.00	1.00	$ 24,000.00
Ambient Air monitoring	6.00	c/u	$1,500.00	1.00	$ 9,000.00
				TOTAL	**$ 33,000.00**

Source: Elaboration by Consuting Team

10.3.2 Noise Monitoring

Type of measure: Preventive

Description of the Measure

The noise will be measured after the start of the equipment. An independent contractor selected by EDP will carry out sampling.

Methods of measurement shall be US EPA reference methods and ASTM methods. The noise measurement to be performed is detailed: (See Table 10.56).

Table 10.56 – Summary of the Noise Testing Program	
Sampling site:	4 points in sensitive receptors, sampled for the baseline of the project and boundary of the property.
Frequency:	Annual, 3 tests at each point
Parameters to determine:	dB(A) during the day and night
Methods to use:	Measurement with sound meter
Number of tests:	3
Duration of sampling:	Timely
Standard to be met	The noise in the residential areas where the points are located should be less than 55 dB (A) during the day and no more than 3 dB (A) of the noise measured at the baseline, at night: L1 50 dB (A) , L2 54 dB (A), L3 56 dB (A) and L4 45 dB (A). 70 dB (A) on the edge of the property.

Source: Elaboration by Consulting Team

In addition, EDP should respond to the concerns of the community if there are any complaints regarding noise by the operations of the facility.

Location of the Environmental Measure

Baseline Noise Measurement Points (Figure 5.9)

- L1: 193799E, 1503738N
- L2: 194277E, 1503885N
- L3: 194760E, 1503024N
- L4: 193286E, 1503558N

In addition, the noise measurements to be taken in the boundary of the property of the Thermal Power Plant.

Estimated amount of the environmental measure

Table 10.57 – Estimated Amount of Environmental Measure - Noise Monitoring

Activity	Quantity	Unit	Unit Price	Term (months)	Total
Five Point Noise Measurement	1.00	Total	$ 1,000.00	3.00	$ 3,000.00
				TOTAL	$ 3,000.00

Source: Elaboration by Consulting Team

10.3.3 Protective Equipment for Personal and Spills

Type of measure: Prevention.

Description of the Measure

Objective

Prevent damages to employees and visitors for possible events, especially for the handling of hazardous materials, such as LNG and other hazardous materials in the Thermal Power Plant.

Description

The holder will acquire an industrial and personal safety equipment.
Personal protective equipment will be available, at least the following:

- Neoprene gloves;
- Helmets;
- Bucket shoes;
- Suits against fire 12.00;
- Breathing equipment 4.00.

Acquisition of portable equipment for detection of vapors

Constant monitoring of pressure in the tank will help monitoring possible LNG leaks in pipes, which, upon detecting a pressure drop, will automatically, close the affected equipment-section. In addition, periodic inspections with portable explosive gas detection instruments and oxygen meters.

Location of the Environmental Measure

Power Plant in general.

Estimated Amount of Environmental Measure

Table 10.58 – Estimated Amount of Environmental Measure – Spill and Personal Protective Equipment

Description	Quantity	Unit	Unit Price	Term (months)	Total
Suits Against Fire	12.00	each	$200.00	1.00	$ 2,400.00
Breathing Equipment	4.00	each	$200.00	1.00	$ 800.00
a set of gloves, shoes and helmet	60.00	each	$111.00	1.00	$ 6,660.00
Spill Kit	5.00	each	$300.00	1.00	$ 1,500.00
				TOTAL	**$ 9,860.00**

Source: Elaboration by Consulting Team

10.3.4 Training on Environment, Hygiene and Safety

Type of Measure: Prevention.

Description of the Measure

One of the most important measures to take is to provide the necessary information to the staff about the materials to be used and the safety measures to be taken in addition to the risks to which they would be exposed. Instruct staff about the likelihood of incidents during operations and maintenance activities, training them in safety standards for the type of work and the proper handling of equipment and tools.

This will be achieved by implementing training in safety and hygiene standards, with reinforcement at least every three months. Should include:

a. Introduction to environmental management: importance and understanding of environmental management;

b. Occupational health and safety aspects;

- First aid;
- Fire prevention and control;
- Handling of hazardous chemicals or materials;
- Signals used;
- Use and importance of personal protective equipment;

- Contingency plan: knowledge and training about it; and
- Provide safety equipment and personal protection.

Location of the Environmental Measure

To all the staff in the Thermal Power Plant.

Estimated Amount of Environmental Measure

Table 10.59 – Estimated Amount of Environmental Measure - Training in Environment, Hygiene and Safety

Description	Quantity	Unit	Unit Price	Term (months)	Total
Training	60.00	each	$50.00	1.00	$ 3,000.00
				TOTAL	**$ 3,000.00**

Source: Elaboration by Consulting Team

10.3.5 Environment, Hygiene and Safety Plans and Procedures

Type of measure: Prevention

Description of the measure

Objective

Prevent contamination of soil and water by poor management of waste from the operation of the Project.

Description

The best practices of the international industry will be used for the handling, storage, use of hazardous materials, including:

- Personal protective equipment;
- Overfilling and spill protection;
- Signals, labelling and inventory control;
- The use of secondary containment;
- Incompatible materials stored in separate places;
- Spill response material and easy-to-clean cleaning; and
- Fire extinguishers available.

In addition, a Solid Waste Management Plan will be implemented. This plan consists of the classification and separation of solid wastes according to their nature (packaging, domestic, organic and dangerous). Also, stored temporarily in plastic containers with lid located inside the property, for later withdrawal by the service collection, to a dump authorized to receive non-hazardous waste (domestic, organic),

recycling (packaging wastes). This prevention measure is considered as part of the Project, and will operate from the beginning of activities.

The use of chemicals (like, pesticides) for site landscaping management has the potential to affect the health of the community. The use of chemicals for gardening purposes will be minimized and used within local regulatory requirements.

Generation of common solid waste

Solid waste generated during the operating stage will be removed at least 3 times a week, by the garbage truck of the City Hall.

A set of containers will be provided to keep the waste separated in the following manner: Household Waste "and" Recyclable Material "(cans, plastic bottles, and others).

Generation of special type waste

Oil contamination

Regarding the oil residues that will be obtained from the oil separation trap, they will be separated during the cleaning activities of the trap (every 6 months) and stored in plastic barrels for their treatment, through companies dedicated to it, such as Geocycle company.

- Temporary storage

"Hazardous wastes" (wipes and paper contaminated with oil, empty containers of oil), generated in the different areas of customer service, will be stored temporarily in plastic containers properly covered and labeled. These will be properly disposed of through recycling companies.

Estimated Amount of Environmental Measure

Table 10.60 – Estimated Amount of Environmental Measure - Environment, Hygiene and Safety Plans and Procedures

Description	Quantity	Unit	Unit Price	Term (months)	Total
Treatment of waste with oils	1.00	Total	$350.00	36.00	$ 12,600.00
Containers for solid waste	12.00	Each	$45.00	1.00	$ 540.00
				TOTAL	**$ 13,140.00**

Source: Elaboration by Consulting Team

10.3.6 Relation with the Community

Type of measure: prevention

Description of the Measure

A communications plan must be established during the first three years of the Project's operation, to be carried out by the project's social and environmental management office.

Objectives

This measure pursues the following objectives:

- Provide information to the local citizens in relation of the operation of the Project;
- Preventing social conflicts and maintaining a good relationship with Project's neighbours;
- Prevent discomfort to the population residing in areas immediate to the Project site;
- Serve the population that is affected in some way during the operation, attention of complaints or discomfort of the community;
- Contact with fishermen, boats personnel, and schools; and
- Safety-related meetings.

Resources

The office will have at least the following staff:

3. Social Specialist: Will be responsible for all social management of the Project. The profile required for the manager of social management is as follows:
    - Bachelor's Degree in Social Work, Sociology or Anthropology;
    - Experience in mediation of conflicts and processes of stakeholders engagement; y,
    - Experience in social promotion of community development projects;

Functions of the office and its personnel

- Respond to queries and complaints from the population and respond or coordinate a response for them;
- Verify that the ENVIRONMENTAL MANAGEMENT PROGRAM is executed, as planned. Keep a record and prepare an annual report, which will be available when MARN carries out the environmental audits;
- Coordinate the environmental management of the Project;
- Hold informative meetings. These meetings should include community leaders, representatives of the main institutions and the corresponding municipality. At least every six months;
- Talks to workers related to environmental protection, respecting customs and values, monthly, to different groups of 20 people;

- Prepare written informational documentation of the Project, in surrounding areas, municipality, and schools.

Location of the Environmental Measure

The office will be installed within the administrative facilities of the Project.

Consideration should be given to the placement of 2 notices visible to pedestrians and drivers, on the location of the Social Management Office, on the project's site walls.

Estimated Amount of Environmental Measure

Table 10.61 – Estimated Amount of Environmental Measure - Relationship with the Community

Description	Quantity	Unit	Unit Price	Term (months)	Total
Social and environmental specialist	1.00	Person	$800.00	36.00	$ 28,800.00
Premises and materials	1.00	Total	$150.00	33.00	$ 4,950.00
				TOTAL	**$ 33,750.00**

Source: Elaboration by Consulting Team

10.3.7 Maritime Terminal Lightning Plan

Type of measure: Attenuation

Description of measure

Establish a lightning management plan, for the activities at sea in the operation phase, so it does not affect the marine fauna. The plan consists of:

- Reduce night time lightning in non-essential areas, particularly during critical periods in the life cycle of wildlife, such as turtle nesting;
- Use screens to direct lighting to work areas;
- Direct all lighting to work areas and do not directly illuminate water.
- Low beam mounting;
- Use of light shielding to reduce the amount of glare, as well as reduce visible light to animals, so there is less chance of them being trapped, repelled, or their day / night patterns result altered;

- Installation of long wavelength lights (like amber and red lights) makes visible light appear less intense for nocturnal animals (State of Florida 2014[3]).

Location of the Environmental Measure

Marine terminal

Estimated Amount of Environmental Measure

Table 10.62 – Estimated Amount of Environmental Measure - Temporal Dock Lightning Plan

Description	Quantity	Unit	Unit Price	Term (months)	Total
Marine Terminal Lighting Plan	1.00	Total	$1,000.00	1.00	$ 1,000.00
				TOTAL	**$ 1,000.00**

Source: Elaborationby Consulting Team

10.3.8 Maintenance to Reforestation and Support to FIAES

Type of measure: Attenuation

Description of the measure

To compensate for the loss of vegetation by cutting trees, as well as the reduction of infiltration by waterproofing of areas and the use of underground water, revegetation will be done in the construction stage, as detailed below; In the operations phase is included the maintenance of the plantation.

1. Revegetation on Project grounds: 1,871;
2. Revegetation on land of the Municipality of Acajutla: 18,114; y
3. Donation to the Environmental Fund of El Salvador, for revegetation projects and other environmental projects, equivalent to 2,127 trees.

Maintenance method

Species maintenance starts from the time they are sown (early winter or rainy season) or according to construction activities as scheduled) and will last for three years:

[3] State of Florida. 2014. "Wildlife Lighting - About Light Pollution" Florida Fish and Wildlife Conservation Commission. Online: http://myfwc.com/conservation/you-conserve/lighting/pollution/

- Irrigation of planted species: the process must be repeated until the plant has been established for at least 2 years. Special care must be taken during dry days, during the heat stroke, rainy-dry and dry transitional season;
- Protection with mulsh: it is advisable to place a cover of dry plant material, with a thickness of 3 to 5 cm around the plant, to minimize the loss of water from the soil and avoid the possibility of growth of weeds around them;
- Tutoring: some plants need the support of a guardian, to avoid the lodging (inclination);
- Cleaning and reseeding: this involves the elimination of herbs that are competing with the plant, keeping the area of the crown clean (1 m diameter) and replenishing mulsh. When necessary, the malformed plants and, of course, the dead plants will be replaced, to maintain the adequate density of vegetation cover. The developer as owner of the Project will have the responsibility to maintain the planting until the final reception of the Project or the deliver of the plantation to the corresponding institutions.

Location of the environmental measure.

For planting compensation:

1. Revegetation on Project lands: 2,190. As shown in Figure 10.3. (See appendix 10.A);
2. Revegetation on land of the Municipality of Acajutla: 18,114. (See appendix 10.B) ; y
3. Donation to the FIAES, to invest in environmental projects, the amount of $119.328.52.

Estimated Amount of Environmental Measure

The cost of planting is included in the construction phase and the cost of maintenance in the operations phase of the Project for three years.

Table 10.63 – Estimated Amount of Environmental Measure - Maintenance to Reforestation and Support to Environmental Fund of El Salvador Measure

Description	Quantity	Unit	Unit Price	Term (months)	Total
Trees on Project Property	1,871	each	$ 0.18	36.00	$11,540.88
Trees on municipal property	18,114.00	each	$ 0.18	36.00	$ 117,378.72
FIAES donation	2,127	each	$6.60	1.00	$14,038.20
	22,022.00			**TOTAL**	**$142,957.80**

Source: Elaboration by Consulting Team

10.3.9 Flow Monitoring Equipment and Monitoring of Wells

Type of Measure: Prevention

Objective: Prevention

Verify the water flows extracted from the well to be drilled for the supply of drinking water.

Description of the measure

Monitoring of water meters of 2 "with flange and standard pressure multi-jet, in the discharge shaft.

As described in measure 10.1.30 on the construction phase, the operation phase is followed up to ensure the correct operation of the installed equipment according to the conditions described in measure 10.1.30 including maintenance every 6 months to the equipment during the operation of the Thermal Power Plant (for 20 years).

Location of the Environmental Measure

Same as detailed in construction stage.

Estimated Amount of Environmental Measure

Table 10.64 – Estimated Amount of Environmental Measure - Flow Monitoring and Salt Intrusion Detection Equipment

Description	Quantity	Unit	Unit Price	Term (months)	Total
Analysis to determine saline intrusion	1.00	Each	$ 75.00	**36.00**	**$ 2,700.00**
Monitoring of levels with piezometric tubes	2.00	Each	$ 100.00	**4.00**	**$ 800.00**
				TOTAL	**$ 3,600.00**

Source. Elaboration by Consulting Team

10.3.10 Environmental Measures Plan Operation Phase

On the next page, Figure 10.18 presents the plan of environmental measures in the construction phase.

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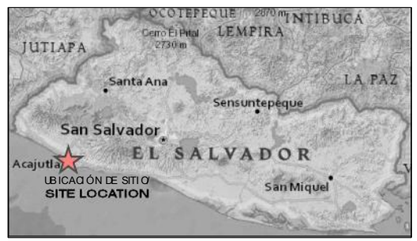
LNG TO POWER PROJECT

MEDIDAS AMBIENTALES EN ETAPA DE OPERACIÓN / ENVIRONMENTAL MEASURES IN STAGE OF OPERATION

FIGURA 10.18 / FIGURE 10.18

SIMBOLOGÍA / SYMBOLS	UBICACIÓN DE MEDIDAS / LOCATION OF MEASURES	CONTENIDO DE MEDIDAS / CONTENT OF MEASURES
	MEDIDA 1 / MEASURE 1	MONITOREO DE EMISIONES EN CHIMENEA / STACK EMISSIONS MONITORING
		MONITOREO DE EMISIONES AIRE AMBIENTE / AMBIENT AIR MONITORING
	MEDIDA 2 / MEASURE 2	MONITOREO DE RUIDO / NOISE MONITORING
	MEDIDA 3 / MEASURE 3	EQUIPO DE PROTECCIÓN PERSONAL Y DE DERRAMES / SECURITY EQUIPMENT AND SPILL RESPONSE
	MEDIDA 4 / MEASURE 4	ENTRENAMIENTO EN MEDIOAMBIENTE, HIGIENE Y SEGURIDAD / WORKER EHS TRAINING
	MEDIDA 5 / MEASURE 5	PLANES, PROCEDIMIENTOS, MEDIOAMBIENTE, HIGIENE SEGURIDAD / EHS PLANS AND PROCEDURES
	MEDIDA 6 / MEASURE 6	RELACIÓN CON LA COMUNIDAD / COMMUNITY LIAISON
	MEDIDA 7 / MEASURE 7	PLAN DE ILUMINACIÓN DEL ROMPEOLAS / LIGHTING PLAN ON COFFERDAM
	MEDIDA 8 / MEASURE 8	MANTENIMIENTO A REFORESTACIÓN / MAINTENANCE OF REFORESTATION
	MEDIDA 9 / MEASURE 9	MONITOREO DE AGUAS SUBTERRANES / PREVENTION GROUND WATER



0 50 100 150m

1:8,000

N W E S

FUENTE / SOURCE:
PLANOS WARTSILA / WARTSILA SITE PLAN

MAP CREATED BY / MAPA CREADO POR: ECO INGENIEROS
MAP CHECKED BY / MAPA REVISADO POR: LF
MAP PROJECTION / PROYECCIÓN DE MAPA:
UTM ZONE 16 WGS84/ UTM ZONA 16 WGS84

FILE / ARCHIVO
C:/CAP 10,ECO,DIBUJO 1, EL SALVADOR/ ECO INGENIEROS
C:/CAP 10,ECO,DRAWING 1, EL SALVADOR/ ECO INGENIEROS

PROJECT / PROYECTO: 14-9114
STATUS / ESTATUS: FINAL / FINAL
DATE / FECHA: 12/22/2016

DILLON CONSULTING

ECO INGENIEROS
LÍDERES EN CONSULTORÍA AMBIENTAL

10.4 Summary of the Environmental Management Program

The Environmental Management Program (PMA) aims to prevent, mitigate and compensate the negative impacts that the Project activities will generate on the environment. The Environmental Management Program basically consists of:

Measures and environmental investments to implement.
A summary Table containing all the measures proposed above is provided, with the respective actions required for each one, including implementation costs.

Monitoring program
Control and monitoring to verify the implementation and effectiveness of measures and investments.

Included in the monitoring program are other monitoring measures to be carried out for the project not associated with any environmental measure.

Schedule for the implementation of measures and investments.
The implementation of the measures has been programmed, according to the development of the Project.

The summary of the environmental management plan, monitoring plan and timetable for the application of environmental measures are included in the following Tables. The environmental bail has been quantified at an investment cost for **TWO HUNDRED FORTY THREE TOUSAND, THREE HUNDRED SEVEN 80/100 DOLLARS ($ 243,307.80)** for the measures to be implemented during the operational phase.

Table 10.65 – Environmental Management Program Operation Phase

Execution Stage	Project Activity	Description of Generated Environmental Impact	Environmental Measure	Description of Proposed Measure	Location of the Environmental Measure	Responsible for its execution	Calculated Amount of Environmental Measure	Time of execution	Expected result
Operations	NG burning to produce power in the engines	Emissions to the atmosphere	**1. Emission Monitoring**	Conduct emission measurements every year for the first three years, install a PEM (Emission Prediction Monitoring) and measure ambient air quality for nitrogen dioxide (NO2) for 20 continuous days	4 motors chimneys selected randomly, and Communications office (environment air)	EDP	$33,000.00	Annual	Emissions and ambient air levels below benchmarks
Operations	NG burning to produce power in the engines	Noise	**Prevention** **2. Noise Monitoring**	Measuring of noise levels during three years, annually. If there are major changes in equipment / operations that could produce an increase in noise, more would be needed.	The noise must be monitored at baseline points and at the plant property boundary.	EDP	$3,000.00	Annual	Noise in residential areas shall be less than 55 dB (A) during the day and not more than 3 dB (A) of the noise measured at baseline, at night: L1 50 dB (A), L2 54 dB (A), L3 56 dB (A) and L4 45 dB (A). 70 dB (A) on property boundary.
Operations	Storage, handling, use and disposal of raw materials, waste and hazardous waste	Accidental dumping of hazardous materials at the site with potential for: • Pollution of the environment (soil, surface waters, groundwater, sea water) • Exposure of workers to toxic or irritant materials • • Possible contamination of the human food chain (by contamination of sea water)	**Prevention** **3. Protective Equipment for personal and spills**	Use the Best Practices of the International Industry for the handling, storage, use of hazardous materials, including: • Overfilling and spill protection • Inventory Labeling and Control • The use of secondary containment • Incompatible materials stored in separate places • Easily accessible spill response and cleaning material (onshore and offshore) • Personal protective equipment available	All the plant and terminal	EDP	$9,860.00	Duration of operations	Low risk of significant environmental pollution from operations Low risk of significant exposure of workers or the human food chain to hazardous materials
Operations	Storage, handling, use and disposal of raw materials, waste and hazardous waste	Accidental dumping of hazardous materials at the site with potential for: • Pollution of the environment (soil, surface water, groundwater, sea water) The exposure of • workers with toxic or irritant substances • The potential contamination of the human food chain (from marine water pollution)	**Prevention** **4. Training environment, hygiene and safety**	Provide training on the environment, hygiene and safety for workers appropriate for their role and position Provide advanced training for workers handling hazardous materials	Project's site	EDP	$3,000.00	During operations	All workers will receive appropriate training for handling and management of hazardous materials

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Table 10.65 – Environmental Management Program Operation Phase

Execution Stage	Project Activity	Description of Generated Environmental Impact	Environmental Measure	Description of Proposed Measure	Location of the Environmental Measure	Responsible for its execution	Calculated Amount of Environmental Measure	Time of execution	Expected result
Operations	Storage, handling, use and disposal of raw materials and hazardous waste	Accidental dumping of hazardous materials at the site with potential for: • Pollution of the environment (soil, surface water, groundwater, sea water) • Exposure of workers to toxic or irritant substances • The potential contamination of the human food chain (from marine water pollution)	**Prevention** **5. Environment, health and safety plans and procedures**	Use the Best Practices of the International Industry for the handling, storage, use of hazardous materials, including: • Personal protective equipment available • Avoid overfilling and spill protection • Signaling, labeling and inventory control • Use of secondary containment • Incompatible materials stored in separate places • Spill response and cleaning material available • Fire extinguishers available	Hazardous materials storage areas	EDP	$13,140.00	During operations	Low risk of significant environmental media pollution as a result of operations Low risk of significant exposure of workers or the human food chain from hazardous materials
Operations	• LNG delivery • FSU movements • Physical presence of facilities • General Operations Activities	• potential safety for artisanal fishermen and the general navigating public • The general relationship with the public and interested parties	**Prevention** **6. Relation with the community**	• Continue Community Liaison Program initiated during construction, including: • safety brochures for fishermen and boaters and for schools • security meetings • Response to complaints from stakeholders	Non-applicable	EDP	$33,750.00	Comprehensive safety disclosure prior to operations. Liason and assistance with the program as needed during operations	General knowledge of the risks of maritime safety, safety of navigation and navigation behaviour, and the danger of unauthorized entry. All complaints must be legitimately addressed.
Operations	General operations	Artificial lighting at the dock and near the coast may affect the behavior of marine fauna, including turtles	**Attenuation** **7. Maritime Terminal Lightning Plan**	Apply Lighting Management Plan: • Reduce lighting in non-essential areas, particularly during critical periods of life-cycle (ex: nesting of turtles) • Use guards to direct lights to areas requiring lighting • Direct light away from water	Areas of operation at sea	EDP	$1,000.00	During operations	Eliminate unnecessary lighting
Operations	Eviction	Loss of habitat and increased habitat fragmentation	**Compensation** **8. Maintenance to reforestation and Support to FIAES**	Maintenance: • Maintenance of 1,781 trees at the project site. • Maintenance of 18,114 trees on properties in the Municipality of Acajutla • The payment of $ 14,038.20 to FIAES for use in restoration works	• The areas identified on the property (Appendix 10A). • Properties of the municipality of Acajutla (Appendix 10B)	EDP	$142,957.80	During years until trees are well established	Establishment of the plantation. The work of restoration will be undertaken by FIAES which will compensate for the local loss of habitat.
Operations	Monitoring of water meters and physico-chemical characteristics.	The decrease of water flow and contamination by saline intrusion.	**Prevention** **9. Flow monitoring equipment and monitoring of wells**	•Monitoring of water flows from the potable water supply. •Monitoring of physicochemical parameters of the extracted water.	• Water extraction well • Monitoring of wells	EDP	$ 3,600.00	During operation time, well exploitation.	The groundwater flow rate and the quality of the groundwater will be kept at the appropriate level.
						Total	**$243,307.80**		

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Table 10.66 – Monitoring Program Stage of Operations

Execution stage	Environmental Activity	Parameters to consider	Place or Monitoring Point	Frequency of Monitoring	Method to Use	Responsible for Monitoring	Interpretation of Results	Feedback	Reference in Impact Description Text
Operations	**Prevention** **1. Monitoring of Emission**	NOx; PTS; O2; CO; CO2; Flow of gases; Composition; Production (MW) emissions when starting operations, the next two years only NOx sampling.	Sampling in port, in chimney of 4 motors chosen at randomly	Annually for the first three years; Then, during the life of the project, if the results are favorable, the monitoring will be done every three years.	Isocinetic Method, EPA Methods	EDP	Comparison to the World Bank Guide Issue Limits Project, 200 mg / Nm3	Perform diagnostic and maintenance for any engine that is emitting excess concentrations of NOx	Page 10-87
		Predictive emission monitoring	Engines in plant	Continuous	PEM equipment	EDP	Comparison to the Project Fuel cell Emission Limits	Perform diagnostic and maintenance for any engine that is emitting excess NOx	Page 10-87
		NO2 Soil Concentrations	Off-site, permanent monitoring site	Continuous 20 days for one year	According to NSO 13.11.01: 01, Table 1, electrochemical analyzer or similar	EDP	Comparison NSO 13.11.01: 01, Nitrogen Dioxides: 150 µg / Nm3, for 24 hours	Apply measures to reduce the concentration in the ambient air	Page 10-87
Operations	**Prevention** **2. Noise Monitoring**	(Off-site) Environmental noise, including low-frequency noise	In the four points in near residential areas, used for the baseline and in boundary	Annual and thereafter only if complaints are received from the population	Monitoring to be performed according to Acoustics international standard 9613-2	EDP	Noise in residential areas shall be less than 55 dB (A) during the day and not more than 3 dB (A) of the noise measured at baseline, at night: L1 50 dB (A), L2 54 dB (A), L3 56 dB (A) and L4 45 dB (A). 70 dB (A) on property boundary.	If the excess noise identified after analysis determines potential sources and remedial measures	Page 10-91
Operations	**Prevention** **3. Spills and Personal Protective Equipment**	Installation of all equipment and operation test	Tank yards, cargo rack and bottling plant	Biannual	Equipment Operations Report, Preventive Maintenance and Inventory of Spill and Containment Equipment	EDP	Preventive maintenance and inventory of spill and containment equipment	Replacement of defective equipment	Page 10-92
Operations	**Prevention** **4. Environment, hygiene and safety training**	Training and accident records	In offices to staff	Biannual	Interviews to personnel	EDP	Prevent damage to personnel, infrastructure and the environment	Updating of training topics	Page 10-93
Operations	**Prevention** **5. Environmental, Hygiene and Safety Plans and Procedures**	Containers for solid waste and handling of hazardous materials	Waste collection site	Monthly	Visual Inspection and Photographic Record	EDP	Prevent contamination of soil and water	Ensure transport and proper disposal and proper use of latrines	Page 10-94
Operations	**Prevention** **6. Relationship with the community**	Verify the information of the population about the project and conflicts that arise	Record of meetings and complaints	Monthly	Review complaints and their resolution	EDP	Verify that project information and conflict resolution have been provided	Improve the media and attention to complaints	Page 10-96
Operations	**Attenuation** **7. Dock lightning Plan**	Lighting on the jetty	Jetty	Monthly during construction	Visual Inspection and Photographic Record	EDP	Lighting should not be directed to sea water	Correct the lighting direction	Page 10-97

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Table 10.66 – Monitoring Program Stage of Operations

Execution stage	Environmental Activity	Parameters to consider	Place or Monitoring Point	Frequency of Monitoring	Method to Use	Responsible for Monitoring	Interpretation of Results	Feedback	Reference in Impact Description Text
Operations	**Compensation 8. Reforestation and Support to FIAES**	Number of species planted, donation record	Green Areas of the land	Monthly	Visual inspection and photographic record	EDP	Compensation for deforestation	Care and maintenance	Page 10-98
Operations	**9. Well Flow Monitoring Equipment and Monitoring Wells**	Well water	Water from extraction well and monitoring of wells	Biannual (2 times a year) for physicochemical parameters. Monthly (12 times a year) piezometer inspection.	Laboratory analysis method according to NSO 13.11.01: 01	EDP	Comparison with baseline conditions and water quality criteria	If the monitoring detects signs of intrusion, the project should review the consumption and look for alternative sources	Page 10-100
Operations	**10. Surface water quality**	Oils and Fats, Hydrocarbons	Wastewater discharge points, prior to discharge	Quarterly (4 times per year)	Laboratory analysis method according to NSO 13.11.01: 01	EDP	Comparison with standards	If monitoring detects project-related pollution, then take corrective action to stop additional pollution and investigate the need for corrective action	Non-applicable
Operations	**11. Water quality of effluent from domestic wastewater treatment system**	BOD 5, COD, pH, Oils and Fats Sedimentary solids Total Suspended Solids, Total Coliforms (CT)	Domestic wastewater from the treatment plant of Central Thermal PowerPlant , FSU and FSRU.	Quarterly (4 times per year)	Laboratory analysis method according to NSO 13.11.01: 01	EDP	Comparison with standards	If monitoring detects project-related pollution, then take corrective action to stop additional pollution and investigate the need for corrective action	Non-applicable
Operations	**12. Presence of disease vectors**	Presence of mosquito larvae	Areas of stagnant water, such as rainwater ponds and the site in general	Twice a week during the rainy season. Monthly during dry season	Visual inspection	EDP	Presence of breeding habitat, presence of larvae in water	If larvae are detected, corrective actions should be taken to solve the problem	Non-applicable
Operations	**13. Marine Fauna**	Presence of marine biota inside the breakwater of the terminal. Amount and type of fish caught	Marine Terminal	Weekly for one year and monthly after first year	Visual inspection	EDP	A significant number of species, particularly those considered significant, should not be trapped within the breakwater nor be captured through water intake.	Replace the grid in the openings of the breakwater and in the water intake openings, consideration of displacement screens/meshes if necessary	Non-applicable
Operations	**14. Water discharge from FSU and FSRU**	Temperature	Water discharge points	MOnthly	Temperature sensor	EDP	Should not be greater than 5ºC of the body temperature recipient	Take corrective actions to reduce temperature, prior to discharge	Non-applicable

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Table 10.67 – Schedule of the Environmental Management Program, Operation Phase

Stage of Execution	Environmental Measure	Execution Time (Quarters since Start of Operations)												Estimated Amount of Environmental Measure
		YEAR 1				YEAR 2				YEAR 3				
		1	2	3	4	5	6	7	8	9	10	11	12	
Operations	**Prevention** **1. Emission Monitoring**													$33,000.00
Operations	**Prevention** **2. Noise Monitoring**													$3,000.00
Operations	**Prevention** **3. Spills and Personal Protective Equipment**													$9,860.00
Operations	**Prevention** **4. Environment, hygiene and safety training**													$3,000.00
Operations	**Prevention** **5. Environmental, health and safety plans and procedures**													$13,140.00
Operations	**Prevention** **6. Relationship with the community**													$33,750.00
Operations	**Attenuation** **7. Dock Lightning Plan**													$1,000.00
Operations	**Compensation** **8. Maintenance for reforestation and Support to FIAES**													$142,957.80
Operations	**Prevention** **9. flow monitoring equipment and monitoring of wells**													$ 3,600.00
TOTAL AMOUNT OF ENVIRONMENTAL MEASURES OPERATIONS PHASE														**$243,307.80**

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Environmental Impact Assessment
LNG to Power Project
TOME III

December 2016 16-3489

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