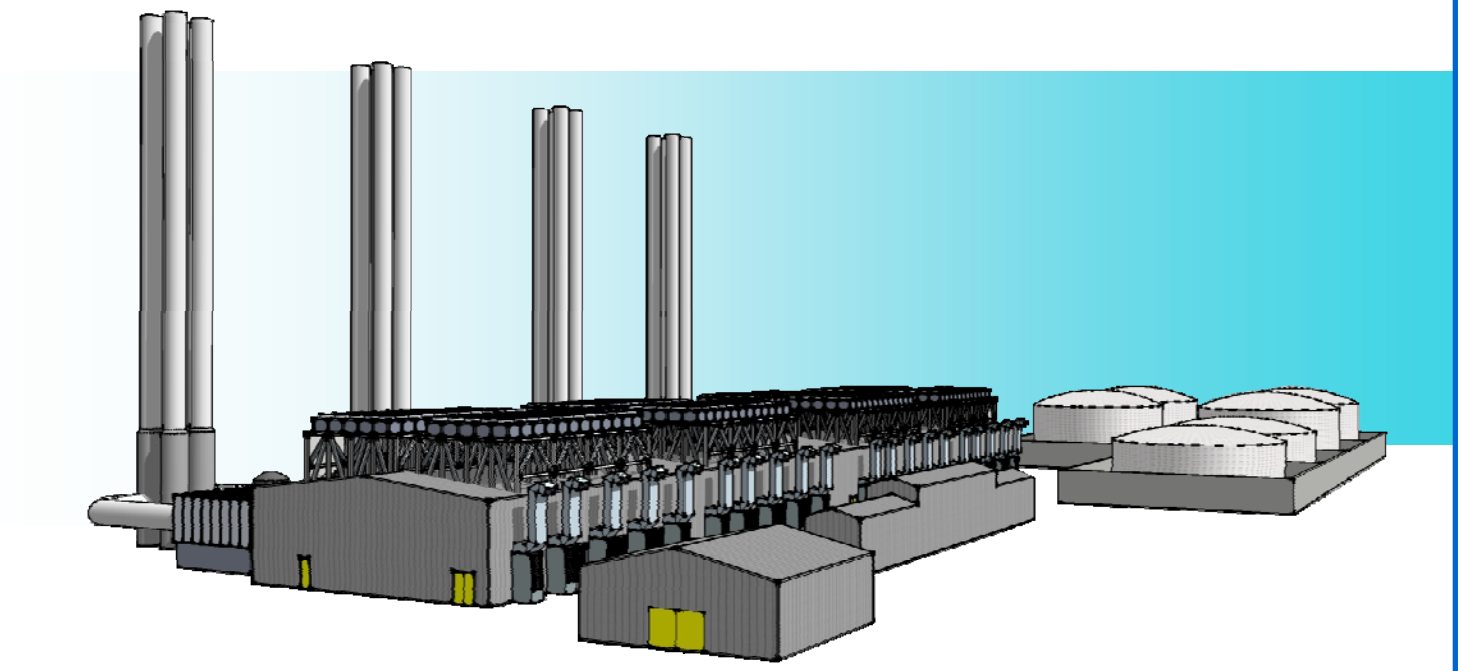
AES Baltic Holdings B.V.

Mitsui & Company Limited

AES Levant Holding BV Jordan PSC

IPP4 Al-Manakher Power Project



ENVIRONMENTAL STATEMENT

Prepared by

PARSONS BRINCKERHOFF

May 2012

In association with

الجمعية العلمية الملكية
Royal Scientific Society

IPP4 Al-Manakher Power Project
Environmental Statement

Prepared for
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CONTENTS

LIST OF ABBREVIATIONS

ACC	Air cooled condenser
ACES	Arab Centre for Engineering Studies
AERMOD	American Meteorology Society/Environmental Protection Agency Meteorology Processor
BAT	Best Available Techniques
Bgl	below ground level
BRef	BAT reference
BS	British Standard
CEMP	Construction Environmental Management Plan
CCGT	Combined Cycle Gas Turbine
CD ROM	Compact Disk Read Only Memory
°C	Degrees Celsius
Co	Company
CO	Carbon Monoxide
CO_2	Carbon Dioxide
dB	Decibel
DC	Direct Current
DCS	Distributed Control System
DFO	distillate fuel oil
DLN	Dry low NOx
DoA	Department of Antiquities
EC	Electrical Conductivity
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
ERC	Electricity Sector Regulatory Commission
EMMP	Environmental Mitigation and Monitoring Programme
EMS	Environmental Management System
EPC	Engineer Procure Contract
EU	European Union
ES	Environmental Statement
FGD	Flue gas desulphurization
g	grams
GDP	Gross Domestic Product
1996 GEL	1996 General Electricity Law
1999 GEL	1999 General Electricity Law
2002 GEl	2002 General Electricity Law
GW	Gigawatt
GWh	Gigawatt hour
HCl	hydrochloric acid
H_2S	Hydrogen Sulphide
HHV	Higher Heating Value
HRSG	heat recovery steam generator

HFO	heavy fuel oil
hr	Hour
HSE	Health, Safety and Environment
Hz	Hertz
IFC	International Finance Corporation
IOA	Institute of Acoustics
IPP	Independent Power Producers
ISO	International Organisation for Standardisation
IT	Information Technology
JBIC	Japan Bank of International Cooperation
JD	Jordanian Dollars
J/g	joules per gram
JS	Jordanian Standards
K	degrees Kelvin
kg	kilograms
km	kilometre
kV	kilovolt
LCV	lower calorific value
LNG	liquefied natural gas
m	metre
mm	Millimetres
m^3	metres cubed
MCM	Million Cubic Metres
MEMR	Ministry of Energy and Mineral Resources
MENA	Middle East North Africa
MJ/m^3	Mega Joules per metre cubed
$\mu g/m^3$	microgram per cubic metre
mg/l	milligrams per litre
mg/Nm^3	milligrams per normal cubic metre
m/s	Metres per Second
MoE	Ministry of Environment
mol	mole
MW	Megawatt
MWe	Megawatt electrical
MWth	megawatt thermal
NEPCO	National Electricity Power Company
NGO	Non Governmental organisation
NSR	Noise Sensitive Receptor
NTS	National Transmission System
NO_2	Nitrogen Dioxide
NO_x	oxides of nitrogen
OHS	Operational Health and Safety
OHSMS	Operational Health, Safety and Management System
PB	Parsons Brinckerhoff
PPA	Power Purchase Agreement

PPE	Personal Protective Equipment
PM_{10}	Particulate matter
ppm	parts per million
PPV	Peak Particle Velocity
PS	Performance Standard
QIZ	Qualified Industrial Zone
RSS	Royal Scientific Society
RSCN	Royal Society for Conservation of Nature
SCR	Selective Catalytic Reduction
SO_2	Sulphur Dioxide
SPT	Standard Penetration Test
ToR	Terms of Reference
TSP	Total suspended particulates
TSS	Total Suspended Solids
t/yr	tonnes per year
UK	United Kingdom
w/w	Weight by weight
wt	weight
WAJ	Water Authority of Jordan

NON TECHNICAL SUMMARY

Overview

AES Levant Holding BV Jordan PSC, a project company incorporated in Amman, Jordan proposes to construct a Power Project on the behalf of the Consortium AES Baltic Holdings B.V and Mitsui & Company Ltd near the village of Al-Manakher, approximately 14 km to the east of Amman on a site leased from the Ministry of Finance / Department of Lands and Survey. The Power Project will involve the construction of 16 x 18V50DFtri-fuel compression ignition engines that will be able to fire on heavy fuel oil (HFO), distillate fuel oil (DFO),andnatural gas (when this becomes available). The Power Project will have a nominal output of up to 250 MWe at specified site rated conditions.

The Power Project site is located adjacent to the existing AES Amman East Combined Cycle Gas Turbine (CCGT) Power Plant, referred to as IPP1.

The Power Project will be used to rapidly assist in meeting temporary generating demands or to maintain the stability of the National Transmission System (NTS) in the event that there is a sudden drop in the power delivered to the system (e.g. a forced power plant outage). The Power Project may also be required to operate in order to maintain the electrical stability of the supply in terms of voltage control and frequency regulation. As such, the anticipated operating regime of the Power Project will be peaking to provide short-term support to the NTS.

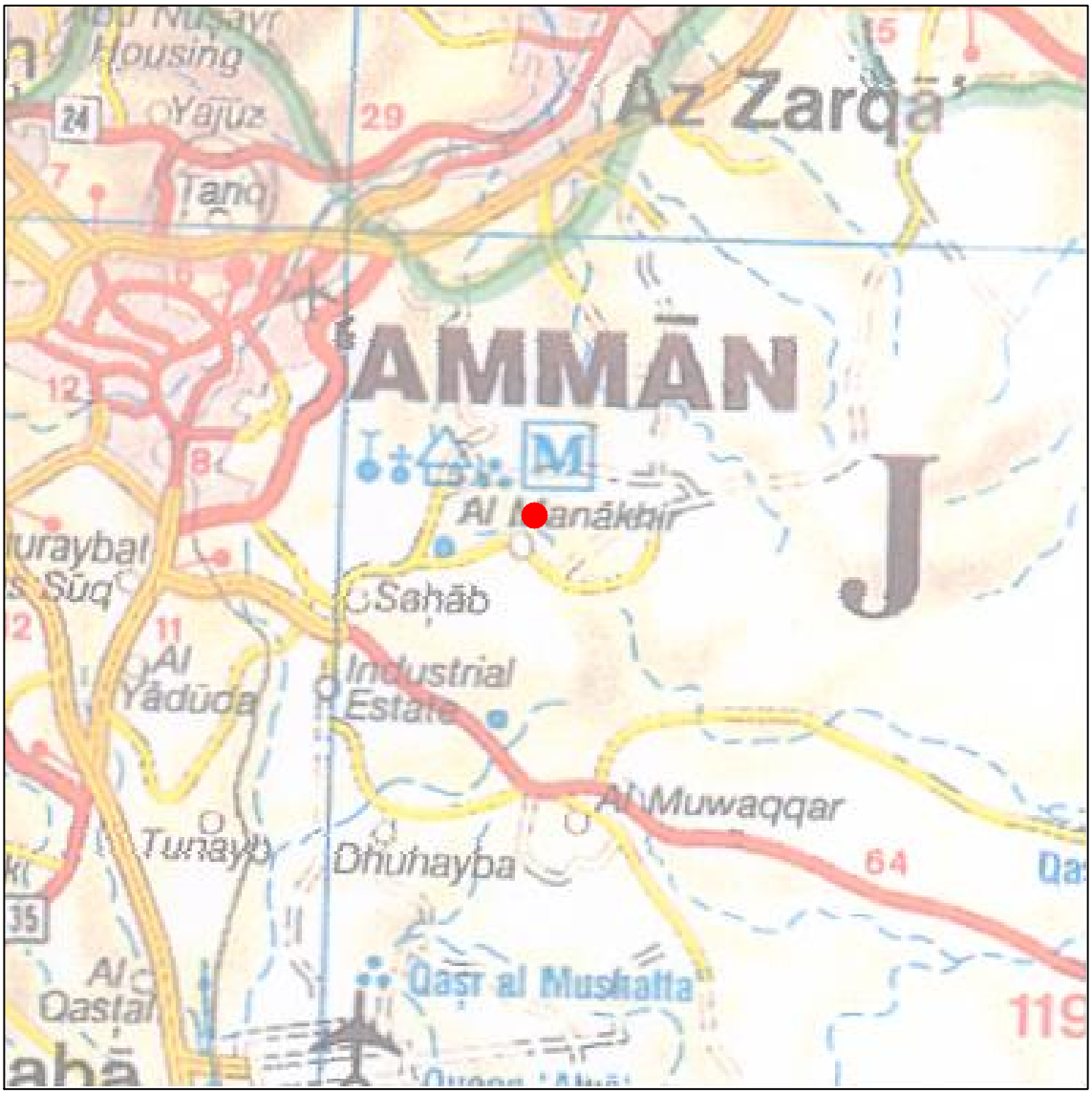
Developer

The project company AES Levant Holding BV Jordan PSC shall develop the Power Project on the behalf of the Consortium AES Baltic Holdings B.V and Mitsui & Company Ltd.

The Site

The Power Project site is located near the village of Al-Manakher, approximately 14 km to the east of Amman on a site leased from the Ministry of Finance / Department of Lands and Survey. The Power Project will involve the construction of a 16 x 18V50DFtri-fuel compression ignition engine power plant that will be able to fire on HFO, DFO and natural gas (when this becomes available). The Power Project will have a nominal output of upto250 MWeat specified site rated conditions. The site location is shown in Figure 1.1.

With the exception of the existing IPP1, there are no other industrial plants in the immediate vicinity of the Power Project site. The majority of the surrounding land is either farmed (for cereal crops) or unused. There are several houses in the vicinity of the plant which are part of Al-Manakher Village, which can be seen from the aerial photograph shown in Figure 1.2.



SITE LOCATION

PARSONS BRINCKERHOFF

Amber Court
William Armstrong Drive
Newcastle upon Tyne NE4 7YQ
Tel: 44-(0)191-226-2000
Fax: 44-(0)191-226-2104

Client/Project:
IPP4 AL-MANAKHER POWER PROJECT

Title:
SITE LOCATION

Drawn:		Checked:	
Designed:		Approved:	
Date: 09/08/2011	Scale:	A4	Sheet:
Project Number:	Drawing Number:		Revision:
3511309A	FIGURE 1.1		

Login: Donnelly, David Plot Date: 16/08/2011 16:44:31 File Name: K:\Projects\62671 - Amman East IPPZ. Drawings\1. Current\Environmental\FIGURE 1.1.dwg

N
W E
S

Legend

Project Boundary

Point	Cassinin Grid X	Cassinin Grid Y	Latitude DEGREE	Latitude MIN	Latitude SEC	Longitude DEGREE E	Longitude MIN	Longitude SEC
1	252343	145298	31	53	51.49	36	4	50.15
2	252280	145085	31	53	44.59	36	4	47.69
3	252262	145023	31	53	42.59	36	4	46.98
4	252050	145163	31	53	47.19	36	4	38.96
5	252065	145202	31	53	48.45	36	4	39.54
6	251965	145233	31	53	49.48	36	4	35.75
7	251969	145249	31	53	50.00	36	4	35.90
8	251916	145263	31	53	50.47	36	4	33.89
9	251903	145278	31	53	50.96	36	4	33.40
10	251965	145404	31	53	55.03	36	4	35.80

0 50 100 150
Meters

- PROJECT: IPP4 Al-Manakher Power Project
- TITLE: Project Boundary

• DATE	01.07.2011	• DRAWN BY	LS
• SCALE	NTS	• PRODUCED BY	LS
• CAD REF	-------	• CHECKED	MW
		• APPROVED	MW

PB PARSONS BRINCKERHOFF 125 YEARS

Parsons Brinckerhoff
Amber Court, William Armstrong Drive, Newcastle upon Tyne, NE4 7YQ
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• DRAWING NUMBER: FIGURE 1.2

The main Zarqa to Sahab road runs to the north of the Power Project site and is considered to be of a high standard for the area.

The topography of the area is undulating with many small hills and valleys. The Power Project site is fairly elevated in relation to the surrounding area but is afforded some screening by small hills to the south and east.

The geology of the Power Project site is typical of that in the surrounding area consisting of sedimentary rocks and relatively fertile soils. There is no sign of any ground contamination at the Power Project site, and the Power Project site is not known to have been used in the past for any purpose that would likely have lead to contamination of the soils.

The 'Arab Gas Transmission Pipeline' (which provides natural gas from Egypt to Jordan) runs north-south about 1 km to the west of the site.

Adjacent to the Power Project site is the existing National Electricity Power Company (NEPCO) 400 kV and 132 kV substation.

The Power Project site is not located in or near to any Ecologically Designated Areas with the on-site ecology being typical of the area. There are no notable species (of fauna or flora) located within the Power Project site boundary.

There are some protected archaeological sites in the area, but these are located outside a 5 km radius of the Power Project site.

The Proposed Development

The Power Project will consist of 16 generating units with an individual unit rating of 15.83 MW. Each unit will consist of: a compression ignition engine, electricity generator; and dedicated flue.

In each engine, the fuel is injected into cylinders and compressed. The fuel ignites and drives pistons, which power the drive shaft, which rotates the electricity generator. Each engine is cooled by cooling water circulated through the engine block.

Air blast radiators will be used to reject heat from the cooling water systems, and will be installed outside the main engine hall. Air blast radiators work in much the same way as a car radiator (i.e. cooling hot water in a closed circuit cooling system with ambient air blown across the radiator acting as a heat exchanger). Hot air leaves the cooling water system, whilst the cooled water is recirculated.

Each generating unit will be served by a dedicated flue. The flue gases will discharge to the atmosphere through a stack (wind shield) containing four individual flues. The height of the four proposed stacks is 70 m. This height has been determined through the appropriate sensitivity studies undertaken as part of a comprehensive air dispersion modelling study.

Waste heat recovery boilers will be installed to improve efficiency. The exhaust gases leaving the engines will be used to generate steam in waste heat recovery boilers. This steam is then used for fuel pre-heating. Following fuel pre-heating the steam is condensed, producing condensate which is then re-used in the waste heat recovery boilers.

An emergency / 'black-start' diesel generator will be installed to provide emergency back-up and enable the Power Project to be shut down in a safe manner in the event of loss of electricity and self start the plant should this be required. The remainder of the Power Project will consist of air compressing equipment, storage facilities, control equipment and electrical switchgear. In addition, the Power Project will include support facilities such as: administration buildings; warehouses; workshops; fuel delivery and back-up fuel storage facilities; main and plant transformers; plant switch gear; and, metering required. Also included will be all necessary site infrastructure, such as roads.

The thermal input of the Power Project will be of the order of 568 MWth, and the Power Project will operate at a typical net efficiency of approximately 44 per cent.

During normal operation, the Power Project will fire on HFO, DFO and natural gas when it becomes available. HFO and DFO will be brought to the Power Project site by road tankers and unloaded at a

dedicated unloading station. NEPCO will be responsible for the fuel until delivered to site. In the event the given specification of fuel can be sourced in country then it shall be sourced locally and delivered to site from the Jordanian Petroleum Refinery. If this is not possible, fuels will be imported into Aqaba and delivered by road to the Project site via the Aqaba Back Road, Primary Trunk Road (No.15) and the new Amman Ring Road. The new Amman Ring Road is anticipated to be in operation at the time of Project commissioning.

The Power Project may also fire on natural gas but this will be dependant on when the natural gas becomes available to the site. A Gas Metering Facility will be located on the IPP4 site to which natural gas will be supplied when it becomes available. The pipeline providing this gas supply will tee into the flange connection of the existing pipeline supplying IPP1 outside the boundary of IPP1.The natural gas will be supplied at a pressure in the range of 25 to 65 bar(g). There will be no gas storage tanks on the Power Project site

The generating units chosen for the Power Project will be equipped with proven pollution control technology which will limit the production of nitrogen oxides (NO_x) to a maximum of 740 mg/Nm^3 during oil firing. Selective Catalytic Reduction (SCR) shall be incorporated within the Power Project design in order to control emissions of NO_x to within the relevant regulatory limits as necessary.

The production of sulphur dioxide (SO_2) is directly related to the sulphur content of the fuel. The Fuel Supply Contracts will specify a sulphur content for HFO of less than 1 per cent w/w and the sulphur content of DFO is typically low at less than 0.9 per cent weight by weight (w/w). The combustion of natural gas does not result in the emissions of significant levels of SO_2 or particulate matter (PM) associated with burning fuel oil.

All water required by the Power Project will be provided by the Water Authority of Jordan (WAJ) and Miyahuna through a connection point just outside the boundary of the existing IPP1 site.

The electrical output from the Power Project will be transformed and transmitted to the existing 132 kV NEPCO substation to the north of the Power Project site via a 132 kV underground cable.

The Power Project will operate within relevant Jordanian Law, Standards and Regulations as well as World Bank / International Finance Cooperation (IFC) Performance Standards and Guidelines.

The construction workforce will likely peak at approximately 1 000 personnel, with an average of between 600 to 700 personnel. The permanent operational personnel for the Power Project will be of the order of 40.

The Power Project will be designed to have an expected operational life of 30 years, although it could potentially continue generation beyond this. Maintenance of the Power Project shall be scheduled as per manufacturer's recommendations. The Civil Infrastructure, on-site roads etc will be designed to have a minimum working life of 30 years.

Public Consultation

The Consortium has undertaken additional Public Consultation to allow members of the general public to become better acquainted with regards to the Power Project.

The public consultation process allowed for the discussion of the Power Project directly between members of the ESIA Project Team and members of the local community (principally residents of the village of Al-Manakher). Al-Manakher Village was selected as the most appropriate location for the public consultation as it represents the nearest community to the Power Project site and, as a result, its residents will be most affected. Al-Manakher is a small village with a population of approximately 436 people who depend mainly on governmental jobs and agricultural activities for their livelihoods.

The public consultation process was conducted by two methods.

1. House to house meetings with local people to explain the nature of the Power Project and its expected impacts and benefits.
2. Public meeting in Al-Manakher Village as part of the scoping process.

House to House Meetings

A sample of 15 houses out of approximately 35 houses (approximate number of Al-Manakher village houses) was obtained. 20 per cent of the interviewed residents were women.

Based on the results and analysis from the house to house meetings, the issues and concerns are summarised as follows:

- Negative Concerns:
  - Dust emissions and noise during construction and operation of the Power Project which may negatively affect residents and their health.
  - Home cracks from construction and operation activities.
  - AES not giving priority of employment to the local community during the construction and operational phases.
  - Reducing the price of the land.
- Positive Issues:
  - The Power Project will attract other industries and businesses to the area.
  - The Power Project will help in raising the living standards for the residents of Al-Manakher Village and the surrounding areas.

Public Meeting

A public meeting was held at Al-Manakher Village on August 4 2010 by the RSS Team and the AES Jordan Team. The meeting aimed to identify the concerns of the residents regarding the Power Project and the associated activities in relation to the major environmental and social aspects.

Approximately 75 people attended the public meeting including the Deputy Parliament of the area, Chairman of Al-Manakher Village and the police station staff of Al-Manakher.

Based on the results and analysis from the public meeting, the main issues and concerns from the existing IPP1 and the Power Project are:

- Decreasing the price of their land.
- Non-expansion of the village as no one wants to buy a land next to a power plant.
- Air pollution, especially when the Power Project uses diesel as a fuel.
- High levels of noise.
- Cracks in their buildings from construction and operation activities.
- Concern from some participants that discharge of treated wastewater outside the Power Project site boundary may cause problems to their livestock.
- There would be no recruitment / employment (for either skilled or unskilled labour) from the local community.
- Dissatisfaction of the contribution provided by the existing IPP1 Project Company to the local community (e.g. the provision of electricity subsidies).

Therefore, based on the outcome of the Public Meeting, and in response to the issues and concerns raised by the participants, the following are the residents' requirements:

- Suitability of site location.
- Addressing and solving the noise problem.
- Stopping discharging the treated wastewater outside the Power Project site boundary.
- Providing the village with water directly from the company water pipeline.

- Supporting the Al-Manakher Village School by building three class rooms for the village girls.
- Purchasing air conditioners and water coolers for the Al-Manakher Village Mosque.
- Providing recruitment / employment opportunities for the local community.

Summary

Based on the public consultation process, it is considered that most of the Al-Manakher village residents now have a much better understanding of the Power Project, and the environmental and social impacts associated with the construction, operation and decommissioning phases.

In order to continue the good relationship established with the local community, the Consortium have nominated one of their local employees to act as a direct point of contact with the local community. It is hoped that this will afford the local community easy access to Consortium management to raise any concerns.

Furthermore, it is considered that the measures outlined in the Environmental Mitigation and Monitoring Programme (EMMP) in this Environmental Statement (ES) should be sufficient to mitigate the impacts identified.

Air Quality

The construction impacts would potentially comprise emissions of dust and emissions during commissioning. Due to the distance from the Power Project site to the nearest receptor dust impacts are not expected to noticeable. Emissions during commissioning will be of short duration and low mass; the impact will therefore not be significant.

The predicted short-term process contributions from the Power Project are well within the World Bank / IFC Guidelines for ambient air quality concentrations of NO_2, SO_2, CO and PM_{10}/$PM_{2.5}$. The process contributions of Total Suspended Particulates (TSP), Hydrogen Sulphide (H_2S) and unburned hydrocarbons from the Power Project are negligible. It is considered that the impact of the Power Project will be insignificant both in isolation and in conjunction with the existing IPP1.

Water Quality

The discharge of any effluents during construction, including site drainage, will be the responsibility of the Construction Contractor, who will be required by the Consortium to dispose of any construction effluents in a responsible manner. Standard good working practices should ensure that any impacts due to the water discharging from the site would be insignificant.

During operation the water will be supplied from the WAJ water supply and there will be no abstraction from local water courses. There may be from time to time discharge of treated water to the wadi to the north-west of the site from the on-site collection pond.

The Power Project will comply with all relevant Jordanian Standards and World Bank / IFC Guidance with regard to water discharge, use and quality.

The environmental impact of the Power Project on water resources is not considered to be significant.

Geology, Soils and Wastes

The environmental impact of the Power Project to geology is not considered to be significant.

As the Power Project site has not been used for industrial purposes in the past, the likelihood of encountering significant soil contamination during the construction works will be negligible. As such, the potential of exposing any significant soil contamination to the human / natural environment will be negligible.

Throughout the construction, operation and decommissioning of the Power Project, the Consortium will ensure that emission to soils / ground waters are negligible. This will be achieved though good engineering practises which will ensure that the Power Project has and insignificant impact to these receptors.

Noise and Vibration

During construction mitigation measures will be implemented to reduce noise levels to an acceptable threshold wherever possible.

The impact of predicted operational noise has been assessed for the Power Project against background noise levels obtained during the attended noise survey. It is predicted that the noise impact at all Power Project boundary locations meet the noise requirements for the Power Project.

Predicted operational noise levels at two noise sensitive receptor locations at best case will be 0.2 dBA above the existing background noise level recorded at receptors 12 and 13 but a worst case of 1 dBA above the existing background noise level depending on final site layout and mitigation measures available to the EPC contractor at the time of construction.

Where predicted noise changes as a result of the introduction of IPP4 are of the order of, up to, 1 dBA above the existing background noise level, this is still considered to be an insignificant impact. This is because the noise modelling has been undertaken in accordance with ISO9613-2, which has a stated accuracy between 100 and 1000m of +/- 3 dB. Also, as noise changes of 1 dB are not perceptible by humans, there is no demonstrable environmental impact associated with a noise increase of 1 dB. World Bank /IFC Guidelines also allow for an increase of up to 3dBA above the existing background levels. Even at the worst case, IPP4 will operate well within this limit.

Landscape and Visual

The architectural design of the Power Project (and its associated plant, buildings and enclosures) will be carefully considered to provide a high standard of visual amenity.

Wherever appropriate, planting / landscaping will be undertaken to provide additional screening.

The landscape and visual impact of the Power Project is considered to be insignificant.

Transport and Infrastructure

NEPCO will be responsible for the fuel until delivered to site. It is considered that the Power Project will have an insignificant impact to local traffic and infrastructure due to the good standard of the existing road network and the proposed mitigation measures and monitoring programmes for all phases of the Power Project.

Socio-Economics and Land Use

During the construction period it is expected that the Power Project will enhance business prosperity in Al-Manakher Village, where the construction personnel will represent a new purchase power to be injected into the local market.

The Power Project does not involve the resettlement of indigenous peoples / the removal of land from ownership of individuals used for crops.

During operation, the Power Project is expected to create permanent and temporary jobs for both skilled and non-skilled workers.

It is also anticipated that priority will be given to Local Contractors to provide construction personnel with suitable transport / other services on a competitive rates basis.

The concerns of the participants at the Scoping Meeting and Public Consultation Event have been identified.

The provision of additional electricity generation / supply to the country as a whole has an overall positive impact on the socio-economic conditions of Jordan.

Operation of the Power Project will be vital to avoid supply disruptions and to secure the needed power. This is of utmost importance for economic growth in Jordan.

Through the existing IPP1, AES have supported the local community by providing the following services:

- Purchasing new computers for the Al-Manakher Village School;
- Purchasing new printer and photo-copier for the Al-Manakher Village School;
- Giving awards to outstanding students; and,
- Giving a yearly support to the value of 5000 JD.

In addition, AES support the local community by lighting one of the village streets and by giving material support to the poorer families

AES will continue to support the local community in the form of various schemes deemed to be appropriate. .

Ecology and Biodiversity

From the ecology and biodiversity assessment undertaken it can be concluded that whist the construction of the Power Project would result in the destruction of all or much of the existing habitat on-site, the on-site habitat does not represent a source of any notable fauna or flora when considered in the context of the surrounding area.

Mitigation measures have been outlined that should ensure that the construction, operation and decommissioning of the Power Project will have an insignificant impact to ecology and biodiversity in the area.

Cultural Heritage / Archaeology

The Power Project will not impact on any known archaeological sites, and is outside 1 km of any sites protected by the Jordanian Archaeology Law.

In addition, as the Power Project will not damage any known archaeological remains.

As required, a site walk over has been undertaken by a competent archaeologist. This has confirmed that no visible surface archaeology exists at the site.

Despite the absence of evidence for any archaeology within the vicinity of the Power Project site, there is a small (but unlikely) potential (during the construction phase) to impact on sub-surface archaeology yet to be identified. In this event, the Department of Antiques (DOA) is to be invited to assess the discovered archaeological antiquities / sites and may carry out emergency excavation salvage.

Health and Safety

The Consortium plans to implement the mitigation measures and monitoring programmes outlined in this ES and the EMMP.

Therefore the Power Project will comply fully with all relevant health and safety requirements (with regard to construction personnel, operational personnel and members of the general public) of the relevant Jordanian Legislation, as well as the requirements of the World Bank / IFC.

Cumulative Impact

The cumulative impacts resulting from the Power Project and the existing IPP1 Power Station will not be significant. Additionally, in the case of socio-economic conditions for the local population, the cumulative effect of both projects is considered to be beneficial. The existing high standards of management currently employed at the IPP1 Power Station and the mitigation measures which will be introduced as an integral part of the Power Project will further ensure that there are no adverse cumulative impacts.

SECTION 1

INTRODUCTION

1 INTRODUCTION

1.1 The Power Project

1.1.1 The Power Project will involve the construction of 16 x18V50DF tri-fuel compression ignition engines that will be able to fire on heavy fuel oil (HFO), distillate fuel oil (DFO) and natural gas (when this becomes available) with a nominal output of up to250 MWe at specified site rated conditions.

1.1.2 The Power Project site is located adjacent to the existing AES Amman East Combined Cycle Gas Turbine (CCGT) Power Plant, referred to as IPP1.

1.1.3 The Power Project will be used to rapidly assist in meeting temporary generating demands or to maintain the stability of the National Transmission System (NTS) in the event that there is a sudden drop in the power delivered to the system (e.g. a forced power plant outage). The Power Project may also be required to operate in order to maintain the electrical stability of the supply in terms of voltage control and frequency regulation. As such, the anticipated operating regime of the Power Project will be peaking to provide short-term support to the NTS.

1.2 The Developer

1.2.1 AES Levant Holding BV Jordan PSCshall develop the project on the behalf of the AES Baltic Holdings B.V and Mitsui & Company Ltd. Consortium.

1.3 Environmental and Social Impact Assessment

1.3.1 Parsons Brinckerhoff (PB), assisted by the Royal Scientific Society (RSS), have undertaken an Environmental and Social Impact Assessment (ESIA) for the Power Project to determine the impact that the construction, operation and where possible decommissioning will have on the receiving environment. The results of the ESIA are reported in this Environmental Statement (ES).

1.3.2 The Power Project is considered to be a “Category B” project under the Equator Principles, requiring a full ESIA to be undertaken to assess the Power Project’s impact to the natural and human environment. The Power Project is, therefore regarded as a “Category B” project with the potential for limited adverse social or environmental impacts that can be addressed through mitigation. It should be noted that there is no difference between the ESIA requirements for either “Category A” or “Category B” projects and this ESIA is considered to, whilst applying to a “Category B” project, provide a level of detail suitable for “Category A” projects, in full accordance with the applicable Equator Principles.

1.3.3 ES Investigations undertaken for this Power Project demonstrate compliance with the Equator Principles; resultant mitigation measures are included throughout this ES and assembled collectively in the associated EMMP for construction, operation and decommissioning phases. The EMMP has been prepared in accordance with Equator Principle 4: Action Plan and Management System; it should be noted that this requirement applies for either “Category A” or “Category B” projects and that the level of detail is commensurate with the project’s potential impacts and risks identified by the results of this ESIA.

1.3.4 A detailed scoping and consultation exercise has previously been undertaken to identify the potential environmental issues associated with the construction, operation and decommissioning of the Power Project and how these should be addressed. This study also established the relevant Jordanian Law, Standards and Regulations and

the World Bank /International Finance Corporation (IFC) Performance Standards and Guidance.

Scoping Meeting and Terms of Reference Report

1.3.5 A scoping meeting and Terms of Reference (ToR) report was prepared by PB and RSS for the Power Project in August 2011. The ToR described the scoping meeting undertaken and the key environmental issues that, in PB's opinion, would require detailed evaluation as part of this ESIA process.

1.3.6 The principle objectives of the report were to:

- Present the results of the scoping meeting;
- Identify the key environmental issues to be included in the ESIA;
- Identify the likely legal requirements and framework for the Power Project through the course of its lifetime;
- Identify the relevant component studies to establish the relevant baseline for the Power Project; and
- To finalize the proposed ToR.

1.3.7 A formal scoping session was held on the 31st August 2011 at the Holiday Inn, Amman on the request of the Ministry of Environment (MoE) in accordance with MoE ESIA Regulation. The MoE invited relevant and potentially relevant stakeholders (including organizations from the public and private sectors in addition to NGO's and neighbouring residents) to this scoping session.

1.3.8 A registration form showing the list of the participants at this event is provided in Appendix A.

1.3.9 As part of the scoping session, members of the ESIA Team gave a presentation detailing the activities, facilities, and processes for the Power Project. Graphics and diagrams were included in the presentation. These highlighted the importance of the Power Project and the need to identify potential interactions between the Power Project activities and the receiving environment.

1.3.10 The participants were provided with a comments form to detail their concerns regarding the Power Project (if any), and sufficient time was allowed for any comments to be noted. A summary of the concerns raised in included in Section 6 (Socio-economics).

1.3.11 A public meeting was held at Al-Manakher village on August 4 2011 by the RSS Team and the AES Jordan Team. The meeting formed part of the scoping process and aimed to identifying the concerns of the residents regarding the Power Project and the associated activities in relation to the major environmental and social aspects. A list of the participants that attended the public meeting are provided in Appendix B.

The ESIA

1.3.12 The ESIA has comprised a comprehensive study of the baseline environmental conditions of the Power Project location, the predicted impact of the Power Project and the mitigation measures necessary to protect the environment from the impacts of the Power Project.

1.3.13 The ESIA has included:

- Screening Stage (which concluded that a full ESIA was required to satisfy the MoE and the World Bank / IFC requirements);
- Scoping Stage (described above, to allow interested and affected parties to participate in the ESIA process and allow their concerns relating to the Power Project to inform the ESIA process);
- Collection of Baseline Data Stage (against which the environmental impacts of the Power Project can be assessed);
- ESIA Stage (to determine the impact of the Power Project on the receiving environment);
- Identification of Mitigation and Monitoring of Impacts, where appropriate (this includes the preparation of an Environmental Mitigation and Monitoring Programme (EMMP) for the Power Project); and
- Summary of the above in an Environmental Statement (ES) for consideration by the relevant Jordanian Ministries and World Bank / IFC.

1.3.14 Accordingly, the findings of the ESIA have been reported in this ES.

The Environmental Statement

1.3.15 This ES summarizes the findings of the Environmental and Social Impact Assessment ESIA studies undertaken for the Power Project. The structure of the ES is as follows:

Non Technical Summary

Section 1	-	Introduction
Section 2	-	Policy and Administrative Framework
Section 3	-	Analysis of Alternatives
Section 4	-	Project and Site Description
Section 5	-	Description of Environmental and Social Baseline
Section 6	-	Environmental Impact
Section 7	-	Environmental Mitigation and Monitoring Programme
Section 8	-	Inter Agency, Public and NGO Consultation.
Section 9	-	Conclusion

1.3.16 For each impact considered, the existing environmental baseline has been described and the potential impacts of the construction and operation phases of the Power Project have been discussed. Mitigation measures and monitoring programmes have been proposed where appropriate.

1.3.17 The worst case option has been considered to allow final design flexibility. This ensures that the ES evaluates the alternatives of the greatest potential environmental and social impact.

SECTION 2

POLICY, LEGAL AND ADMINSTRATIVE FRAMEWORK

2 POLICY, LEGAL AND ADMINSTRATIVE FRAMEWORK

2.1 Introduction

2.1.1 The ESIA, and resulting ES, are considered to conform to relevant Jordanian Laws, Regulations and Standards and World Bank / International Finance Cooperation (IFC) Performance Standards and Guidance. The relevant legislation is summarised in this Section.

2.2 Applicable Jordanian Laws, Regulations and Standards

2.2.1 A brief description of the applicable Jordanian Laws, Regulations and Standards are provided below:

Environmental Protection Law (No. 52, 2006)

2.2.2 The proponent should comply with article (3) of this law, which is related to the necessity of preserving the environmental components including atmosphere, water, soil and ecology.

Environmental Impact Assessment (EIA) Regulations (No 37, 2005)

2.2.3 This Regulation states that all industrial projects should conduct an EIA study, the level and type of the EIA study will be decided based on EIA community accommodation. A scoping session is required to prepare the final draft EIA ToR's.

2.2.4 This Regulation also controls the reviewing of the EIA documents. The required period for the EIA review is 45 days.

Ambient Air Quality Standards (JS: 1140, 2005)

2.2.5 This Standard prescribes the ground level concentration limits of a range of pollutants in the ambient air.

Water Authority Law (No. 18, 1988)

2.2.6 This Law is related to prohibiting pollution of any source of water resources under the supervision control of the water authority directly or indirectly.

Underground Water Monitoring By-law (No. 85, 2002)

2.2.7 It is compulsory to follow article (51) of this by-law related to the appearance of underground water. The proponent should inform the general secretariat in a period of time not exceeding 7 days from the appearance date.

Instruction for Management and Handing of Consumed Oil for 2003

2.2.8 This instruction applies to all those directly or indirectly involved in the management and handling stages of oil.

Jordanian Guidelines for Prevention of Noise (2003)

2.2.9 This Guideline outlines the highest permissible noise levels during the day and night for different areas of classification.

Management of Solid Waste Regulations (No. 27, 2005)

2.2.10 This legislation is concerned with the protection of human health and the environment by the recycling or treatment of solid waste. This includes increasing the management of the waste, minimisation of the effect of dumping sites and providing suitable solutions for the problems of managing solid waste.

Dimensions, Total Weights and Vehicles' Engine Horse Power By-law issued in accordance with Paragraph (a) from Article (19) and Article (64) from the Traffic Law (No. 49, 2008)

2.2.11 Vehicles transporting material to and from the site will need to comply with article (2) of this by-law related to vehicle dimension and the allowable limit for load protrusion from the vehicle.

2.2.12 Consideration will also need to be given to article (4) off this by-law which defines the vehicle's total weight in order to preserve the integrity of the streets. In worst cases the load should not exceed that stated in article (7) of this law. It is necessary to obtain permission from the Housing and Public Works Minister if loads exceed the limits.

Agriculture Law (No. 44, 2002)

2.2.13 Article (32) of this Law prohibits the trespass onto woodlands or its boarder marks, by dumping solid and liquid wastes or any other environmental colouring materials.

Labor Law (No. 8, 1996);

2.2.14 The key issue of this Law is the working hours, consequently the project should comply with the working hours stated by article (56) paragraphs (a) & (b) regarding the right of the labor not to work more than eight hours per day, as well as, the proponent should comply with article (73) of this law, that ban employment of the under-aged, whom are less than 16 years.

2.2.15 The Law also outlines that the proponent should comply with article (78) related to occupational health and safety, where the proponent should provide essential precautions and arrangements to protect the workers from the risk of hazards and supply them with Personal Protective Equipments (PPE).

Archaeology Law (No. 21, 1988)

2.2.16 This Law specifically outlines the excavation process in site preparation and outlines that projects need to comply with article (3) which bans excavation within a distance less than 1 km from archaeological location. This Law also requires a project location to be free from any archaeological materials, before any excavations, in order to avoid any penalty defined by this law.

Instructions for Hazardous Waste Management and Handling for 2003

2.2.17 This instruction provides definition for transport, treatment and storage of hazardous waste. Article No. (4) identifies the procedures for collection and storage of harmful waste and packaging , also Article No. (5) item three specifies the specifications for the transportation instrument and provides methods for handling and storage of hazardous waste.

Management, Transport and Handling of Harmful and Hazardous Substances Regulations (No. 24, 2005);

2.2.18 This Regulation outlines the requirements concerned with the management, transport and handling of harmful and hazardous substances.

Civil Defence Law (No. 35, 1999);

2.2.19 Article No (13) paragraph (z) and article No. (14) states that it is the duty of the general directory to define the preventive measures and the personal protective equipments prerequisites toward permission for manufacturing, storing and selling chemicals, hazardous material and others. Therefore, the proponent should coordinate with the civil defence administration for the use and storage of chemical materials.

Public Heath Law (No. 47, 2008)

2.2.20 This Law is concerned with the protection of public health by setting out laws concerned with the disposal of hazardous waste.

General Electricity Law (No. 64, 2002)

2.2.21 This Law clarifies the role and function of the Commission as an independent agency responsible for regulating the power sector in three areas: generation; transmission; and, distribution.

Regulation of the Organisation and Administration of the Ministry of Energy and Mineral Resources (No. 26, 1985)

2.2.22 This Regulation is concerned with the objectives of the Ministry of Energy and Mineral Resources (MEMR). The relevant objective to this project is the management of primary, renewable and electric energy. The MEMR sets tasks to achieve the objectives and those tasks relevant to this project are:

- Provision of a secure electricity supply to meet the country demand;
- Develop the national electricity network to allow for the interchange of energy, internally and to other Arab countries;
- Determine the prices of fuel and its deliverables;
- Set the national quality (standards) for fuel derivatives; and
- Set the general strategy for importing fuel.

2.3 Applicable World Bank / IFC Performance Standards and Guidance

2.3.1 A brief description of the applicable World Bank / IFC Performance Standards (PS) and Guidelines are provided below:

PS 1: Assessment and Management of Environmental and Social Risks and Impacts 2012

2.3.2 PS 1 highlights the importance of managing social and environmental performance throughout the life of a project (defined as any business activity that is subject to assessment and management).

PS 2: Labor and Working Conditions 2012

2.3.3 PS 2 recognises that the pursuit of economic growth through employment creation and income generation should be balanced with the protection of basic rights for workers.

PS 3: Resource Efficiency and Pollution Prevention 2012

2.3.4 PS 3 recognises that increased industrial activity and urbanisation often generate increased levels to air, water and the land that may threaten people and the

environment. The PS outlines a project approach to pollution prevention and abatement taking into account available technologies.

PS 4: Community Health, Safety and Security 2012

2.3.5 PS 4 recognises that projects and infrastructure often bring benefits to communities, but can also have the potential to increase community exposure to risks and impacts resulting from equipment accidents, structural failures and releases of hazardous materials. Therefore this PS addresses the clients responsibility to avoid or minimise risks and impacts to communities.

PS 6: Biodiversity Conservation and Sustainable Management of Living Resources 2012

2.3.6 PS 6 recognises that protecting and conserving biodiversity is fundamental to sustainable development.

PS 8: Cultural Heritage 2012

2.3.7 PS 8 recognises the importance of cultural heritage for current and future generations. It aims to protect irreplaceable cultural heritage and guide clients on protecting cultural heritage in the course of their business operations.

Air Emissions and Ambient Air Quality Guidelines 2007

2.3.8 This Guidance provides information about common techniques for emissions management which may be applied to a range of industry sectors. This Guideline provides an approach to the management of significant sources of emissions, including specific guidance for assessment and monitoring of impacts. It is also intended to provide additional information on approaches to emissions management in projects located in areas of poor air quality, where it may be necessary to establish project-specific emissions standards

Wastewater and Ambient Water Quality Guidelines 2007

2.3.9 This Guidance provides common techniques on wastewater management, water conservation, and reuse that can be applied to a wide range of industry sectors. Projects with the potential to generate process wastewater, sanitary (domestic) sewage, or stormwater should incorporate the necessary precautions to avoid, minimize, and control adverse impacts to human health, safety, or the environment.

Water Conservation Guidelines 2007

2.3.10 This Guidance states that water conservation programs should be implemented commensurate with the magnitude and cost of water use. These programs should promote the continuous reduction in water consumption and achieve savings in the water pumping, treatment and disposal costs.

Waste Management Guidelines 2007

2.3.11 These Guidelines apply to projects that generate, store, or handle any quantity of waste across a range of industry sectors. They specify what can be done in terms of waste minimisation and safe disposal of waste.

Noise Guidelines 2007

2.3.12 This Guidance addresses impacts of noise beyond the property boundary of the project and facilities and how these can be mitigated.

Community Health and Safety Guidelines 2007

2.3.13 These Guidelines address some aspects of project activities taking place outside of the traditional project boundaries, but nonetheless related to the project operations, as may be applicable on a project basis. These issues may arise at any stage of a

project life cycle and can have an impact beyond the life of the project. They cover a range of aspects including Water Quality, Structural Safety of Project Infrastructure, Life and Fire Safety, Traffic Safety, Transport of Hazardous Materials, Disease Prevention and Emergency Preparedness and Response.

Construction and Decommissioning Guidelines 2007

2.3.14 These Guidelines provide additional, specific guidance on prevention and control of community health and safety impacts that may occur during new project development, at the end of the project life-cycle, or due to expansion or modification of existing project facilities. A number of sub-sections are included in the guidelines which deal with Environment, Occupational Health and Safety and Community Health and Safety.

Thermal Power Plant Guidelines 2008

2.3.15 These Guidelines include information relevant to combustion processes fuelled by gaseous, liquid and solid fossil fuels and biomass and designed to deliver electrical or mechanical power, steam, heat, or any combination of these, regardless of the fuel type (except for solid waste which is covered under a separate Guideline for Waste Management Facilities), with a total rated heat input capacity above 50 Megawatt thermal input (MWth) on a Higher Heating Value (HHV) basis.

2.4 Energy Sector Administrative Framework

2.4.1 The Government of the Hashemite Kingdom of Jordan has established a number of objectives to facilitate the development of the national power sector. These objectives include:

- Provision of a secure electricity supply to meet the country's domestic internal demand;
- Generate sufficient amounts of electricity to allow the Kingdom to export electricity to other countries in the region;
- Develop the national electricity network to allow for the interchange of energy, internally and to neighbours in the region; and
- Attracting of private investment (domestic and foreign) to the Jordanian power sector.

2.4.2 The Government has a particular interest in attracting foreign investment to Jordan. To this end, the Government has passed legislation and is implementing policy initiatives to continue to encourage this investment. The Government wants to introduce Independent Power Producers (IPP) to Jordan, and it is particularly interested in participating (via such IPPs and interconnection to neighbouring national girds) in the development of a regional power market. Jordan offers the region a favourable geographic location, a well developed and efficient infrastructure, political and economic stability, and a quality human resource base with a solid commercial orientation that makes it suitable to offer this service.

2.4.3 To support these specific policy objectives, the Government has adopted a strategy for the development of the power sector. This strategy envisages greater participation by the private sector. As part of the strategy, the Government has decided that all new generation capacity will be installed, owned, and operated by the private sector. This new capacity will be procured through an international competitive tendering process. Specifically, the Government has recently taken measures to commercialize the power sector, increase competitiveness within the sector, and improve the environment for private sector investment.

2.4.4 The electricity sector within Jordan has been undergoing a continuous process of reform since as early as 1996. In September 1996, the Government of Jordan enacted Law No. (10) of 1996, the General Electricity Law ("1996 GEL"). Under the 1996 GEL, the Government took its first step in privatizing the national electricity industry by converting the Jordan Electricity Authority to a public shareholding company called the National Electric Power Company (NEPCO). The 1996 GEL also provided for the issuance of licenses for the generation of electricity to private companies. Such licenses were to be issued by the Council of Ministers.

2.4.5 In 1999, the 1996 GEL was amended and replaced by the General Electricity Law No. (13) ("1999 GEL"). One of the principal features of the 1999 GEL was the establishment of the Electricity Sector Regulatory Commission ("Commission" or "ERC"). The Commission was charged with the responsibility for issuing licenses to companies for the generation, transmission and distribution of electricity. This law also envisaged the issuance of licenses to developers of electric power stations planned for capacity in excess of 5 MWe through a competitive tendering process.

2.4.6 The Government of Jordan has taken steps to enact a new electricity law. This is the General Electricity Law for the Year 2002 (2002 GEL), and this clarifies the role and function of the Commission as an independent agency responsible for regulating the power sector in three areas: generation; transmission; and, distribution. Although the 2002 GEL envisages issuance of licenses for generation of electricity pursuant to applications to the Commission, initial IPPs will be granted licenses pursuant to the Applicable License Form and the Electricity Companies Licensing By-Law and the terms of the concession (or implementation) agreement entered into with the Ministry of Energy and Mineral Resources. It is under this Statutory Regime that the IPPs in Jordan have been established, including this Power Project which will be the fourth IPP.

2.4.7 AES Baltic Holdings B.V, and Mitsui & Company Ltd were awarded, and have become, the successful Project Sponsor in 2012. The Project Company AES Levent Holding BV Jordan PSC has been incorporated in Jordan and will construct, own, and operate the Power Project throughout the Term of the Power Purchase Agreement (PPA), and will pay taxes and fees as may be required. AES Levant Holding BV Jordan PSC will mobilize the project via financing sufficient to develop and construct the Power Project, using both equity and debt resources. Debt fundingis is sought from the Overseas Private Investment Corporation (OPIC).

2.5 Institutional Framework and Mandate

2.5.1 A summary of responsibilities of Governmental Authorities is outlined below and in Table 2.1.

TABLE 2.1: SUMMARY OF RESPONSIBILITIES OF SOME RELEVANT REGULATORY AUTHORITIES

Authority	*Responsibility*
Ministry of Environment	Permitting prior to operation (ESIA is required). Inspection during operation.
Ministry of Labour	Permitting prior to operation (after occupational health and safety measures). Inspection during operation.
Water Authority	Permitting prior to construction (identification of intersection with water piping distribution system). Supplying water needs for hydraulic test.
Department of Antiquities	Permitting in case of existence of Archaeological remains (ESIA would be needed).
Ministry of Energy and Mineral Resources	Responsible for energy sector.
Civil Defences	Approval for construction plans. Permitting prior to operation.
Ministry of Housing and Public Works	Permitting prior to construction
Department of Land and Survey	Permitting prior to construction

2.6 Compliance with Jordanian and World Bank / IFC Performance Standards and Guidance

2.6.1 The Power Project fully complies with relevant Jordanian Laws, Regulations and Standards, and World Bank / IFC Performance Standards and Guidance.

2.6.2 For clarity these are summarized in Table 2.2 and Table 2.3.

TABLE 2.2: COMPLIANCE WITH RELEVANT JORDANIAN LAW, REGULATIONS AND STANDARDS

Jordanian Law / Regulation / Standard	**Compliance / Rational**
Environmental Protection Law (No. 52, 2006)	Power Project Complies: The Power Project will not pose an unacceptable impact to the environment and complies with all relevant Jordanian legislation.
Environmental Impact Assessment Regulations (No. 37, 2005)	Power Project Complies: An Environmental Impact Assessment has been undertaken for the Power Project.
Ambient Air Quality Standards (JS: 1140, 2006)	Power Project Complies: The Power Project will comply with all relevant Jordanian ambient air quality requirements
Water Authority Law (No. 18, 1988) and Underground Water Monitoring By-law (No. 85, 2002)	Power Project Complies: All water will be provided by WAJ with no water taken from other sources. No water will be released to sensitive surface or ground waters.

Jordanian Law / Regulation / Standard	Compliance / Rational
Instruction for Management and Handing of Consumed Oil for 2003	Power Project Complies: The Power Project will handle all waste oils in accordance with the instruction.
Jordanian Guidelines for Prevention of Noise (2003)	Power Project Complies: The Power Project will comply with the criteria of the Guidelines.
Management of Solid Waste Regulations (No. 27, 2005)	Power Project Complies: The Power Project will ensure proper and appropriate handling of waste materials during the construction, operational and decommissioning phases.
Dimensions, Total Weights and Vehicles' Engine Horse Power By-law issued in accordance with Paragraph (a) from Article (19) and Article (64) from the Traffic Law (No. 49, 2008)	Power Project Complies: The Power Project will comply with the requirements of the law.
Agriculture Law (No. 44, 2002)	Power Project Complies: The Power Project will not include the removal of large areas of agricultural land from its current use or impact on these during construction or operation.
Labor Law (No. 8, 1996)	Power Project Complies: The Power Project will operate under the requirements of this law
Archaeology Law (No. 21, 1988)	Power Project Complies: No significant archaeological interests were identified at site.
Instructions for Hazardous Waste Management and Handling for 2003	Power Project Complies: The Power Project will ensure the proper storage and use of any hazardous substances to be used.
Management, Transport and Handling of Harmful and Hazardous Substances Regulations (No. 24, 2005)	Power Project Complies: The Power Project will ensure the proper storage and use of any hazardous substances. All hazardous waste will be transported from site by a licensed Waste Contractor.
Civil Defence Law (No. 35, 1999)	Power Project Complies: The Power Project will not pose a safety hazard to the general public.
Public Heath Law (No. 47, 2008)	Power Project Complies: The Power Project will not pose a health hazard to the general public.
General Electricity Law (No. 64, 2002)	Power Project Complies: The Power Project complies through the role of an IPP.
Regulation of the Organisation and Administration of the Ministry of Energy and Mineral Resources (No. 26, 1985)	Power Project Complies: The Power Project complies by supporting the NTS.

TABLE 2.3: COMPLIANCE WITH IFC PERFORMANCE STANDARDS

IFC Performance Standard	Compliance / Rational
Assessment and Management of Environmental and Social Risks and Impacts	Power Project Complies: An environmental assessment, and Environmental Mitigation and Monitoring Programme (EMMP) has been prepared for the Power Project.
Labor and Working Conditions	Power Project Complies: No person will be harmfully or unwilling employed by the Sponsor.
Resource Efficiency and Pollution Prevention	Power Project Complies: The Power Project has considered technologies and practices (techniques) to reduce adverse impacts on human health and the environment while remaining technically and financially feasible and cost-effective.
Community Health, Safety and Security	Power Project Complies: Preventative measures have been employed in the Power Project design to ensure community, health, safety and security.
Biodiversity Conservation and Sustainable management of Living Resources	Power Project Complies: The Power Project will not impact significantly on local habitats.
Cultural Heritage	Power Project Complies: No historic or culturally significant features were identified on the Power Project site.

2.7 Environmental Reporting

2.7.1 The Power Project will report on environmental performance during the construction and operational phases.

2.7.2 This will include annual reports to the Banks and bi-annual reports to the MoE.

2.8 Conclusion

2.8.1 Following a full ESIA, the Power Project has been identified as being fully compliant with relevant Jordanian Law, Standards and Regulations and the requirements of the World Bank / IFC Performance Standards and Guidance.

2.8.2 The remainder of this ES summarizes the ESIA undertaken that underpins this conclusion.

SECTION 3

ANALYSIS OF ALTERNATIVES

3 ANALYSIS OF ALTERNATIVES

3.1 Identification of the Need for Additional Power Generation in Jordan

3.1.1 The Power Project is to be constructed to help meet the rising electricity demand in Jordan.

3.1.2 From the 15 Year Electricity Master Plan issued by the Electricity Regulatory Commission of Jordan, the electricity demand is expected to rise from its current level of about 9368 GWh to 15422 GWh in 2020 (assuming a nationwide low case).

3.1.3 This will require an increase in power generation capacity in Jordan of 1029 MW (i.e. from 1326 MW to 2355 MW).

3.1.4 The location of the Power Project, close to the centre of the electricity demand in Jordan, will help Jordan to generate electricity in a manner that will minimize the transmission losses associated with long transmission lines.

3.2 Selection of the Site

3.2.1 The Power Project site has been selected by the MEMR as being potentially suitable to house the development of a Power Project with a nominal output upto 250 MWe.

3.2.2 There are many advantages of the Power Project site that make it an ideal location for power generation. These include amongst others:

- An existing transport infrastructure in the form of the Zarqa to Sahab road that will readily accommodate construction traffic;
- Availability of sufficient land to house the Power Project;
- The close proximity to an electrical connection (i.e. the existing 132 kV NEPCO substation to the north of the site);
- The close proximity to a gas connection (i.e. the existing NEPCO Metering Facility on the IPP1 site);
- Proximity to centre of electricity demand in Jordan in the form of Amman which located approximately 14 km to the west; and
- A site removed from highly populated areas.

3.2.3 It is considered that the IPP4 Al-Manakher Power Project site is therefore highly suitable for the intended use of power generation.

3.3 Selection of Technology

Overview

3.3.1 The Power Project will involve the construction of a 16 x 18V50DFtri-fuel compression ignition engine power plant that will be able to fire on HFO, DFO and natural gas (when this becomes available). The Power Project will have a nominal output of upto250 MWeat specified site rated conditions to meet the future energy demands of Jordan.

Choice of Plant

3.3.2 There are a number of options available for the generation of up to250 MWe, but the Power Project is considered to represent the most appropriate option for generation of the energy required (i.e. providing peaking / support requirements).

3.3.3 In theory, the generation of up to250 MWe of electricity could be generated from a number of other types of generating power plant including:

- Conventional Thermal Power Plant (solid fuels / oil / gas); or,

- Renewable Energy Generating Plant (such as Biomass / Waste to Energy Power Plant / Wind Turbines / Solar Photovoltaic Panels).

3.3.4 The generation of the electricity from other Conventional Thermal Power Plant (i.e. not oil / gas) is not considered to be desirable given that such power plant would be expected to be less efficient / less flexible than the Power Project and more costly to construct.

Renewable Energy Generating Plant

3.3.5 In order to provide of the order of 250 MWe, any Biomass Power Plant constructed would require approximately 2 million tonnes of wood-based biomass per year based on the consumption of Biomass Power Plant in other parts of the world. Due to constraints associated with fuel availability and transport it would not be feasible to install a Biomass Power Plant of this scale either at the proposed site or indeed elsewhere in Jordan.

3.3.6 In order to provide of the order of 250 MWe, any Waste to Energy Power Plant constructed would need to incinerate approximately 1.6 million tonnes of waste per year based on the consumption of Waste to Energy Power Plant in other parts of the world. This is clearly impracticable in terms of collection and transport of such quantities of waste. Additionally, due to their significant expense, Waste to Energy Power Plant are generally regarded as a waste management option rather than a power generation option. Due to these constraints it would not be feasible to install a Waste to Energy Power Plant of this scale either at the proposed site or indeed elsewhere in Jordan.

3.3.7 The installation of 250 MW of Wind Turbines would be possible. However, the intermittent nature of generation from wind would not allow the Power Project to provide short-term support to the NTS, and therefore Wind Turbines would not be able to meet the specific type of electricity demand in this case.

3.3.8 Solar Photovoltaic (PV) Panels are increasingly being used to form large PV arrays providing hundreds of MW of renewable energy in countries across the world. However as with generation from Wind Turbines, there would be an intermittent nature associated with generation from Solar Photovoltaic Panels. This would not allow the Power Project to provide short-term support to the NTS, and therefore Solar Photovoltaic Panels would not be able to meet the specific type of electricity demand in this case.

Summary

3.3.9 The Power Project is considered to represent the most appropriate option for generation of the energy required.

Choice of Cooling System

3.3.10 The Power Project will utilize the heat from the exhaust gases leaving the engines to generate steam in waste heat recovery boilers. This steam is then used for fuel pre-heating. Following fuel pre-heating the steam is condensed, producing condensate that is then reused in the waste heat recovery boilers.

3.3.11 Cooling techniques available include:

- Water Cooling (Once Through Cooling (e.g. direct sea water or river cooling) / Evaporative Cooling Towers);
- Hybrid (Water / Air) Cooling Towers; and
- Air Cooling (Air Cooled Condensers (ACC) / Air Blast Radiators).

3.3.12 Due to the lack of a suitable cooling water source only air cooling (via either ACC or Air Blast Radiators) can provide a practical cooling system for the Power Project. The use of air cooling will help limit the use of water to an absolute minimum, therefore avoiding unnecessary consumption of large qualities of water (which is at a premium in Jordan).

3.3.13 The performance of any air cooling, as for water cooling, is dependent on a number of factors, including: ambient temperature; prevailing wind direction; gusty conditions; and, the height / position of buildings and other structures in the vicinity. The Power Project will be designed to minimize the impact of these sensitivity factors.

3.3.14 The preferred design for the air cooling units involves the positioning of the heat exchangers above the fan units.

3.4 Pipeline Routing and Alternatives

3.4.1 The Power Project will be served by two short new pipelines. These are a:

- Gas Pipeline; and
- Water Pipeline.

3.4.2 The routing of these pipelines (which run from the connection points just outside the boundary of the IPP1 site) has been designed to minimize the need for any confiscation of lands / displacement of peoples, and avoid unnecessary impact to sensitive receptors such as ecologically sensitive or residential areas.

3.5 Transmission Line Routing and Alternatives

3.5.1 The electrical output from the Power Project will be transformed and transmitted to the existing 132 kV NEPCO substation to the north of the Power Project site via a 132 kV underground cable. The route of the underground cable runs along the perimeter of the Power Project site, IPP1 site and the NEPCO site boundary. This is shown in Figure 3.1.

3.5.2 The routing of this underground cable has been designed to minimize the need for any confiscation of lands / displacement of peoples, and avoid unnecessary impact to sensitive receptors such as ecologically sensitive or residential areas. Although access rights and wayleaves shall be sought from IPP1 for routing this underground cable.

N

W E

S

Legend

- Project Boundary
- Underground Cable

• PROJECT	IPP4 Al-Manakher Power Project
• TITLE	Underground Cable Route to 132 kV Substation

• DATE	17.08.2011	• DRAWN BY	LS
• SCALE	------	• PRODUCED BY	LS
• CAD REF	---	• CHECKED	MW
		• APPROVED	MW

PARSONS BRINCKERHOFF

Parsons Brinckerhoff
Amber Court, William Armstrong Drive, Newcastle upon Tyne, NE4 7YQ
Tel: +44-(0)-191-226-1234 Fax: +44-(0)-191-226-2345

• DRAWING NUMBER **FIGURE 3.1**

SECTION 4

POWER PROJECT AND SITE DESCRIPTION

4 POWER PROJECT AND SITE DESCRIPTION

4.1 The Power Project

Introduction

4.1.1 It is expected that for the majority of its life, the Power Project will operate primarily as a peaking plant, and shall be capable of automatic operation and control. However, as the operation schedule may change, the Power Project should be capable of operating at base load throughout the year.

4.1.2 The Power Project will be designed to have an expected operational life of 30 years, although it could potentially continue generation beyond this. Maintenance of the Power Project shall be scheduled as per manufacturer's recommendations. Major maintenance shut-downs will be planned on a long-term basis with immediate stoppages being infrequent and of short duration only.

4.1.3 The Civil Infrastructure, on-site roads etc will be designed to have a minimum working life of 30 years.

Process Description

4.1.4 The Power Project will consist of 16 generating units with an individual unit rating of 15.83 MW. Each unit will consist of: a compression ignition engine; electricity generator; and dedicated flue..

4.1.5 In each engine, the fuel is injected into cylinders and compressed. The fuel ignites and drives pistons, which power the drive shaft, which rotates the electricity generator. Each engine is cooled by cooling water circulated through the engine block.

4.1.6 Air blast radiators will be used to reject heat from the cooling water systems, and will be installed outside the main engine hall. Air blast radiators work in much the same way as a car radiator (i.e. cooling hot water in a closed circuit cooling system with ambient air blown across the radiator acting as a heat exchanger). Hot air leaves the cooling water system, whilst the cooled water is recirculated back.

4.1.7 Each generating unit will be served by a dedicated flue. The flue gases will discharge to the atmosphere through a stack (wind shield) containing four individual flues. The height of the four proposed stacks is 70 m. This height has been determined through the appropriate sensitivity studies undertaken as part of a comprehensive air dispersion modelling study.

4.1.8 Waste heat recovery boilers will be installed to improve efficiency. The exhaust gases leaving the engines will be used to generate steam in waste heat recovery boilers. This steam is then used for fuel pre-heating. Following fuel pre-heating the steam is condensed, producing condensate which is then re-used in the waste heat recovery boilers.

4.1.9 An emergency / 'black-start' diesel generator will be installed to provide emergency back-up and enable the Power Project to be shut down in a safe manner in the event of loss of electricity or self start the facility in the event of a grid black out.

4.1.10 The remainder of the Power Project will consist of air compressing equipment, storage facilities, control equipment and electrical switchgear. In addition, the Power Project will include support facilities such as: administration buildings; warehouses; workshops; fuel delivery and back-up fuel storage facilities; main and plant transformers; plant switch gear; and, metering required. Also included will be all necessary site infrastructure, such as roads.

4.1.11 The compressed air system will be provided to compress and deliver air of a quantity and quality suitable for all general, instrument and control purposes at all appropriate points in the Power Project.

4.1.12 The thermal input of the Power Project will be of the order of 568 MWth, and the Power Project will operate at a typical net efficiency of approximately 44 per cent.

Project Operations

4.1.13 The Power Project will be used to generate electricity at peak demand time and also during periods of instability of the NTS. The fundamental characteristics required of such a Power Project are that is should be capable of starting quickly as required.

4.1.14 It is expected that the Power Project will operate intermittently for approximately 40 per cent load factor. It is generally expected that the individual generating units will operate at maximum continuous output or not during this period. Part-load running is not anticipated. Where the peak demand requires less than maximum continuous output and efficiency, minimise emissions and optimise running hours of engines. The number of generating units in operation at any one time will depend on the size of the peak load experienced. Generating units will be brought on load or taken off load as required.

4.1.15 A conservative view of the operation of the Power Project has been adopted in the ESIA so that a “worst case” is presented. The ESIA studies presented in this ES has assumed that the Power Project will be operating at 100 per cent through out the year rather than the anticipated 40 per cent load factor. This has ensured that there is a factor of safety built into all of the ESIA studies, giving a high degree of confidence that the actual impact presented in this ES will be less.

Plant Layout

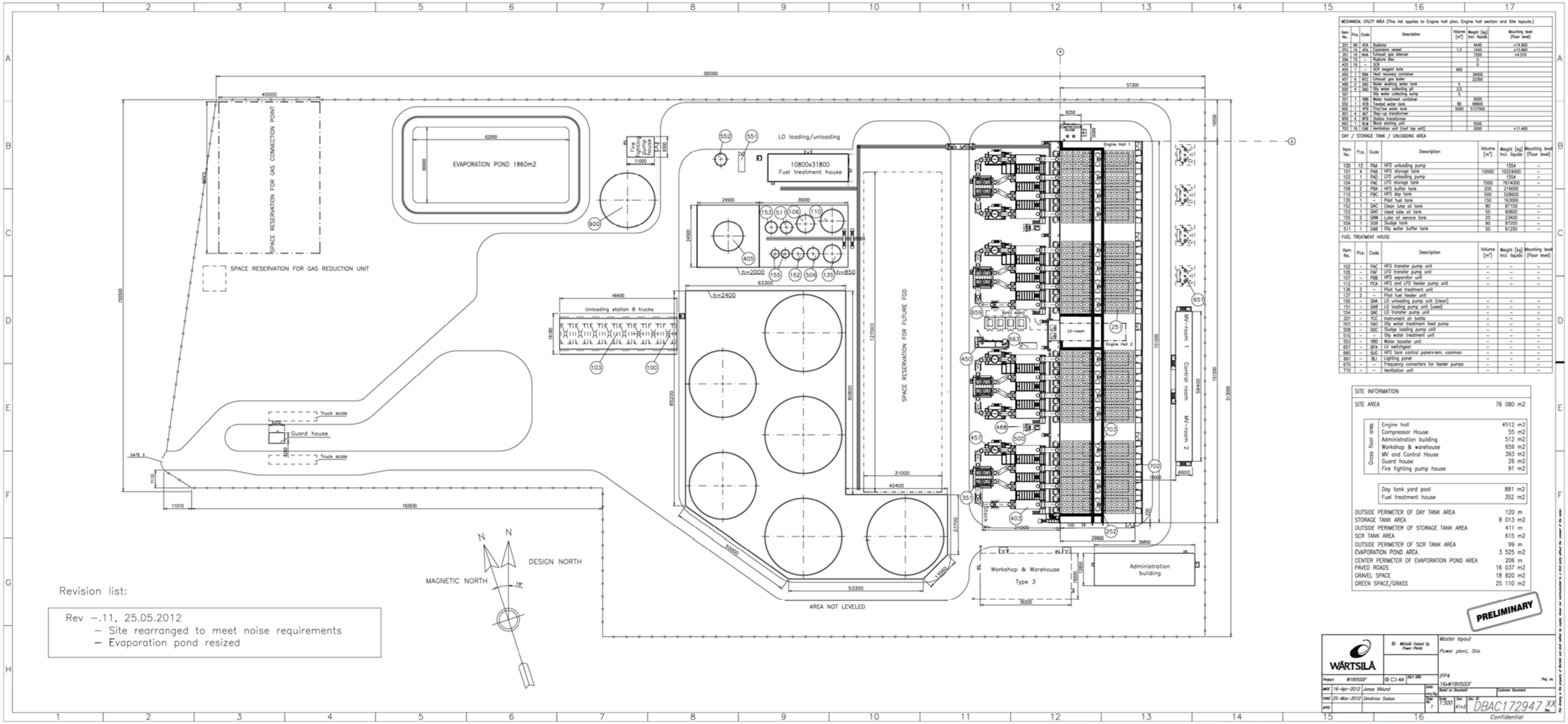
4.1.16 An engine hall will house the engines and electricity generators that will be aligned transversely across the width of the structure.

4.1.17 The layout of the Power Project has been designed taking the following factors into consideration:

- Road access;
- Connection to gas pipeline network;
- Connection to water pipeline network;
- Connection to electricity transmission network;
- Provisions to minimize noise / visual impacts;
- Compliance with Regulatory Requirements;
- Technical Requirements; and
- Plant / personnel safety.

4.1.18 An indicative site layout is shown in Figure 4.1. However it should be noted that the layout may be subject to some changes as the design process is completed.

4.1.19 The design of the plant, buildings and enclosures will aim to minimize regular and long term maintenance. Sufficient spares will be held on-site to ensure reliable operation of the Power Project. Materials and finishes will be selected to meet this objective and ensure that the appearance of the Power Project does not deteriorate with time.



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DRAWING NUMBER FIGURE 4.1

Fuels

4.1.20 During normal operation, the Power Project will fire on HFO,DFO or natural gas, when it becomes available. Liquid fuelwill be brought to the Power Project site by road tankers and unloaded at a dedicated unloading station. NEPCO shall be responsible for the fuel until delivered to site. The expected typical HFO specification is shown in Table 4.1 and the expected typical specification of DFO is shown in Table 4.2.

TABLE 4.1: EXPECTED HFO SPECIFICATION

Component	***Percentage by Weight (%)***
Carbon	87.5
Hydrogen	11.4
Sulphur	1.0
Ash Content	0.05 (typical) *
Gross Calorific Value	41.1 MJ/m^3

** Ash content of the fuel is expected to be 0.05%, however, this is dependent on a locally available fuel source and an exemption raised with MoE allows a maximum ash content of 0.08%. Both scenarios have been modelled for the purposes of the impact assessment although the project anticipates to use 0.05%*

TABLE 4.2: EXPECTED DFO SPECIFICATION

Component	***Percentage by Weight (%)***
Carbon	89.0
Hydrogen	10.1
Sulphur	0.9
Ash Content	<0.001
Gross Calorific Value	42.8 MJ/m^3

4.1.21 HFO and DFO will be stored on-site in storage tanks of suitable size to allow for 30 days continuous operation of HFO and 10 days continuous operation of DFO. There will be separate HFO and DFO unloading pumps (each at 2 x 100 per cent, allowing for simultaneous unloading of 6 road tankers). Fuel Oils will be pumped directly to the appropriate storage tanks. Annual consumption of either fuel oil will depend on the operating regime of the Power Project, which is determined by any peaking / support requirements.

4.1.22 The Power Project shall also be equipped to operate on natural gas.

4.1.23 For firing on natural gas, a gas connection is also anticipated. A typical natural gas specification is provided in Table 4.3.

TABLE 4.3: NATURAL GAS SPECIFICATION

Component	*Typical Mol (%)*
Nitrogen	0.01
Carbon Dioxide	0.55
Methane	92.24
Ethane	4.09
Propane	1.87
Butane	0.84
Pentane	0.30
Hexane	0.10
Gross Calorific Value	42.6 MJ/m^3
Methane Number	91

4.1.24 Natural gas consumption is expected to be low. With the exception of temperature and pressure regulation, the natural gas will not be treated at the Power Project site. Natural gas will not be stored on the Power Project site. Venting and emergency relief valves will be provided on the natural gas system to enable safe start up, shut down and operation of the natural gas supply system.

Pollution Control Technology

4.1.25 The generating units chosen for the Power Project will be equipped with proven pollution control technology which will limit the production of nitrogen oxides (NO_x) to a maximum of 740 mg/Nm^3 during HFO firing. Selective Catalytic Reduction (SCR) shall be incorporated within the Power Project design in order to control emissions of NO_x to within the relevant regulatory limits as necessary.

4.1.26 The production of sulphur dioxide (SO_2) is directly related to the sulphur content of the fuel. The Fuel Supply Contracts will specify a sulphur content for HFO of less than 1 per cent w/w and the sulphur content of DFO is typically low at less than 0.9 per cent w/w. The combustion of natural gas does not result in the emissions of significant levels of SO_2 or particulate matter associated with burning fuel oil.

Storage

4.1.27 In addition to the oil storage, storage facilities will also be provided for the small quantities of chemicals (including sodium phosphate, hydrazine, ammonia/urea and others) used in boiler water dosing. All such chemicals will be retained in suitable containment areas.

4.1.28 The oils, chemicals and miscellaneous materials (such as oils, greases, cleaning substances / materials, laboratory chemicals etc) will be stored in suitable storage bunds or containers on-site.

4.1.29 The boiler dosing chemicals and dosing systems will be shielded from the atmosphere. Air discharged from the ammonia and oxygen scavenger dosing and dilution tanks will pass through a device such as a common water seal and an active carbon filter to avoid the uncontrolled release of these chemicals to the atmosphere.

4.1.30 The chemical unloading bay will adjoin the Water Treatment Plant. Tankers will be connected by flexible hoses to the discharge lines in the unloading facility between the unloading bay and the Water Treatment Plant. The chemicals will be pumped directly into the storage tanks in the chemical storage area.

4.1.31 The Power Project will be supplied with a raw water storage facility with a total capacity equal to seven days of maximum water consumption plus a fire water storage tank sized to meet the NFPA and Jordan Fire Department and the local fire

code requirements. The fire water storage tank will be installed with fire pumps, hose reels, fire hydrants and portable extinguishers as necessary.

Water Supplies / Effluent Discharge

4.1.32 Water supplies will be required for the make-up water for the exhaust gas boiler and SCR system. In addition, the water supplies will be needed for any service waters (i.e. drinking water and washing water).

4.1.33 All water required by the Power Project will be provided by the Water Authority of Jordan (WAJ) through a connection point just outside the boundary of the existing IPP1 site. The water pipeline will likely be made of steel and will be buried such that it is an appropriate depth below ground level.

4.1.34 The agreement with WAJ will allow the Power Project to use of the order of 240 m^3 of water per day, although the Power Project may ultimately use less than this during operation.

4.1.35 The raw water (mains water) will be treated and de-mineralized on-site. The Water Treatment Plant will consist of: a raw water tank; treated water (de-mineralized water) storage tanks; sand filters; active carbon filters; ion exchange streams; an acid storage tank; a caustic storage tank; an automatic effluent neutralizing system; a control panel; and, all interconnecting pipe work. The make-up water for the waste heat recovery boilers will be treated in mixed bed units before being used.

4.1.36 The water treatment process involves sand filters and active carbon filters prior to reverse osmosis. This is followed by ion exchange streams which include the exchanging of cations (calcium, magnesium, sodium, etc) for hydrogen ions using cation exchange resins followed by the exchanging of anions in the decationized water (sulphate, chloride, carbonate, silicate, etc) for hydroxyl ions by using anion exchange resins. When the ion exchange resins are exhausted, the ion exchange resin beds are backwashed, regenerated with dilute acid (for the cation resin) and with dilute caustic soda (for the anion resin), rinsed to remove any excess regenerant and returned to service.

4.1.37 Small quantities of boiler water (boiler blowdown) from the exhaust gas boilers will be discharged to avoid the build-up of impurities. This effluent will be virtually pure water, containing very small quantities of various chemicals that are used to prevent corrosion and scaling. Boiler blowdown will be re-used where possible.

4.1.38 The effluent discharged from the Power Project will comprise the effluent from the water treatment plant, which will contain salts removed from the mains water and also some additional sodium sulphate or chloride produced by neutralization of the spent regenerants.

4.1.39 These effluents will be treated in an effluent treatment plant prior to discharge to an on-site collection pond. The effluent treatment includes: cooling; oil separation; neutralization to adjust the pH to meet the necessary standards; coagulation; settling and clarification. Sludge from the fuel treatment and water treatment plant will be removed from site by road tanker and disposed of at an appropriate disposal site.

4.1.40 In addition, the Power Project will include adequate sanitary facilities during construction and operation to treat sanitary sewage prior to disposal of in the on-site collection pond.

4.2 Safety and Emergency Plans

4.2.1 The hazards associated with power plant, such as the Power Project, have been studied over many years and a considerable volume of design and procedural experience has built up in this area.

4.2.2 Accordingly, the design of the Power Project will incorporate all the features needed to comply with relevant Safety Regulations.

4.2.3 Fire Detection and Protection systems will be provided throughout the Power Project and Power Project site area. These will include (amongst others): total flood carbon dioxide system; fixed foam spray protection systems; fire alarms; and, portable appliances. The Power Project will therefore not need to store large quantities of water for fire fighting.

4.2.4 A comprehensive Fire Protection System will be installed to cover equipment on-site which could constitute a significant fire risk. For the protection of equipment within the engine hall, where water spray could cause damage, a total flood carbon dioxide system will be used. For the protection of storage tanks, fuel handling areas and associated pipeline an automatic fixed foam spray protection system will be used. Heat sensors / smoke detectors will be used in conjunction with automatic spray nozzles. Furthermore, non-combustible and fire resistant building materials will be utilized. Venting systems will be designed to prevent explosion of air / natural gas accumulations. Ignition sources will be protected from damage. Testing of fire detection and protection systems will be carried out as appropriate.

4.2.5 The Power Project will employ the standard mechanical and electrical protective devices, including: emergency relief valves; shut down sequence controls; safety interlocks; fault detection; and, alarm systems. Operating procedures will be implemented to ensure that safety is maintained under all likely circumstances.

4.2.6 For all cases of storage, (oils, chemicals and miscellaneous materials) there will be no drains within the storage bunds and all valves and couplings will be within the bunded area.

4.2.7 In the event of leakage or spillage from any storage tank, the leak / spill will be contained within the storage bund surrounding the tank. Any oil / chemical found in the storage bund will be removed for disposal to a licensed site.

4.2.8 An oil / chemical spill is recognized as being the principal environmental emergency that could arise at the Power Project. Emergency Response Plans will be developed for both construction and operation periods.

4.2.9 The Power Project will be designed with a view to a high level of automatic operation with minimum operator intervention. An Operating System will be installed with full facilities for interfacing the information / control / alarm systems such that the Power Project can be operated from the Central Control Room. The Operating System will include trending information from the process monitoring systems, continuous emissions monitoring system (for emissions to air) and monitoring alarms. Any significant deviations will be alarmed and corrections carried out on occurrence. Records of performance and deviation shall be maintained.

4.2.10 Process parameters will be continuously recorded to ensure correct and efficient operation of the Power Project. Any major deviations will be alarmed and corrections carried out on occurrence. Records of performance and deviation will be maintained.

4.2.11 The Power Project will be constructed, installed, commissioned, operated and maintained in full compliance with all relevant Health and Safety at Work Orders, all related Acts, Regulations, Codes and Statutory Requirements.

4.2.12 The Power Project will be designed to withstand extreme ambient conditions to which it may be exposed and to continue to function normally, within appropriate range of de-rating factors to account for such ambient conditions.

4.2.13 Access to the Power Project site will be strictly controlled. Site security will be achieved by providing suitable fencing to the site perimeter and cameras.

4.2.14 There will be no emergency situations at the Power Project site that could compromise the safety of the public in the vicinity.

4.3 The Gas Pipeline

4.3.1 For firing on natural gas, a gas connection is required. This will be by a flange located just outside the boundary of the existing NEPCO Metering Facility on the IPP1 site. The natural gas will be supplied at a pressure in the range of 25 to 65 bar(g).

4.3.2 The IPP1 site is supplied via a dedicated gas pipeline which tees into to 'Arab Gas Transmission Pipeline'. This provides natural gas from Egypt to Jordan.

4.3.3 The gas pipeline will likely be made of steel and will be buried such that it is an appropriate depth below ground level.

4.4 The Transmission Line and Substation

4.4.1 The electrical output from the Power Project will be transformed and transmitted to the existing 132 kV NEPCO substation to the north of the Power Project site via a 132 kV underground cable. From the NEPCO substation it will be exported to the Jordanian NTS.

4.4.2 Additionally, the Power Project will include equipment necessary to receive power from the NTS and transform it to the voltage required for start-up of the Power Project and other needs.

4.4.3 The Power Project shall be provided with an emergency / black-start capability to allow for start-up of the Power Project in the event of a power failure.

4.5 Construction of the Power Project

4.5.1 The Construction Contractor will be required to prepare and implement the following:

- A Construction Environmental Management Plan (CEMP);
- A Soil and Water Management Plan (SWMP), including details of a Dust Management Plan; and,
- An Environmental Noise Management Plan for construction and commissioning.

Construction Environmental Management Plan

4.5.2 The CEMP will identify the mitigating measures and management procedures that will be put in place to adequately control the environmental impacts of the construction of the Power Project. The CEMP will incorporate relevant sections of this ESIA where appropriate.

4.5.3 The principal items of the CEMP will include: management roles; contractors induction; emergency procedures; earthworks; clearing; management of fuels, oils and chemicals, including bunding; waste management and disposal (including spoil); dangerous goods; management of contaminated and potentially contaminated material; dust control; noise control; groundwater management; erosion and sediment control; heritage management; traffic management; legislative compliance; and, compliance with approvals and licences.

Soil and Water Management Plan

4.5.4 The SWMP will describe the measures to be employed to minimise soil erosion and the discharge of sediment / other pollutants to lands and / or waters during construction activities. The SWMP will include an accidental spill contingency plan.

4.5.5 Furthermore, the SWMP will include an agreed Dust Management Plan / Dust Monitoring Program.

Environmental Noise Management Plan

4.5.6 The Environmental Noise Management Plan will address the potential noise impacts during construction and commissioning.

4.5.7 In terms of construction, the Environmental Noise Management Plan will cover: compliance standards; community consultations; complaints handling monitoring system; site contact person to follow up complaints; mitigation measures; the design / orientation of the proposed mitigation methods demonstrating best practice; construction times; monitoring methods and program; management strategies for construction activities that might produce high level intermittent noise (such as pile driving or blasting); management strategies for any impulsive or tonal noise sources; and, a clearly described construction schedule for all construction works with the aim of achieving an environmental objective of no offensive noise being transmitted past the premises boundary.

4.5.8 In terms of commissioning, the Environmental Noise Management Plan will cover: contingency measures where noise complaints are received; and, monitoring methods and program (including a noise audit to verify noise levels produced by the Power Project).

Site Preparation

4.5.9 A pre-construction contaminated land survey will be undertaken by the Construction Contractor. As a starting point, this survey will use the results of the Site Investigations carried out during the development phase of the Power Project.

4.5.10 The major civil works activities during the construction phase of the Power Project include:

- Site preparation works;
- Construction of foundations; and
- Construction of buildings.

4.5.11 Site preparation works will comprise the levelling of the site, any earthworks and excavations. The excavations will be required to construct the foundations, culverts, buried services and basement structures. Excavation activities create a potential disturbance risk. Therefore, risk assessments will be carried out prior to trenching, installation of underground services and provision of temporary construction facilities and services.

4.5.12 It will be the Construction Contractor's responsibility to notify the Department of Antiquities Representative if antiquities are encountered in any stage during construction.

4.5.13 An area will be made available for the laydown and storage of plant / equipment within the site boundary, or leased adjacent to the site, if required, for the duration of the construction period. This area will be available for any fabrication that may be necessary for construction works. An area will also be set aside for car parking and office accommodation. On completion of the construction phase, all necessary measures will be taken to return the laydown and car parking areas to their previous state.

4.5.14 The Programme for the mechanical and electrical plant can be considered in terms of the following activities:

- Engine / Exhaust Gas Boiler / generator / Air Blast Radiator manufacture;
- Engine / Exhaust Gas Boiler / generator / Air Blast Radiator installation;
- Power Project commissioning;
- Plant take-over;
- Commercial operation of the Power Project; and
- Guarantee period of the Power Project.

4.5.15 The construction period will be of 17 months duration, including commissioning.

4.5.16 The construction workforce will likely peak at approximately 1 000 personnel, with an average of between 600 to 700 personnel. The permanent operational personnel for the Power Project will be of the order of 40.

4.6 Decommissioning

4.6.1 At the end of the useful life of the Power Project, approximately 30 years, the Power Project will be decommissioned in accordance with Legislative Guidelines current at that time. Alternatively, if market conditions and / or electricity supply constraints at that time indicate that it would be appropriate to extend the life of the Power Project, then decommissioning may be deferred to a later date.

4.6.2 In order to ensure continuing adequate conditions and environmental performance, the Power Project would be re-engineered and re-permitted as required, dependent of the Legislative Requirements at that time.

4.6.3 Independently validated closure / demolition methodologies have been developed for power plants that are at the end of their useful life. The closure / demolition methodologies cover: demolition of plant and buildings; and, removal of any contaminated and hazardous material from the site.

4.6.4 In order to facilitate decommissioning, much of the plant on-site will be made of materials suitable for recycling. In addition a large proportion of the buildings will be constructed of pre-fabricated steel and will therefore also be of interest to a scrap metal merchant. After the removal of the main items of plant and steel buildings, the remaining buildings will be demolished to ground level. All underground structures will either be removed or made safe. All debris to be removed off-site will be sent to a Licensed Disposal Facility.

4.6.5 During decommissioning, all reasonable measures required to prevent any future pollution of the site will be carried out. This will include measures such as:

- The emptying / cleaning and removal of storage tanks; and
- The removal from site of all materials / liquids liable to cause contamination.

4.6.6 The surface water drainage system for the Power Project will continue to operate through the decommissioning phase. Any areas where oil spillage could occur will continue to drain to an oil interceptor, which will continue to be maintained.

4.6.7 Decommissioning is likely to take place over several months.

4.6.8 The results of the pre-construction contaminated land survey will be used as a basis for a further contaminated land survey to be performed when the Power Project is closed. The aim of the further contaminated land survey will be to assess whether or not any contamination of the site has taken place during the lifetime of the Power Project.

4.6.9 A full Environmental Departure Audit will be carried out. This will examine, in detail, all potential environmental risks existing at the site and make comprehensive

recommendations for remedial action to remove such risks. Following completion of the demolition, a final Environmental Departure Audit will be carried out to ensure that all remedial work has been completed. The Audits will be made available to future users of the site.

4.6.10 The site will be returned to a condition suitable for reuse. The subsequent uses of the site would be discussed with the Relevant Authorities as part of the decommissioning process.

4.6.11 When decommissioning / demolishing the Power Project, it will be a matter of policy to ensure that the site is left with no environmental risks.

SECTION 5

DESCRIPTION OF ENVIRONMENTAL AND SOCIAL BASELINE

5 DESCRIPTION OF ENVIRONMENTAL AND SOCIAL BASELINE

5.1 Introduction

5.1.1 This Section discusses the existing environmental and social baseline within the study area for the ESIA undertaken for the Power Project.

5.2 Air Quality

5.2.1 The Power Project will be required to comply with relevant Jordanian and World Bank / IFC Standards and Guidelines regarding ambient air quality.

5.2.2 The anticipated operating regime of the Power Project will be to provide short-term support to the NTS, and therefore the potential impacts on local air quality will be limited accordingly to short-term averaging periods. The Jordanian Standards that are considered to be applicable to the plant are detailed in Jordanian Standard (1140/2006). These are shown in Table 5.1.

TABLE 5.1: JORDANIAN EMISSION STANDARDS FOR AMBIENT AIR QUALITY (1140/2006) – PARTS PER MILLION (PPM), MICROGRAMS PER CUBIC METRE OF AIR (µg/m^3)

Pollutant	*Averaging Period*	*Maximum Limit*	*Number of Exceedances*
NO_2	1 hour	0.21 ppm* (400 µg/m^3)	3 times during any consecutive 12 months
	24 hours	0.08 ppm (150 µg/m^3)	3 times during any consecutive 12 months
SO_2	1 hour	0.3 ppm (786 µg/m^3)	3 times during any consecutive 12 months
	24 hours	0.14 ppm (370 µg/m^3)	Once during any consecutive 12 months
PM_{10}	24 hours	120 µg/Nm^3	3 times during any consecutive 12 months
$PM_{2.5}$	24 hours	65 µg/Nm^3	3 times during any consecutive 12 months
CO	1 hour	26 ppm (30279 µg/m^3)	3 times during any consecutive 12 months
	8 hours	9 ppm (10481 µg/m^3)	3 times during any consecutive 12 months
TSP	24 hours	260 µg/m^3	3 times during any consecutive 12 months
H_2S	1 hour	0.030 ppm (42 µg/m^3)	3 times during any consecutive 12 months
	24 hours	0.010 ppm (14 µg/m^3)	3 times during any consecutive 12 months

5.2.3 The Power Project is also required to meet the emissions guidelines of the World Bank / IFC as specified in the 2007 General Environmental, Health and Safety (EHS) Guidelines for Air Emissions and Ambient Air Quality. These are shown in Table 5.2.

TABLE 5.2: WORLD BANK/IFC AMBIENT AIR QUALITY GUIDELINES – (µg/m^3)

Parameter	Averaging Period	Maximum Limit
SO_2	24-hour	125 (Interim Target 1)
		50 (Interim Target 2)
		20 (Guideline)
NO_2	1-hour	200 (Guideline)
PM_{10}	24-hour	150 (Interim Target 1)
		100 (Interim Target 2)
		75 (Interim Target 3)
		50 (Guideline)
$PM_{2.5}$	24-hour	75 (Interim Target 1)
		50 (Interim Target 2)
		37.5 (Interim Target 3)
		25 (Guideline)

Ambient Air Quality Monitoring

5.2.4 As part of the site identification studies for the existing IPP1 Power Project, the Ministry of Energy and Mineral Resources (MEMR) commissioned a study by the Royal Scientific Society (RSS) of air quality in the vicinity of the site for a one year period. Additional ambient air quality monitoring at the Power Project site entrance has been undertaken in order to determine if there have been any significant changes to the baseline ambient air quality since the previous monitoring was completed. The new data was collected over a period of four weeks (two consecutive weeks in May to June 2011 and two consecutive weeks in September to October 2011). Continuous monitoring of oxides of nitrogen, SO_2, CO and PM_{10} were undertaken in this period. Daily spot measurements forH_2S were undertaken once per week for a period of four weeks.

5.2.5 Correlations were performed for the two sets of data; the results of the latest monitoring are presented, together with the results of the previous study, in Table 5.3.

TABLE 5.3: AMBIENT AIR QUALITY MONITORING (PPM UNLESS STATED)

	2005-2006		***2011***		***2005-2006***		***2011***	
Pollutant	***Maximum daily average (ppm)***	***Average Maximum Daily Average (ppm)***	***Maximum daily average (ppm)***	***Average Maximum Daily Average (ppm)***	***Maximum Hourly average (ppm)***	***Average Maximum Hourly Average (ppm)***	***Maximum Hourly average (ppm)***	***Average Maximum Hourly Average (ppm)***
SO_2	0.017	0.005	**0.042**	0.003	0.069	0.025	**0.299**	0.017
NO	0.071	0.026	0.012	0.001	1.476	0.421	0.077	0.005
NO_2	0.070	0.020	0.006	0.003	0.498	0.148	0.018	0.007
NOx	0.101	0.037	0.015	0.004	1.975	0.549	0.078	0.010
CO	-	-	-	-	3.550	2.813	1.950	0.777
H_2S	0.017	-	0.001	0.000	0.090	-	0.003	0.000
PM_{10} (µg/m^3)	339	177	975	115	-	-	-	-

*Note: Figures in **bold** indicate significant changes between the monitoring datasets*

5.2.6 It is noted that in the 2011 survey results, the measured maximum daily and hourly concentrations of SO_2 are higher than the equivalent measurements from the 2005 to2006 study, however these maxima do not exceed the relevant Jordanian Standards.

5.2.7 The higher values are the result of isolated occurrences during the monitoring period (7 hours from the 699 recorded hourly values) representing 1.0 per cent of the data. These results can statistically be considered as outliers and, as such, if these results are removed the maximum daily average and maximum hourly average for the 2011 monitoring are 0.021 ppm and 0.092 ppm respectively.

5.2.8 For oxides of nitrogen, CO and H_2S, the 2011 monitored data indicates that there are no exceedances of the relevant Jordanian Standards. Seven exceedances of the Jordanian Standard of 120 ug/m^3 were recorded for PM_{10} during the 2011 monitoring period however this is similar to the previous survey results recorded in 2005 to 2006. The maximum and mean daily average concentrations reported in Table 5.3 are significantly affected by one 24-hour period during the monitoring survey where hourly average concentrations reached 2768 ug/m^3. The cause for this is unknown however such elevated concentrations occur for less than 1 per cent of the total survey data. As with SO_2, if the 99th percentile values are considered, the maximum daily average reduces to 341 ug/m^3 and the average daily concentration reduced to 93 ug/m^3.

5.2.9 In general, the results of the 2011 monitoring study suggest that air quality in the region may have improved since 2005 to 2006 given that the recorded 2011 maxima are, on the whole, less that the average maxima in the previous study. However, given the shorter nature of the latest monitoring, the main conclusion is that there has been no significant detrimental change to the ambient air quality.

5.2.10 It is therefore considered that the air quality monitoring data collected in 2005 to2006, supplemented by the 2011 surveys, represents a suitable measure of the current baseline.

5.2.11 The most recent monitoring has also shown that the ambient air quality in the vicinity of the Power Project does not exceed the more stringent World Bank / IFC Guideline for NO_2 or Interim Target 1 for SO_2. One exceedance of Interim Target 1 for PM_{10} was observed during the monitoring period.

5.2.12 A summary of the results of the monitoring compared against the World Bank / IFC Guidelines are presented in Table 5.4.

TABLE 5.4: SUMMMARY OF AMBIENT AIR QUALITY RESULTS AGAINST WORLD BANK / IFC GUIDELINE (µg/m^3)

Pollutant	*Averaging Period*	*Maximum Value*	*Average Value*	*World Bank/IFC Guideline Exceedance*	*Interim Target Exceedance*
NO_2	1-hour	33.5	6.9	0	-
SO_2	24-hour	111.1	8.2	2	0
PM_{10}	24-hour	975	115	20	3
$PM_{2.5}$	24-hour	18.2	14.5	0	-

5.2.13 Table 5.4 indicates exceedances of the World Bank / IFC Guidelines for both SO_2 and PM_{10}. However, the World Bank / IFC Guidelines provide interim targets for these pollutants in recognition of the need for a staged approach to achieving the recommended guidelines. There are no recorded exceedances of Interim Target 1 for SO_2 and only three exceedances of Interim Target 1 for PM_{10} was observed during the data collection period.

5.2.14 It is considered that these exceedances for the background air quality of the World Bank / IFC Guideline values are insignificant as the Interim Targets allow for the staged improvement of ambient air quality and there are no recorded exceedances of the Interim Target for SO_2. The exceedances of the Interim Target for PM_{10} are considered insignificant due their very small magnitude and that the general (average) ambient concentration is well within the Interim Target.

5.3 Water Quality

5.3.1 The Power Project site is located within the Amman Governorate in the central parts of the Hashemite Kingdom of Jordan, near the village of Al-Manakher. The proposed site is situated within one of the most important and largest ground water basins in Jordan (Amman- Zerqa Basin) which supplies water to the cities of Amman, Zerqa, and their surrounding areas.

5.3.2 The local topography is shown in Figure 5.1.

5.3.3 The Amman-Zarqa basin in which the site is located has a predominantly Mediterranean type climate, characterized by hot dry summer and cool to cold rainy winters. As in most semi-arid areas, temperatures exhibit large seasonal and diurnal variation with daily temperatures may be exceeding 40°C while in winter temperatures can drop at night to reach 0°C.

5.3.4 The Power Project area is affected by a dry wind in summer, which is from east to south east and south west direction, while in winter it is affected by a humid wind from west and south west.

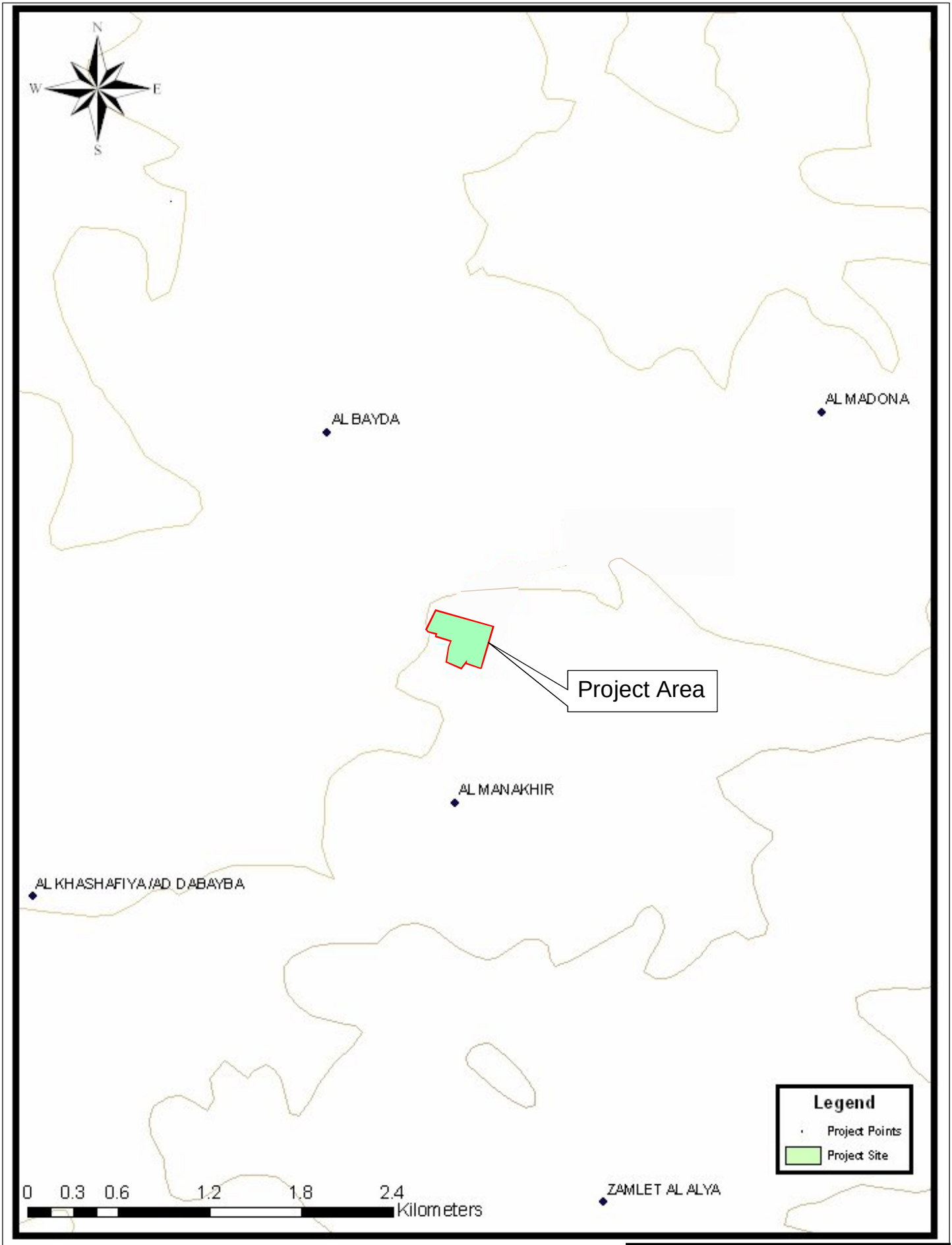
5.3.5 Cold and warm fronts steered from depressions occurring over Cyprus cross Jordan in south westerly to north easterly direction, and cause rainfall in Jordan. In the warmer months (April, May and sometimes October) thunderstorm precipitation can occur.

Site Geology

5.3.6 The geology of the area is dominated by sedimentary rocks related to Cretaceous age that subdivided in two main sequences. These are Lower and Upper Cretaceous rocks.

5.3.7 The Lower Cretaceous rocks are locally known as Kurnub. The Upper Cretaceous rocks are further sub-divided into Ajlun and Belqa groups.

5.3.8 In the area, the sedimentary (carbonate series) are the Belqa and the older Ajlun groups, from the Upper Cretaceous period. Figure 5.2 shows a Geological Map and Figure 5.3 provides a Hydrological Map for the Power Project area. This series consists of limestone, dolomatic limestone, marly limestone, chalky limestone.



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IPP4 AL-MANAKHER POWER PROJECT

Title:
TOPOGRAPHIC MAP OF THE PROJECT AREA

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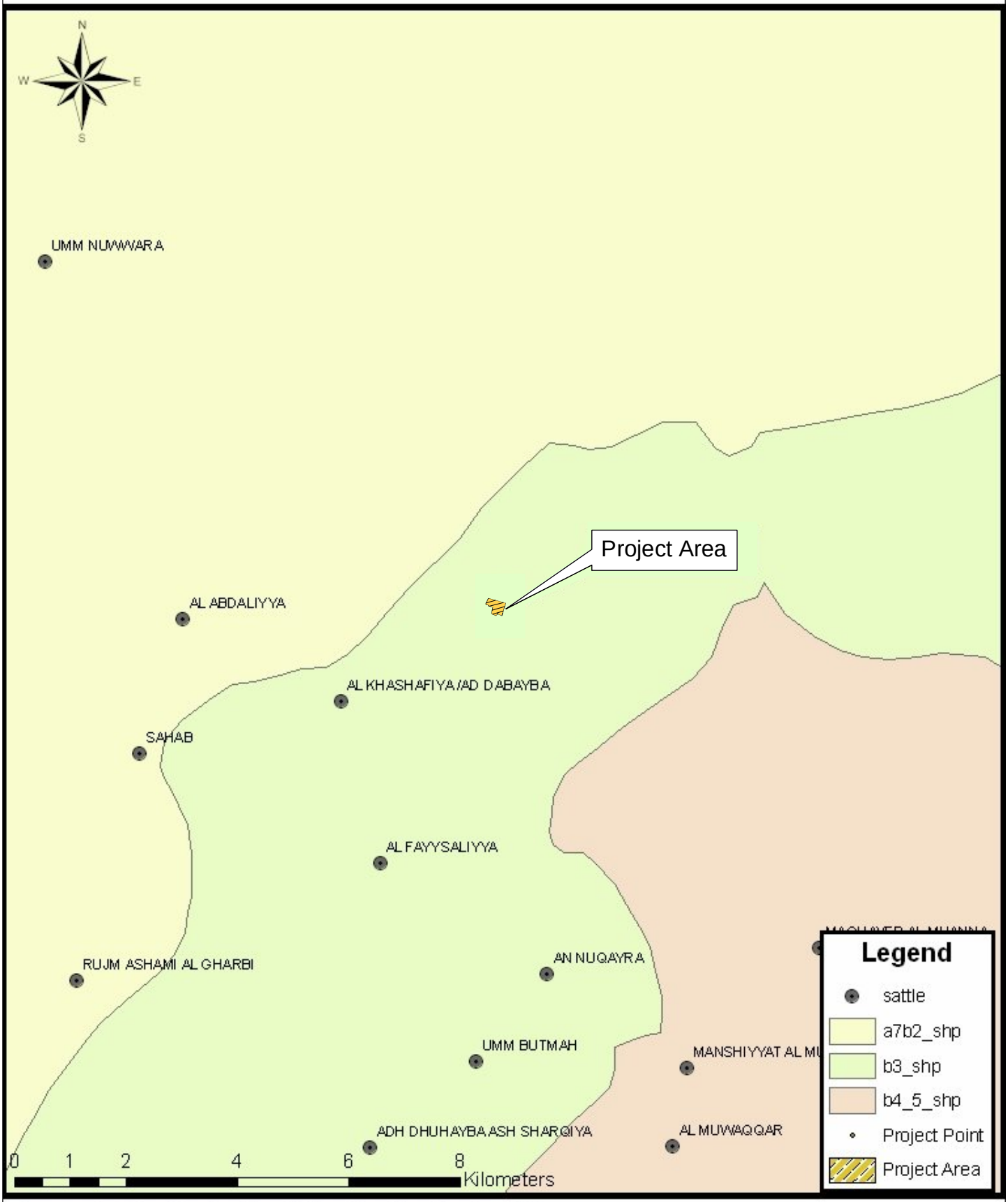

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GEOLOGICAL MAP OF THE PROJECT AREA

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3511309A	FIGURE 5.2		

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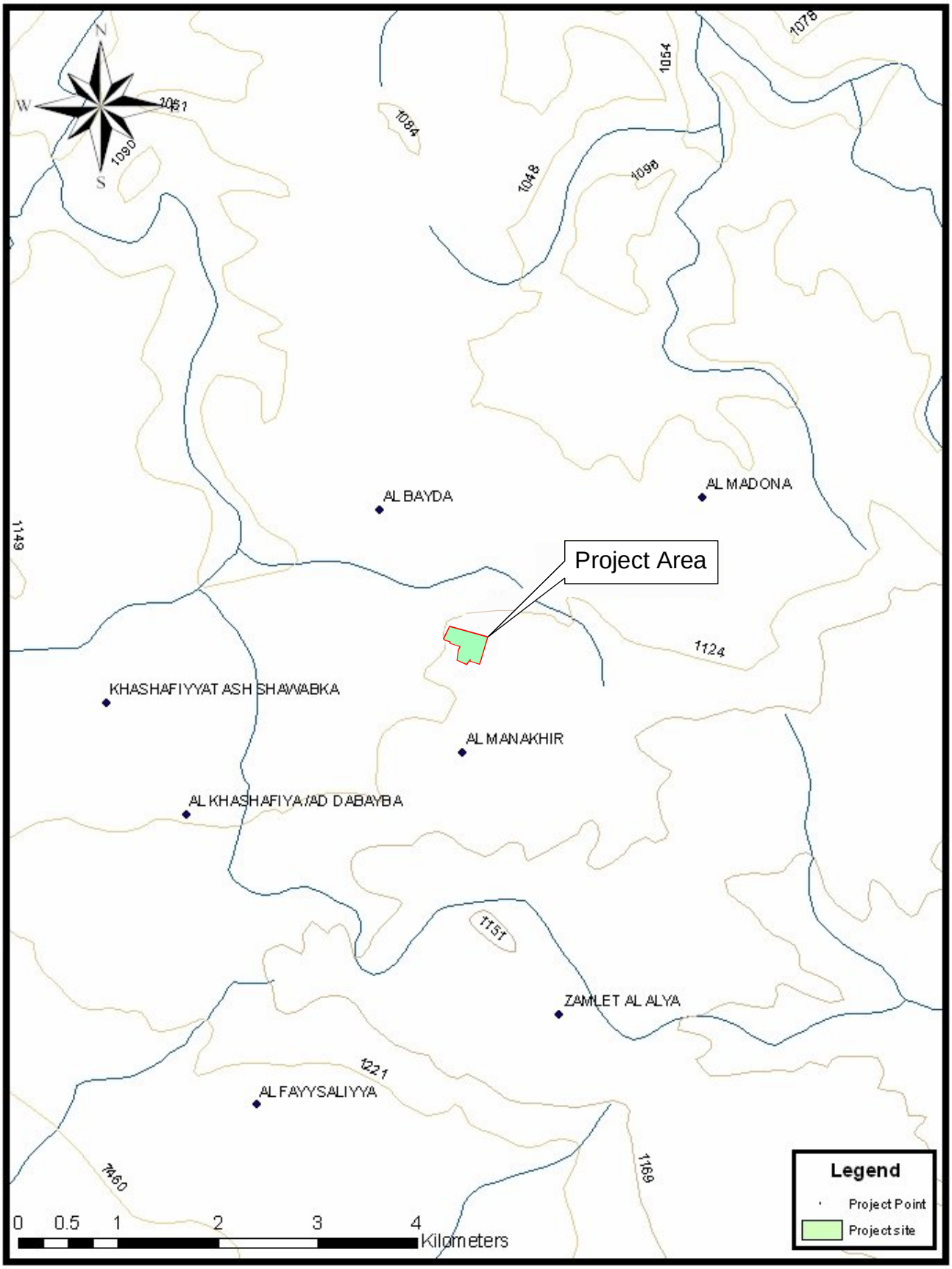

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IPP4 AL-MANAKHER POWER PROJECT

Title:
HYDROLOGICAL MAP OF THE PROJECT AREA

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3511309A	FIGURE 5.3		

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Upper Cretaceous Rocks

5.3.9 The Upper Cretaceous rocks are the most abundant rocks exposed at the Power Project site, and they overly the Lower Cretaceous rocks. The Upper Cretaceous rocks are further sub-divided in two groups, Ajlun and Belqa.

Ajlun Group

5.3.10 This group represents all the marine sediments of the Cenomanian-Turonian age and consists of: carbonate rocks; limestone; dolomite; marl; shale; chalk; and, sometimes sand stone.

5.3.11 The group reaches a maximum thickness of 500 to 550 m, with the group thickness decreasing gradually northwards, towards the river Zerqa and southwards towards Suweilih Flexure.

5.3.12 There are three principal formations of the Ajlun group which act as aquifers, these formations are the: Naur (A1/2); Hummar (A4); and, Wadi Sir (A7). The other principal formations of the Ajlun group act as aquitards, these formations are the: Shueib (A5/6); and, Fuheis (A3).

Belqa Group

5.3.13 This group represents all the sediments of the Paleocene- Eocene age and consists of: chert; limestone; chalk; marl; and, marly limestone.

5.3.14 The younger Balqa group consists of five formations, these are the: W.Shallah (B5); Rijam (B4); Muwaqar (B3); Amman (B2); and, W.Ghudran (B1).

Summary

5.3.15 The carbonate formations (of the Ajlun and Belqa groups) are classed as separate from each other based upon: the presence of fossil records; the mineralogical composition of the limestone; and, the presence of marl and chert. Table 5.5 shows the stereographical description of these two geological groups.

5.3.16 According to the Jordanian Geological Map, the site is located within the out crops of (B3) formation that is considered as a confining bed protecting the aquifer in the Power Project area from any possible pollution that may occur.

TABLE 5.5: SIMPLIFIED LITHO LOGICAL SUCCESSION FOR THE CENTRAL PARTS OF JORDAN

Era	*Period*		*Epoch*	*Series*	*Formation*	*Symbol*	*Lithology*
CENOZOIC	Quaternary		Holocene Pleistocene	Alluvium	Fuviatile Lacst & Eolian	RC	Soil, sand, gravel
					Basalt	Ba	
	Tertiary	Paleogene	Eocene	Balqa	W.Shallah (B5)	B5	Limestone, chalk, marl
			Paleocene		Rijam	B4	Chert, limestone, chalk, marl
					Muwaqar	B3	Marly limestone
					Amman	B2	Chert, limestone, phosphate
		Upper	Meastrichtian Campanian Santonian		W.Ghudran	B1	Chalk, marl, marly limestone
MESOZOIC	Cretaceous		Taronian Cenomanian	Ajloun	Wadi Sir	A7	Limestone, dolomite, chert
					Shuieb	A5,6	Limestone, marly limestone
					Hummar	A4	Dolomite, dolomitic limestone
					Fuheis	A3	Marl, marly limestone
					Naur	A1,2	Limestone, dolomitic limestone
		Lower	Albian	Kurnub	Subeihi	K2	Sand and shale, Clay and sandy and Limestone
			Aptian Neocomian Berriasian		Aarda	K1	Sandstone Marl and shale
	Jurassic		Tithomian Kimmeridgian Oxfordian				

Groundwater Aquifers Systems

5.3.17 The basin is divided into two parts. These are an eastern part to north-east of Wadi Zarqa that flows to the west, and a western part extending to the west of Wadi Zarqa and that flows to the east.

5.3.18 The average renewable groundwater quantity in the basin is approximately 88 MCM/Year, of which about 35 MCM/Year return to the surface as base flow along Zarqa River. The remaining 53 MCM/Year is pumped through wells distributed over the basin area.

5.3.19 The direct recharge to the basin comes from precipitation, floodwater flows and infiltration resulting from irrigation activities. The contribution of domestic, industrial and irrigation activities in groundwater recharge is estimated to be about 40 MCM/Year. The ground water quality in the basin is affected by various factors of such as over pumping, inflows of wastewater and leaching of solid wastes.

5.3.20 The basin consists of two main aquifers in the Power Project area. These are the deep Hummer formation (A4) and the shallow complex consisting of Wadi Sir Amman silicifid unit (B2/A7). These two aquifers are related to the Upper Cretaceous Hydraulic System.

Upper Cretaceous Hydraulic Aquifer

5.3.21 This Upper Cretaceous Hydraulic Aquifer consists of alternating sequences of: limestone; dolomite; marlstones; and, chert beds. The total thickness of the Hydraulic Aquifer in the central part reaches around 700 m.

5.3.22 The lower portion is the Naur formation (A1/2) which consists of about 200 m of limestone and marls. It gives rise to relatively high permeability and in some areas forms a good potential aquifer. An aquitard aquifer (A3) of 80 m thickness consisting of marl and shale overlies the Naur formation and separates it from Hummar formation (A4). The Hummar formation consists of semi crystalline limestone and hence it has very high permeability and porosity. This formation is confined by the overlying aquitard of the Shueib formation (A5/6). The Shueib formation consists of marls and limestone and is overlain by the aquifer of Wadi Sir formation (A7) and Amman silicified formation (B2). The Wadi Sir Amman silicifid unit (B2/A7) consists of limestone, chert-limestone, sandy limestone and marly limestone. The aquifer complex is overlain in the eastern desert by thick marl layer (B3) forming a competent confining bed.

5.3.23 The groundwater in the Hydraulic Aquifer is directed from eastern highlands, partly to the western escarpment within the faults, but mainly to the east where it discharges along the various wadies.

Power Project Area Aquifer Systems

Hummar Aquifer System (A4)

5.3.24 The Hummar Aquifer system comprises a karstified dolomitic limestone, light to dark grey in colour, hard, crystalline, coarse grained and high fractured. The thickness of this aquifer system ranges between 40 to 45 m.

5.3.25 This aquifer is overlain by an aquitared formation (A5/6) which separates the Hummar formation (A4) system from the Wadi Sir Amman silicifid unit (B2/A7) system.

5.3.26 The specific capacity of the Hummar Aquifer is determined to be in the range of 1.1 to 8.8 m^2/hr, with transmissibility ranging between 32 to 300 m^2/day and a hydraulic conductivity range from 6.59 to 6.7 m/day (Water Authority Open Files).

5.3.27 Studies undertaken estimate the total recharge of this aquifer (based on the flow- net analysis of groundwater) of about 5 MCM/Year, while the total abstraction of this

aquifer is about 7.4 MCM/Year (according to WAJ files). Therefore, it can be concluded that the water abstraction from the aquifer exceeds the recharge amount.

Wadi Sir-Amman Aquifer System (B2/A7)

5.3.28 The Wadi Sir-Amman (B2/A7) aquifer is considered as the most important aquifer in Amman-Zarqa Basin, consisting of: limestone; chert-limestone; sandy limestone; and, marly limestone. The aquifer complex is overlain in the eastern desert by a thick marl layer (B3) forming a competent confining bed. The groundwater recharge in this aquifer is from eastern highlands, partly to the western escarpment within the faults, but mainly to the east where discharge is along wadies.

5.3.29 The aquifer can be characterized as a karstified fractured rock aquifer. The karstification in the limestone and dolomites is unevenly distributed which leads to large heterogeneities in permeability and storability.

5.3.30 Parts of the aquifer are highly cavernous. In these areas the movement of groundwater is quite rapid, thus restricting is filtering ability. The exploitation of the B2/A7 aquifer has been increased enormously over the past decade and as a result water levels are declining rapidly. In the past few years, annual water level decline rates reach more than 2 to 3 m/year, while the general depth to water level exceeds 140 m for this aquifer in this part of Amman-Zerqa basin.

5.3.31 Groundwater uses in the Power Project area are represented by the pumped wells encountered in the catchment area. Five wells have been drilled within 4 km of the site.

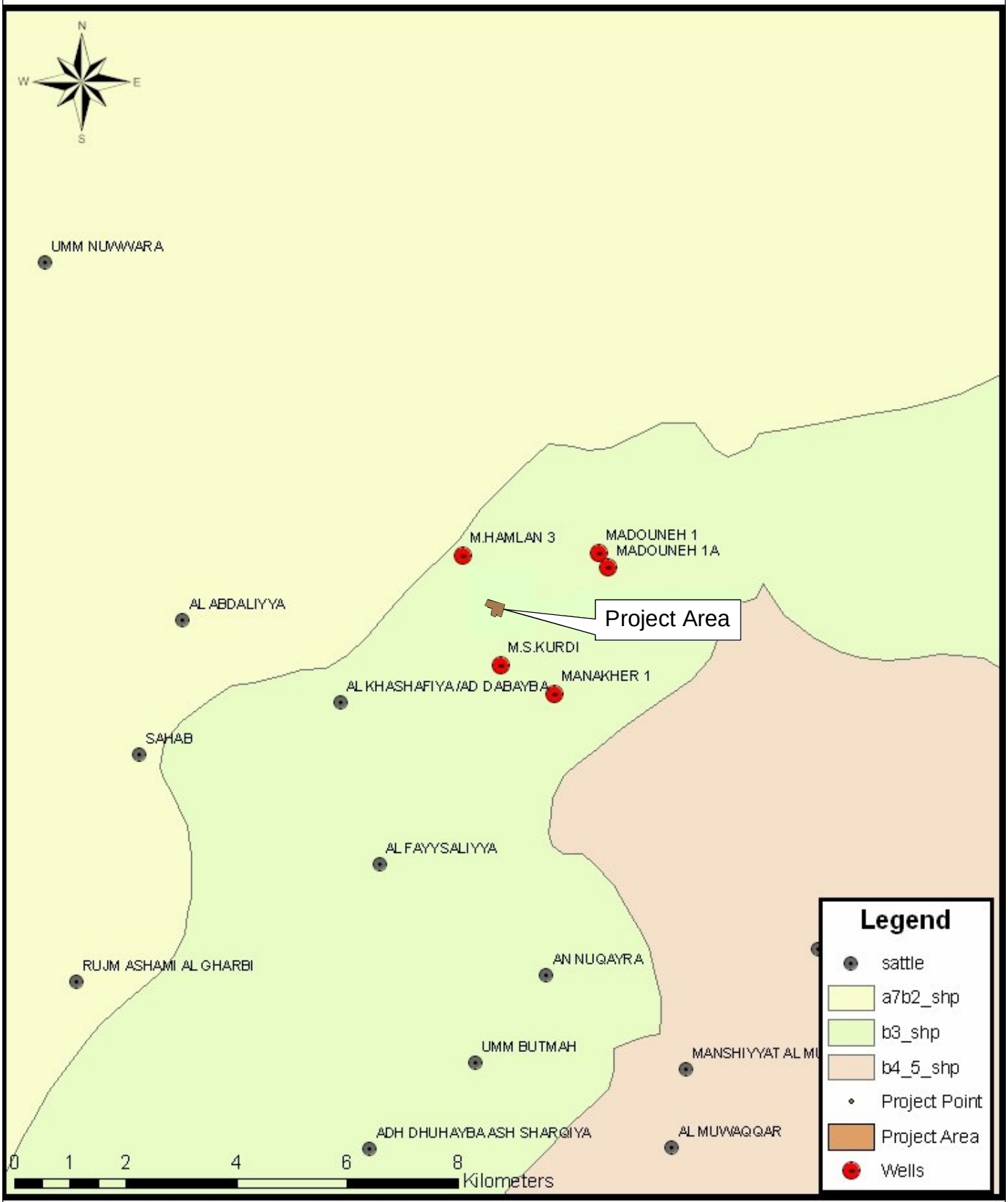
5.3.32 Table 5.6 gives the co-ordinates of the drilled wells close to the site (Source of data: Water Authority files). Figure 5.4 shows the locations of these wells. Studies of these wells have provided information about the nature of the aquifer system in the Power Project area. The pumped water from these wells is presently used for municipal and agricultural purposes.

5.3.33 All of these wells penetrated the Wadi Sir-Amman (B2/A7) Aquifer system, the depth of these wells range between 203 to 421 m, and the yield of these wells range between 16 to 66 m^3/hr, while the static water levels range between 148.3 to158 m below the surface.

5.3.34 There are two wells (AL 3433, AL3503) which penetrate the two aquifers in the Power Project area. The depth of these wells is about 359 to 421 m, and the yield is about 5 to 16 m^3/hr. The static water level in the wells is about 158 to 218 m below the surface.

TABLE 5.6: DRILLED WELLS CLOSE TO THE POWER PROJECT AREA

Well Name	*Well ID*	*Coordination*		*Well Depth*	*Altitude*	*Aquifer*	*S.W. Level*	*Yield*
		East	*North*					
AL1789	Madouneh 1	1146260	253930	203	58	148.3	B2/A7	810
AL1797	M.Hamlan 3	1146180	251470	220	66	169.3	B2/A7	836
AL1807	M.S.Kurdi	1144200	252200	350	-	-	B2/A7	875
AL3433	Al-Manakher 1	1143700	253170	421	5	218	2/A7, A4	880
AL3503	Madouneh 1A	1146000	254100	359	16	158	B2/A7, A4	812



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LOCATION OF WELLS CLOSE TO THE PROJECT AREA

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Groundwater Quality of the Upper Cretaceous Aquifer System

5.3.35 As discussed above, the basin consists of two main aquifers. These are the deep Hummer aquifer (A4) and shallow complex consisting of Wadi Sir Amman silicifid unit (B2/A7) aquifer.

5.3.36 In general from the recharge area of the Wadi Sir Amman silicifid unit (B2/A7) aquifer in the western highland to the discharge areas, there is an increase in salinity. Electrical Conductivity (EC) values vary considerably in the Amman-Zrqa basin from 480 to 8200 µs/cm. Also the Wadi Sir Amman silicifid unit (B2/A7) aquifer in Amman-Zarqa basin shows an increase in the concentration of nitrate, which is typically higher than 50 mg/l.

5.3.37 For the Ajlun aquifers in general, the salinity of groundwater is mostly low, but increases towards the highlands. Several wells with salinity higher than 2000 µs/cm due to over pumping are found in the central part of Amman-Zarqa basin. There is also an increase in nitrate concentration with values greater than 50 mg/l observed in the western part of Amman-Zarqa basin (WAJ Files). This would appear to be due to the over usage of fertilizers in agriculture, and the use of the permeable cesspits to dispose of waste water, especially in Jerash and Ajloun areas.

Surface Water Resources in the Area

5.3.38 There are three main sources for surface water in the area. These are: springs; treated wastewater; and, dams. These resources are all found around the Amman-Zarqa Basin. None are located within 4 km of the Power Project site.

5.3.39 Surface water in the vicinity of the Power Project site is limited to flash storms, which normally occur during the winter months. This surface water is not exploited as most of it either evaporates or percolates into the ground.

5.3.40 The average yearly rainwater (taken for the period 1980 to 2006) is approximately 233 mm during the winter months of October through March (Source of Data: Sahab Rainfall Station).

Relevant Legislation

5.3.41 The current Jordanian Guidelines for wastewater are provided in Table 5.7.

5.3.42 The World Bank / IFC Guideline on effluent quality are provided in Table 5.8.

5.3.43 In addition, it should also be noted that there are 'Water Protection' Regulations which have been issued to support the Environmental Protection Law (No.52, 2006) as necessary.

TABLE 5.7: JORDANIAN WASTE WATER STANDARDS (JS:202/2007)

Parameter	*Maximum Allowable Limit * (Irrigation for green-scaping land, fruitful tree and side road)*	*Maximum Allowable Limit * (Discharge to wadi)*
BOD_5	200	60
COD	500	150
DO	-	≤ 2
TSS	200	60
pH	6 – 9 SU	6 – 9 SU
NO_3	45	80
T-N	70	70
Color	-	15 PCU
Turbidity	-	15 NTU
Escherichia coli	1000 MPN/100 ml	1000 MPN/100 ml
Intestinal Helminthes Eggs	≤ 1 Eggs/l	≤ 1 Eggs/l
FOG	8	8
Phenol	< 0.002	< 0.002
MBAS	100	25
TDS	2000	2000
PO_4-P	30	15
Cl	400	350
SO_4	500	300
NH_4	-	5
HCO_3	400	400
SAR	9	9
TOC	-	55
CN	0.1	0.05
Ba	-	1
Al	5	2
As	0.1	0.05
Be	0.1	1
Cu	0.2	1.5
Fe	5	5
Li	0.075	2.5
Mn	2	2
Mo	0.01	0.01
Ni	0.2	0.2
Pb	0.2	0.2
Se	0.05	0.05
Cd	0.01	0.01
Zn		5
Cr	0.1	0.1
Hg	0.002	0.002
V	0.1	0.1
Co	0.05	0.05

B	1	1
Ag	-	0.1

(*): Units are in mg/l except where noted

TABLE 5.8: THE WORLD BANK / IFC EFFLUENT DISCHARGE LIMITS

Parameter	***mg/L, except pH and Temperature***
pH	6-9
Total Suspended Solids (TSS)	50 mg/l
Oil and grease	10 mg/l
Total residual chlorine	0.2 mg/l
Chromium – Total (Cr)	0.5 mg/l
Copper (Cu)	0.5 mg/l
Iron (Fe)	1.0 mg/l
Zinc (Zn)	1.0 mg/l
Lead (Pb)	0.5 mg/l
Cadmium (Cd)	0.1 mg/l
Mercury (Hg)	0.005 mg/l
Arsenic (As)	0.5 mg/l
Temperature increase by thermal discharge from cooling system.	• Site specific requirement to be established by the Environmental Assessment. • Elevated temperature areas due to discharge of once-through cooling water (e.g. 1 Celsius above, 2 Celsius above, 3 Celsius above ambient water temperature) should be minimized by adjusting intake and outfall design through the project specific Environmental Assessment depending on the sensitive aquatic ecosystems around the discharge point.
Note: Applicability of heavy metals should be determined in the Environmental Assessment. Guideline limits in the Table are from various references of effluent performance by thermal power plants.	

Water Users in the Area

5.3.44 The existing IPP1 to the north of the Power Project site is considered the only significant water user in the area. IPP1 has an agreement with WAJ which allows the use of up to 250 m^3 of water per day.

5.3.45 The next closest significant water user is an Industrial Site (the King Abdulla Industrial Estate, Sahab), located some 6 km to the south east.

5.4 Geology, Soils and Wastes

Introduction

5.4.1 A Desk Study and Site Investigation were undertaken in June 2011 to determine the geological baseline at the Power Project site and to assess its suitability for supporting a range of foundations. Additionally the Desk Study and Site Investigation aimed to determine whether there was any contamination present on the Power Project site.

5.4.2 17 boreholes were drilled to a maximum depth of 30 m below ground level (bgl) and 6 mechanically excavated trail pits were also dug.

5.4.3 A summary of the results (which provide the geological baseline at the Power Project site) are summarised in this Section.

Geological Setting

5.4.4 The Power Project site consists of undulating terrain sloping from the north-east to the south-west. It is sparsely vegetated, with rock outcrops in the more elevated north-easterly parts.

5.4.5 The Desk Study (which included examination of the geological maps of the area) indicated that the south-western corner of Jordan is characterised by Precambrian platonic, metamorphic and volcanic rocks. Thick sequences of sedimentary rocks of Paleozoic and Mesozoic age are exposed in south and south west parts of the country along the Wadi Arab and Dead Sea. These are overlain by marine carbonates, phosphates, and chert dating from the Upper Cretaceous and Tertiary.

5.4.6 The bedrock of the site and immediate surrounding area is characterised by rocks of the Muwaqqar Chalk Marl Formation. The rocks are described as pale gray to white soft to medium hard, thick bedded chalky marl and chalky limestone. These deposits are characterised by abundant marine fossils. Large micritic limestone concertions occur which in the formation are up to 2 m in diameter whilst a grey coloration in the upper part of the formation indicates local bituminization. The lithologies suggest that the rocks were formed through on a sea bed with pelagic sedimentation.

5.4.7 The Site Investigation noted several outcrops of bedrock in the area. At these locations, the bedrock was found to comprise white to creamy coloured, thinly to thickly bedded limestone, marl and chalk. This is in agreement with the geological maps of the area.

5.4.8 The road to the north of the existing IPP1 site passes through a cutting in the surface soil as it passes the north-eastern portion of the site. The cutting reveals the presence of marl and chalky limestone layers about 0.5 m to 1 m bgl in addition to microcrystalline limestone with chert outcrops and intercalations.

5.4.9 There is also a rather deep gulley in a ravine to the west of the site which reveals the presence of some dark brown silty clay and clayey silts with varying amounts of limestone rock fragments up to about 1 m bgl. The depth of silty clay is expected to be few meters in the ravine area while it expected to be shallower in the more elevated area.

5.4.10 During the Site Investigations, boreholes and trial pits were drilled and dug. The boreholes and trial pits recorded the following (generalised) geological sequence on the Power Project site from the surface down:

- Topsoil, comprising brown silty clay and marl with angular gravel, cobbles and boulders of limestone and chert.
- Chalk and Chalk Marl, which is white to brown in colour, medium hard and intercalcated with thin layers of chert and limestone.
- Marl and Clayey Marl, which is light brown to brown (wet) with thin layers of limestone.

Contamination / Chemical Analyses

5.4.11 The soil which underlies the Power Project site is considered to be relatively impermeable. It is also considered to be not conducive to the mobility / transport of heavy metals constituents.

5.4.12 Other than the existing IPP1, there is no discernible evidence of industrial installations in the immediate vicinity that would potentially be of concern with regard to any contamination of surface soils.

5.4.13 The site walkover did not identify the presence of any manmade waste, spills or wastewater at the site. No crops were observed requiring fertilizers and pesticides on-site.

5.4.14 There is a quarry located a few kilometres to the west of the site and the Al-Ghabawi municipal landfill (lined) is located some 12 km east of the site. These two installations represent the only significant industrial developments in the vicinity of the site, but do not represent a source of potential soil contamination due to distance.

5.4.15 There are no known underground fuel storage tanks or septic tanks on the Power Project site. The presence of such structures is highly unlikely give the nature of the site.

5.4.16 Several soil samples were submitted for the analysis as part of the Site Investigation. They were tested for sulphate and chloride in order to determine the likelihood of aggressive ground conditions being present which may cause disturbance to foundations, concrete and metal structures. The analysis revealed that aggressive ground conditions are not present at the Power Project site, and therefore special protection measures are not considered necessary.

Groundwater

5.4.17 No groundwater was recorded in any of the boreholes or trial pits.

5.4.18 Resistivity surveys undertaken at the Power Project site indicate that the depth of groundwater is greater than 50 m bgl. However, the moisture content of some of the deeper limestone marls and shallower cultivated soils is relatively high.

Geotechnical Investigation

5.4.19 Geotechnical parameters were recorded for soils samples submitted for testing as part of the Site Investigation. The geotechnical parameters recorded were:

- Moisture Content;
- Atterberg Limits;
- Grain size analysis;
- Unconfined compressive strength;
- Point load;

- Organic matter content;
- Consolidation test;
- Direct shear; and
- Moisture-density relationship.

5.4.20 The geotechnical parameters of the three geological horizons (described above in section 5.4.10) are summarised in Table 5.9.

TABLE 5.9: GEOTECHNICAL PARAMETERS AT THE POWER PROJECT SITE

Strata	*Moisture*	*Bulk Density*	*Plasticity*	*Compressive Strength*	*Strength (Rock Mass Rating)*
Topsoil	Dry		14 - 18	A-6, A-2-4	
Chalk and Chalk Marl	Dry to moist	1.9 - 1.0	6 - 11	A-2-6, A-2-4	Very Poor
Marl and Clayey Marl	Moist to wet	1.78 - 1.87	9 - 25	A-4, A-6	Very Poor

5.4.21 The allowable bearing capacity has been calculated based on the results of (amongst others) the Unconfined Test and Standard Penetration Tests.

5.4.22 The safety factor for foundations in the Chalk Marl is 10 – 15. Accordingly, a bearing capacity of 2.5 kg/cm^2 is recommended for engine houses and fuel tanks. A bearing capacity of 3.0 kg/cm^2 is recommended for other structures.

Conclusion

5.4.23 The baseline geology at the Power Project site comprises wet, very weak marl and clayey marl, which is overlain by chalk and chalk marl, which is overlain by chalky topsoil.

5.4.24 The Power Project site does not have aggressive or contaminated ground conditions.

5.4.25 No groundwater was recorded at the site, suggesting that any groundwater bodies are greater than 50 m bgl.

5.4.26 All foundations should have the bearing stresses less or equal to the recommended allowable bearing capacity. In addition, they should be stable under all types of loads.

5.5 Noise and Vibration

5.5.1 The baseline assessment focussed on locations on the Power Project boundary and Noise Sensitive Receptors (NSRs) in close proximity to the Power Project. Existing baseline conditions at each location were determined by an attended noise surveys during both day and night.

Project Boundary Noise Measurements

5.5.2 Short term monitoring was undertaken (a measurement period of 5 minutes, 3 recordings) at 10 locations on the Power Project boundary. Measurements covered day and night periods.

5.5.3 The Power Project boundary noise limits are as follows:

- Maximum day time L_{Aeq} of 70dB;
- Maximum night time L_{Aeq} of 65dB.

Noise Sensitive Receptor Measurements

5.5.4 Short term monitoring was undertaken (a measurement period of 5 minutes, 3 recordings) at the nearest residential NSR's in Al-Manakher Village. Measurements covered day and night periods.

5.5.5 The applicable noise limits for the residential receptors are as follows:

- Maximum day time L_{Aeq} of 55dB;
- Maximum night time L_{Aeq} of 45dB.

5.5.6 Continuous noise measurements were undertaken at Al-Manakher Village School over a period of 24 hours for 3 days. A measurement period of 60 minutes was used during the continuous measurements.

5.5.7 The applicable noise limit for the Al-Manakher Village School is as follows:

- Maximum day time L_{Aeq} of 45dB.

5.5.8 The locations of the NSRs are identified in an aerial photograph in Appendix C. Grid references for the NSRs are included in the Noise Monitoring Forms in Appendix D.

The following statistical parameters will be recorded: L_{Aeq}, L_{Amax}, and L_{Amin}.

Results of Survey

5.5.9 The results of the measurements are shown on the Noise Monitoring Forms included in Appendix D.

5.5.10 Table 5.10 summarises the lowest L_{Aeq} recorded at each location. Table 5.10 shows the background noise levels at the NSR's to be already exceeding the ambient regulatory noise limits.

TABLE 5.10: SUMMARY OF LOWEST RECORDED L_{Aeq} AT EACH MEASUREMENT LOCATION

Measurement Position	*Lowest Recorded L_{Aeq} (dB(A))*	
	Daytime	*Night-time*
Power Project Boundary		
Location 1	58.6	58.6
Location 2	49.1	49.6
Location 3	53.1	52.1
Location 4	49.4	51.1
Location 5	56.3	52.5
Location 6	54.1	47.5
Location 7	56.9	48.5
Location 8	49.2	46.1
Location 9	49.0	47.7
Location 10	53.9	46.3
Noise Sensitive Receptor		
Location 11 (School)	60.9	61.1
Location 12 (Residential)	56.4	54.4
Location 13 (Residential)	63.1	54.4

5.6 Landscape

5.6.1 Topography in the area is typical of the Highlands Topographic Region in which the Power Project site is located. The Highlands Topographic Region extends from Um Qais in the north passing through the Ajlun Mountains, the hills of Amman and Moab Regions, and the Edom Mountains Region.

5.6.2 Many creeks and wadies drain from these hills from north to south and lead to the River Jordan, Dead Sea and Wadi Araba. The southern highlands are higher than those in the north, though they are home to fewer species of vegetation types that also have a lower density.

5.6.3 The Power Project site comprises of north / west shallow slopes of Al-Manakher hills that are crossed by rainfall drainage small wadies towards the south.

5.6.4 There are a number of scattered houses to the north whilst the village of Al-Manakher lies to the south of the Power Project site boundary.

5.6.5 The site is bound to the north by the existing IPP1.

5.6.6 The Power Project site is not located close to any archaeological sites protected by Jordanian Legislation (Archaeology Law (No.21, 1988)).

5.7 Transport and Infrastructure

5.7.1 The existing transportation infrastructure in Jordan consists primarily of:

- Air Transportation: Jordan has three airports, two of are international (Queen Alia International Airport in Amman, and King Hussein International Airport in Aqaba). The third is civil airport (Amman Civil Airport).
- Sea Transportation: Aqaba city has the only port in Jordan, most of the imported and exported cargo are transported through Aqaba Port. In addition, this port is used for passengers travelling by boats to and out of the country.
- Land Transportation: The road network in Jordan has progressed in terms of design, construction and maintenance where currently the total length of the network in Jordan is 7,891 km, in 2009; divided into three types of roads (Main, Side, and Rural roads) as shown in Table 5.11 for Jordan and Amman.

TABLE 5.11: LENGTH OF ROADS NETWORK, 2009

Particulars	*Unit*	*Jordan*	*Amman*
Main	km	3,249	367
Side	km	2,173	222
Rural	km	2,469	331
Total	km	7,891	920

5.7.2 The Power Project site is located in the Al-Manakher area which falls under the management of the Sahab municipality. During the construction phase, the Azraq-Zarqa Road will be used for transporting the abnormal loads (machinery and heavy equipment). During the operational phase, the Zarqa-Sahab Road will be used for transporting HFO and DFO. NEPCO shall be responsible for fuel until it is delivered to site. In the event the given specification of fuel can be sourced in country then it shall be sourced locally. If this is not possible, fuels will be imported into Aqaba and delivered by road to the Project site via the Aqaba Back Road, Primary Trunk Road (No.15) and the new Amman Ring Road. The new Amman Ring Road is anticipated to be in operation at the time of Project commissioning.

5.7.3 In 2009, traffic counts were undertaken on the Primary Trunk Road (No.15). The highest daily vehicle movements of 41,669 were observed before the connection to the new Amman Ring Road

5.7.4 Table 5.12 shows the daily number of vehicles movements on the two roads in 2010.

TABLE 5.12: NUMBER OF VEHICLE MOVEMENTS, 2010

Main Roads	*Number. of Vehicles Per Day*
Zarqa - Sahab	22,124 To Zarqa
	22,393 To Sahab
Azraq- Zarqa	4,677 To Azraq
	4,135 To Zarqa

5.7.5 In 2009, the vehicle fleet of the Kingdom amounted to 994 753 vehicles (853 225 private and 99 691 public). Table 5.13 shows the number of licensed vehicle by type of vehicle, ownership and governorate in 2009.

TABLE 5.13: NUMBER OF LICENCENSED VEHICLES BY TYPE OF VEHICLE, OWNERSHIP AND GOVERNORATE, 2009

Type of Vehicle	*Jordan*	*Amman Governorate*
Saloons		
Private	651 798	544 974
Public	27 954	18 494
Buses		
Private	846	616
Public	2 336	1 896
Vans and Trucks		
Private	170 880	114 430
Public	31 606	23 105
Trailers		
Private	1 963	8 557
Public	4 642	24 129
Others		
Private	14 253	9 617
Public	32 001	998

5.7.6 Railway transport in Jordan is managed by the Hijaz Railway and the Aqaba Railway Corporation. The Hijaz Railway is used for transporting merchandize between Jordan and Syria, in addition to tourism purposes. The Aqaba Railway (292 km in length) is used for transporting Jordanian phosphate from Hasa to Aqaba.

5.7.7 The length of the portion of the railway in Jordan is about 452 km. Currently, the railway is not especially effective as a mode of transport. However, the Kingdom is aiming to expanding its railway system to allow for better integration with other countries in the region. Several investment projects are underway in order to improve the utilization of the railways through upgrading and expansion.

5.7.8 There are no railways within the immediate vicinity of the Power Project site.

Communication

5.7.9 Communication services in the Amman Governorate include the telecommunication system and mail services which are provided by private and public sectors.

5.7.10 Jordan Telecom is the only operator of fixed lines. Out of a population of 6.1 million, there are about 501 000 fixed line subscribers. Jordan Telecom also provides a mobile service and internet services. There are currently three mobile phone operators in Jordan. The number of telephone subscribers in the Amman Governorate is 359 280.

5.7.11 The number of post offices is 63 and the number of post boxes 101 716.

5.8 Socio-Economics and Land Use

5.8.1 The Power Project is located to the east of Amman, specifically the Sahab District (near Al-Manakher village). The Power Project site lies in a sparsely populated area.

5.8.2 With the exception of the existing IPP1, there is no industry in the immediate vicinity of the Power Project site. The nearest residential properties are in Al-Manakher Village to the south the Power Project Boundary. There is some agricultural activity in the area, including some olives and wheat crops and goat herds. However, the area is not one which is dominated by significant agricultural landholdings.

5.8.3 The Arab Gas Transmission Pipeline, which provides natural gas from Egypt to Jordan runs at a distance of approximately 1 km to the west of the site.

Demographic

5.8.4 Amman is the capital, and largest city, of Jordan. It is the area's political, cultural and commercial centre covering a total area of 7 579 km^2.

Population

5.8.5 In 2010, the population of Jordan was estimated at 6 113 000. This is an increase from 2009, where the population of Jordan was estimated at 5 980 000. This indicates a population growth rate of 2.2 per cent per annum, and a population density of approximately 68.8 people per square km.

5.8.6 The urban population is around 4 939 400, while rural population is around 1 040 600.

5.8.7 In 2009, the population of the Amman Governorate was estimated at 2 315 600 (which represents 38.7 per cent of the national population) with a population density of 305.5 people per square km. Furthermore, in 2009, the population of Sahab District was estimated at 68 010 and the population of Al-Manakher village was estimated at 436.

5.8.8 The Amman Governorate is divided into nine Districts as shown in Table 5.14.

TABLE 5.14: ESTIMATED POPULATION BY ADMINISTRATIVE DIVISION FOR AMMAN GOVERNORATE, 2009[1]

Administrative Division	*Population*
Amman Qasabah District	658,770
Marka District	576,880
Quaismeh District	306,740
Al-Jami'ah District	333,090
Wadi Essier District	207,220
Sahab District	68,010
Jizah District	50,140
Jizah Sub-District	42,160
Umm Al-Rasas Sub-District	7,980
Muqqar District	35,790
Muqqar Sub-District	22,320
Rajm Al-Shami Sub-District	13,470
Na'oor District	78,960
Na'oor Sub-District	47,770
Um Elbasatien Sub-District	12,430
Hosba'n Sub-District	18,760

Age Distribution

5.8.9 Jordanian society is currently characterized by its high population of young people. More than 37 per cent of the population is under the age of 15 years.

5.8.10 This is also true for the Amman Governorate, where the percentage of population under the age of 15 is 35 per cent. This is shown in Table 5.15. This impacts on the needs of the local community and its aspirations, and on both private and public development efforts. In addition, this population structure could affect how events develop in the city especially when linked with a lack of employment opportunities, as many sociologists believe to be the case.

TABLE 5.15: AGE DISTRIBUTION

Age Group (years)	*Age Distribution (%)*			
	Jordan[2] (2009)	*Amman Governorate[2] (2009)*	*Sahab District[3] (2004)*	*Al-Manakher Village[3] (2004)*
Less than 15	37.3	34.8	37.8	42.3
15 – 24	21.6	21	22.3	20.1
25 – 35	16.8	14.6	19.6	19.1
35 – 64	21.1	25.1	18.1	16.5
More than 65	3.2	4.5	2.2	2.0

Gender Distribution

5.8.11 The gender distribution of the populations of Jordan, Amman Governorate, Sahab District and Al-Manakher Village are shown in Table 5.16.

[1] *Source of Information: Jordan Statistical Yearbook*
[2] *Source of Information: Department of Statistics Website*
[3] *The data at Department of Statistics is only available for 2004*

TABLE 5.16: GENDER DISTRIBUTION

Sex	*Gender Distribution*			
	Jordan[4] (2009)	*Amman Governorate[4] (2009)*	*Sahab District[5] (2004)*	*Al-Manakher Village[5] (2004)*
Male	51.5	51.4	53.4	50.6
Female	48.5	48.6	46.6	49.4

Education

5.8.12 The Jordanian Government spends more than 5 per cent of Gross Domestic Product (GDP) on education and around 9 per cent on health. These investments are higher than those made by other lower-middle-income countries and have been instrumental in improving Jordan's literacy and health indicators.

5.8.13 Women have been equal beneficiaries of these policies. The main general educational services providers in Jordan are the Ministry of Education and the private sector, in addition to Armed Forces, which provide this service to the remote areas in the country.

5.8.14 The educational level in Jordan consists of:

- Kindergartens (2 years)
- Basic Education (10 years)
- Secondary Education (2 years).

5.8.15 Jordanians are relatively well educated, where illiteracy rate is 7.2 per cent for those above 15 years old. Table 5.17 illustrates the gender gap in education in Jordan.

TABLE 5.17: GENDER GAP IN EDUCATION IN JORDAN, 2009[6]

	Male %	*Female %*	*Gender Gap %*
Illiteracy Rate (Population Age15 +)	4.1	11.4	-7.3
Change in Illiteracy Rates (compared to 1990)	55.4	54	1.4
Children in Kindergarten	52.4	47.6	4.8
Students in Basic Education	50.6	49.4	1.2
Students in Secondary Education	49	51	-2
Students in Vocational (Industrial) Education	98.5	1.5	97
Students in Vocational (Trade) Education	52.4	47.6	4.8
Students in Vocational (Agricultural) Education	84.9	15.1	69.8
Students in Higher Education	48.7	51.3	-2.6
Students in Science Colleges	54.4	45.6	8.8
Students in Art Colleges	44.2	55.8	-11.6

5.8.16 In 2009, the average number of students enrolled in all schools in Jordan was 1 643 349 students and the number of teachers providing education was 94 128. Furthermore, the total numbers of students in the Amman Governorate was 544 900 students.

[4] *Source of Information: Jordan Statistical Yearbook*
[5] *The data at Department of Statistics is only available for 2004*
[6] *Source of Information: Department of Statistics Website*

5.8.17 In Jordan, there are 5 718 secondary schools, 50 colleges, 8 public and 13 private Universities and 49 Vocational Training Centres.

5.8.18 The distribution in education levels for Jordan, Amman, Sahab District and Al-Manakher Village are shown in Table 5.18.

TABLE 5.18: EDUCATIONAL LEVELS (%)

Educational Level	*Jordan[7] (2009)*	*Amman Governorate[7] (2009)*	*Sahab District[8] (2004)*	*Al-Manakher Village[8] (2004)*
Illiterate	7.2	5.1	9.3	8.3
Less than Secondary	53.4	48.9	52.7	71.7
Secondary	18.1	20.3	24.1	15.1
Intermediate Diploma	8.4	9.5	7.64	2.0
Bachelor and Above	13.1	16.2	6.25	2.7

Economic Characteristics for the Amman Governorate

Household Income and Expenditure

5.8.19 The average family size in Jordan and Amman is 5.4 and 5.1 respectively.

5.8.20 The average family annual income is 7 590.4 JD in Jordan and 8 896 JD in Amman. In 2008, the average family annual income in Al-Mankher Village was 6475.3 JD.

Labour Force

5.8.21 In 2010, the total labour force of the Jordanian population was approximately 1 412 134.

5.8.22 The number of economically active males was approximately 1 152 853, representing 81.6 per cent of the total labour force in Jordan. The number of economically active females was approximately 259 182, representing 18.4 per cent of the total labour force in Jordan.

5.8.23 The unemployment rate in Amman Governorate is around 11.6 per cent compared to 12.5 per cent nationally.

5.8.24 Table 5.19 shows the percentage of the economically active and inactive persons in Amman Governorate.

TABLE 5.19: ECONOMICALLY AND NOT ECONOMICALLY ACTIVE PERSONS (%) IN 2008[9]

Activity Status	*Jordan*	*Amman*
Economically Inactive	60.5	59.8
Economically Active	39.5	40.2
Employed	34.5	36.3
Unemployed	5.0	3.9

[7] *Source of Information: Governorates Indicators*
[8] *The data at Department of Statistics is only available for 2004*
[9] *Source of Information: Department of Statistics Website*

Infrastructure and Basic Services in the Amman Governorate

Communication

5.8.25 Communication services in the Amman Governorate include the telecommunication system and mail services which are provided by private and public sectors.

5.8.26 Jordan Telecom is the only operator of fixed lines. Out of a population of 6.1 million, there are about 501 000 fixed line subscribers.

5.8.27 Jordan Telecom also provides a mobile service and internet services. There are currently three mobile phone operators in Jordan. The number of telephone subscribers in Amman Governorate is 359 280.

5.8.28 The number of post offices is 63 and the number of post boxes 101 716.

Health Care

5.8.29 Health care in the Amman Governorate is provided by the Ministry of Health, the Armed Forces and the private sector. There are 51 hospitals in the Governorate (comprising 5 public hospitals, 39 private hospitals and 7 government hospitals). There are 6 305 hospital beds in the Governorate.

5.8.30 The Amman Governorate also has the following facilities and centers:

- 81 Health Centres;
- 33 Village Clinics;
- 72 Maternity and Child Health Centres;
- 56 Dental Clinics;
- 1 Epidemic Disease Centre; and,
- 1,101 Pharmacies.

5.8.31 There are three Health Clinics available at Sahab city; one of them located at Al-Manakher Village.

Housing

5.8.32 Housing in Jordan varies from small-crowded dwellings to large villas. In 2004, the total number of buildings in Jordan was estimated at 634 909. The total number of buildings in the Amman Governorate was estimated at 182 666.

5.8.33 The cost of living in Jordan is quite low compared to industrially developed ratios and neighbouring countries of the Middle East North Africa (MENA) region. In 2004, there was an inflation rate of 3.4 per cent.

5.8.34 Table 5.20 shows the fuel prices in Jordan in 2011 according to the Jordan Petroleum Refinery Company.

TABLE 5.20: FUEL PRICES IN JORDAN, 2011

Fuel	*Price*
Unleaded 90 Octane	0.620 JD / litre
Unleaded 95 Octane	0.795 JD / litre
Diesel, Kerosene	0.515 JD / litre
Cooking Gas	6.50 JD / cylinder

5.8.35 The electricity consumption per capita in Jordan is 2427 kWh and the percentage of the population supplied with electricity is 99.9 per cent. The total number of inhabitants in the Amman Governorate who are serviced by electricity is 1 425 800.

5.8.36 Table 5.21 shows the prices of electricity by usage in Jordan.

TABLE 5.21: ELECTRICITY TARIFF IN JORDAN, 2008[10]

Price of Electricity for Utility and Domestic Use	***Fils/kWh***
1 to 160 kW/h (monthly)	32
161 to 300 kW/h (monthly)	71
301 to 500 kW/h (monthly)	85
501 kW/h and above (monthly)	113
Commercial Use	86
Industrial Use	49
Agricultural Use	47
Water Pumping	41
Hotels	86

5.8.37 The Amman Governorate received 41.4 per cent of the kingdom total water supply. Water and sewer services in Jordan are heavily subsidized.

5.8.38 The revenue covers only part of the operation and maintenance costs. The tariff system is an increasing-block system, under which users pay a higher tariff per cubic meter if they consume more water. The first block (corresponding to a consumption of 20 m^3 per quarter) is a minimum charge independent of the amount of water consumed. In 2010, the residential minimum charge in Amman was 5.12 JD / quarter for water and sewerage, including a fixed surcharge of 2.15 JD and a meter fee of 0.3 JD. This corresponds to an average unit tariff of 0.26 JD/m^3 water (US$0.37/$m^3$ water). For a consumption level of 20 m^3 per month (60 m3 per quarter) the average unit tariff is 0.4 JD/m^3 water (US$0.65/$m^3$ water).

5.8.39 The intermittent supply of water leads many people to rely on bottled or tanked water. This is between 8 to 10 times higher in price than piped water. Therefore, the total household expenditures are often much higher than the utility bill.

Land Use

Agriculture

5.8.40 Due to the scarcity of water resources, agricultural activities in Jordan are limited.

5.8.41 In 2009, the agricultural sector contributed 3 per cent to the GDP. This was boosted by irrigation and technological advancements in farming methods, especially drip irrigation. The work force in the agricultural sector is estimated to be about 10 per cent of the workforce at the national level.

5.8.42 In 2010, the total planted area in Jordan was estimated at 2 241 917 donums[11]. Table 5.22 shows the distribution of this planted area.

[10] *Source of Information: Jordan Electric Power Company*
[11] *Donum = 1000m^2*

TABLE 5.22: PLANTED AREA IN JORDAN AND AMMAN, 2009[12]

Agriculture Indicator	*Unit*	*Jordan*	*Amman Governorate*
Planted area with fruit trees	Donum	822 570	85 755
Planted area with field crops	Donum	1 007 552	225 168
Planted area with vegetables	Donum	411 795	31 485

5.8.43 In Jordan natural grazing lands, as well as barley and hay production from grains and legumes, comprise the main forage production which maintain livestock during winter. There are almost 3 055 200 heads of livestock in Jordan. Of this, 540 930 heads of livestock are located in the Amman Governorate.

Industrial Sector

5.8.44 Jordan is very attractive for foreign investments, due to many reasons such as those relating to safety, political stability and its central location in the Middle East.

5.8.45 Industry in Jordan is divided into two main types:

- Manufacturing (Converting) Sector.

  This includes: leather and footwear manufacturing; chemical industry; plastic industry; IT industry; furniture industry; food industry; packaging industry; and the engineering products manufacturing sector.

  This Sector contributes approximately 18 per cent of the Jordanian GDP.

- Mining Sector.

  This Sector contributes approximately 2.6 per cent of the Jordanian GDP.

5.8.46 There are 21 207 industrial establishments in Jordan. This represents 48.5 per cent of the industrial sector in Jordan. Of this, 10 292 industrial establishments are located in the Amman Governorate.

5.8.47 There are three Industrial Qualified Zones (QIZ) in the Amman Governorate. These are: King Abdullah II Industrial Zone in the Sahab municipality; Qastal Qualified Zone in Jiza municipality; and, Tujma'at Industrial Xone in Sahab municipality.

Electricity Production

5.8.48 There is anticipated to be a significant growth in electrical demand in Jordan over the coming years.

5.8.49 Accordingly, the Government of the Hashemite Kingdom of Jordan has established a number of objectives to facilitate the development of the national power sector.

5.8.50 These objectives include:

- Provision of a secure electricity supply to meet the country's domestic internal demand;
- Generate sufficient amounts of electricity to allow the Kingdom to export electricity to other countries in the region;
- Develop the national electricity network to allow for the interchange of energy, internally and to neighbours in the region; and
- Attracting of private investment (domestic and foreign) to the Jordanian power sector.

[12] *Source of Information: Jordan Statistical Yearbook.*

5.8.51 The Jordanian Government has a particular interest in attracting foreign investment to Jordan. To this end, the Government has passed legislation and is implementing policy initiatives to continue to encourage this investment. The Government wants to introduce Independent Power Producers (IPP) to Jordan, and it is particularly interested in participating (via such IPPs and interconnection to neighbouring national girds) in the development of a regional power market. Jordan offers the region a favourable geographic location, a well developed and efficient infrastructure, political and economic stability, and a quality human resource base with a solid commercial orientation that makes it suitable to offer this service.

5.9 Ecology

5.9.1 The ecological studies undertaken have assessed the direct and indirect impacts of the Power Project on various aspects of terrestrial biological environment. The ecological studies cover the direct and indirect impact over the construction, operation and decommissioning phases of the Power Project.

5.9.2 The ecological studies have included consideration of:

- *Bio-Geographical Zones in which the Power Project is located with regard to Flora in the Area.*

  This has included consideration of: typical vegetation coverage; vegetation communities; and, rare and endangered vascular plant species.

- *Fauna of the Area.*

  Among this large taxonomic group, there are certain smaller groups to study which are considered to represent 'easy to assess' bio-indicators for the status of the fauna due to their higher tropic levels. These groups are: large mammals; conservation important small mammals; birds (especially the conservation important resident species); and, conservation important reptiles.

- *Sensitive Habitats.*

  These are the areas of biological importance, which include; Protected Areas; National Parks; Range Land Reserves; Important Bird Areas; Wetlands under Ramsar sites; Unique Habitats / Ecosystems; and, isolated natural sites (Biodiversity Islands).

5.9.3 This assessment has correlated these target biological environment aspects with their physical environment units. The effects of the predicted impacts that would occur for these physical environment units on the biological environment aspects in the Power Project area are then examined.

Assessment Methodology

5.9.4 In order to meet the objectives and scope of the assessment, a variety of methods were employed to assess the existing biological environment aspects in the area and to evaluate the expected impacts on these aspects dependent on the subject being studied.

5.9.5 Assessment methods included the following:

- *Literature Survey.*

  The survey team collected and reviewed the available data relating to the biological environment in the Power Project area. Data collection was achieved through:

  - Library search for the available reference information on the biodiversity or any biologically sensitive areas identified.

- References from institutions that are working in this field of specialty such as, Ministry of Environment (MoE), Royal Society for Conservation of Nature (RSCN) and University scientists and specialists.

- *Field Work Surveys.*

  These surveys were undertaken to confirm the Literature Survey findings. A number of different techniques were used in the field to assess the biological environment as the following:

  - Line Transects: This technique was used to study most of the biological aspects of environment as the following:
    - Flora: Line transects were employed to study changes in vegetation along a physical environmental gradient. This also allowed the surveyor to estimate overall density of cover values of species of a single type of vegetation. This can be correlated to various physical environmental factors such as: salinity; humidity; soil composition; and, topography, etc.
    - Fauna: This involved the surveyors walking the area in a systematic way that enabled them to cover the whole area. This technique was applied for different target groups of fauna as follows:
      - Birds: Line transects are effective methods to study birds of extensive open habitats in both terrestrial and wetland habitats. This method was used to identify counting density along various environmental gradients.
      - Mammals: Line transect were walked for both large and small mammals, and for large reptiles. This represents the most practical and direct method for counting mammals and or recording them through a gradient of various environmental factors. It depends mainly on recording their singes like foot pints, spoors and body remnants.
  - Spotlight Technique: This method was applied for large terrestrial mammals and reptiles also for nocturnal birds. This was implemented easily by car in the area to record the habitat use for these nocturnal species.

- *Interviewing Technique.*

  This technique was used to study the historical record for the flora and fauna of the area. It was used to correlate the environmental changes with the change on the biological environment, then to build up the prediction for the future trend in biological environment with the presence of the expected impacts of the Power Project.

  This technique depends on designing a questionnaire and distributing it between old locals in the area. The questionnaire is then filled in by the locals themselves or with the help of the surveyors in the field.

- *Photographing Technique.*

  This technique was used to document the recorded data, especially the important biological features of the study sites. It was necessary for this study to identify 'photo stations' for selected sampling units in the area. This aids future monitoring, for example by documenting early stage of changes that can happen to the biological diversity in this area.

Existing Environment

5.9.6 No protected sites are close. The closest protected area is located between 80 to 100 km from the Power Project site, and closest national park is not less than 25 km from the Power Project site.

5.9.7 The Power Project site lies in the Al-Manakher area on unused land owned by the Ministry of Finance / Department of Lands and Surveys.

Topography

5.9.8 Topography in the area is typical of the Highlands Topographic Region in which the Power Project site is located.

5.9.9 The Highlands region extends from Um Qais in the north passing through Ajlun Mountains, the hills of Amman and Moab regions, and the Edom mountains region. Many creeks and wadies drain from these hills from north to south and lead to the river Jordan, Dead Sea and Wadi Araba. The southern Highlands are higher than those in the north, though they are home to fewer species of vegetation types that also have a lower density.

5.9.10 The Power Project site comprises of north / west shallow slopes of the Al-Manakher Hills that are crossed by small rainfall drainage wadies toward the south.

Soil Type

5.9.11 There is a direct correlation between soil type, and the vegetation types.

5.9.12 Al-Eisawi (1985) concluded that the soil of Jordan is highly variable, and that this directly affects the vegetation type. The soil type at the area of the Power Project is Terra-Rosa and / or Rendzina soil. These soil types are found in the Mediterranean zone in which the Power Project site is located. They are considered the richest soil types, and are used for cultivation. As such, annual harvests form the main agriculture practice in the area in general.

Climate

5.9.13 According to the analysis made by Al Eisawi (1996), which was based on Emberger quotient (EMBERGER, 1955), the Power Project area is located in the Semi-arid Mediterranean Bioclimatic Zone.

5.9.14 The average minimum temperature during the coldest month (January) varies between -1°C and +7°C. The average maximum temperature during the hottest month (August) varies between 26°C and 33°C.

Existing Biological Environment

5.9.15 This section discussed the fauna and flora of the Biogeographic Zone in which the Power Project site is located.

Flora

5.9.16 Jordan can be split in to a number or Biogeographic Zones, which vary in the nature of their fauna and flora.

5.9.17 The Power Project site exists in the Mediterranean Biogeographic Zone, which is restricted to the highlands of Jordan extending from Irbid in the north to Ras Al-Naqab in the south. The altitude of this Biogeographic Zone ranges from 700 to 1750 m above sea level with rainfall typically ranging from 300 to 600 mm.

5.9.18 The minimal annual temperature ranges from 5 to 10°C and the mean maximum annual temperature from 15 to 25°C.

5.9.19 Soil types in this Biogeographic Zone are dominated by the red Mediterranean soil (Terra Rosa) and the yellow Mediterranean soil (Rendzina). As such, this

Biogeographic Zone comprises the most fertile part of Jordan and presents the best climate for the forest ecosystem.

5.9.20 The Power Project area is represented in one major ecosystem. This is the Scrap and Highland Ecosystem. This consists of escarpments, mountains, hills and undulating plateaus which extend mainly from Irbid in the north to Ras Al Naqab in the south, and from the Rift Valley region in the west to the Badia in the east.

5.9.21 The Mediterranean type woodland of pine and oak, with juniper and cypress, which can be found within this ecosystem area is believed to have originally covered large tracts of the Jordanian highlands. However, human and climatic factors have resulted in high deforestation and replacement of natural vegetation by species that would not necessarily have been found in the area in the past.

5.9.22 The largest remaining areas of natural woodland occur in the highlands between Amman and North of Jordan. These areas of natural woodland are dominated by *Pinus halepensis* above 700 m. At lower elevations mixed evergreen / deciduous oak woodland of *Quercus calliprinos* and *Quercus ithaburensis* dominate where the original pine-dominated woodland has been degraded.

5.9.23 Cultivation of rain fed wheat is widespread between Madaba and Irbid. Olive groves cover a large part of the north-western mountains above 700 m. More than 80 per cent of Jordan's cities and villages occur within this Biogeographic Zone.

5.9.24 Two vegetation types characterise the Power Project area. These are:

- Steppe; and,
- Mediterranean non-forest vegetation.

5.9.25 These are discussed below.

Steppe Vegetation

5.9.26 Steppe Vegetation is confined to the Irano to Turanian Biogeographic Zone and may intrude either into the Mediterranean Biogeographic Zone (which is where the Power Project site is located) or the Saharo-Arabian Biogeographic Zone.

5.9.27 The composition of this vegetation varies according to the soil and climatic differences depending on its location with respect to the Mediterranean Biogeographic Zone. For example the steppe vegetation in the Northern Ghor (which links with the Northern Mountains) is dominated by *Retama raetam*, *Ziziphus lotus*, *Ziziphus nummularia*, and *Ferula communis* with almost no *Artemizia herba-alba.* However, the steppe vegetation in the north, east and south Mediterranean borders shows other elements like Pistacia *atlantica*, *Anabasis syriaca* and *Artemisia herba-alba.* These are not found in the Western Steppes. This maybe due to the fact that the Western Steppes are more affected by the tropical conditions and vegetation in the Rift Valley, while the Eastern Steppes are more affected by the Sahara conditions and vegetation.

5.9.28 Variations in the vegetation composition are recognized. This is a fact that has led to a distinguishing of distinct sub-divisions of the major types. However, since it is very difficult to make a clear distinction it would not be advisable to sub divide this type of vegetation.

5.9.29 The common features of steppe vegetation are the presence of shrubs and bushes and the absence of tree vegetation. This steppe vegetation forms a strip surrounding the Mediterranean Biogeographic Zone. The common species in this type are:

Retama raetam	*Artemisia herba-alba*	*Pistacia atlantica*
Noaea mucronata	*Ziziphus lotus*	*Ziziphus nimmularia*
Asphodelus aestivus	*Urgiea maritime*	*Anabasis syriaca*

Ferula communis	*Hammada spp.*	*Gypsophila Arabica*
Salsola spp.	*Astragalus spinosus*	*Tamarix spp.*
Crocus moabiticus		

5.9.30 Conservation important species are:

Family	***Species***	***Importance***
Caryophyllaceae	*Paronychia argentea*	Used in traditional medicine for the treatment of kidney stones / under pressure
Chenopodiaceae	*Salsola vermiculata*	Palatable for livestock
Compositae	*Achillea fragrantissima*	Used in traditional medicine for the treatment of stomach ache and digestive disorders / under pressure
	Artemisia herba alba	Used in traditional medicine for the treatment of stomach ache and digestive disorders / under pressure and palatable for livestock
	Ifloga spicata	Palatable for livestock
Cucurbitaceae	*Citrullus colocynthis*	Used in traditional medicine for the treatment of Arthroides
Graminae	*Poa sinaica*	Palatable for livestock
	Stipa capensis	Palatable for livestock
Labiatae	*Teucrium polium*	Used in traditional medicine for the treatment of stomach ache / under pressure
Liliaceae	*Urginea maritime*	Used in recent medicines for the treatment of heart disorders.

Mediterranean Non-Forest Vegetation

5.9.31 In the areas where it is not covered by forest, the Mediterranean Biogeographic Zone contains some shrubs and bushes. The vegetation in these areas is often referred to as Garigue and Batha Mediterranean vegetation. In the north, the leading species of Mediterranean vegetation are *Rhamnus palaestinus*, *calycotome villosa*, *Sarcopoterium spinosum* and *Cistus spp*. In the south, the leading species of Mediterranean vegetation is *Artemisia herba-alba* which will be associated with others.

5.9.32 The Mediterranean Non-Forest Vegetation is considered as degraded forest. Therefore, some scientists believe that if this vegetation is protected, steps toward forest climax will be observed until the final stage is reached. This vegetation is found in the entire Mediterranean Biogeographic Zone, except in the forest and cultivated lands.

5.9.33 The common species of Mediterranean Non-Forest Vegetation are:

Rhamnus palaestinus	*Capparis spinosa*	*Echinops spp.*
Sarcopoterium spinosum	*Dactylis glomerata*	*Horedeum bulbosum*
Teucrium polium	*Varthemia iphionoides*	*Ononis natrix*
Artemisia herba-alba	*Ballota undulata*	*poa bulbosa*
Eryngium glomeratum	*Thymus capitatus*	*Noaea mucronata*
Asphodelus aestivus	*Calycotome villosa*	*Asparagus aphyllus*

5.9.34 Conservation important species are:

Family	*Species*	*Importance*
Araceae	*Biarum angustatum*	Common but start to decrease. Sensitive to ploughing
Compositae	*Scorzonera papposa*	Common / recently under pressure as roots collected and edible
	Achillea falcate	Used in traditional medicine for the treatment of stomach ache / under pressure
	Varthemia iphionoides	Used in traditional medicine for different digestive disorders.
	Phagnalon rupestre	Used in traditional medicine (Burning) for all joints pains.
Cruciferae	*Allysum iranicum*	Restricted to Ras al Naqab area
Graminae	*Poa bulbosa*	Palatable for livestock
Leguminosae	*Ononis natrix*	Palatable for livestock
	Onobrychis crista-galli	Palatable for livestock
Liliaceae	*Allium truncatum*	Recently under pressure as bulbs collected and edible
Malvaceae	*Malva parviflora*	Leaves collected and edible
Rhamnaceae	*Rhamnus palaestinus*	Decreasing / cut for fire wood

Fauna

5.9.35 The principle sources of interest with regard to fauna in the project area are mammals and birds.

Mammals

5.9.36 The mammals in the area could potentially include nearly all the mammals found in the two Zoogeographic Zones in the vicinity of the Power Project site. These are the Mediterranean Zoogeographic Zone and the Saharo / Sindian Zone (also referred to as the Saharo-Arabian and Irano-Turanian Phytogeographic region by Zohary (1973)). These are discussed in detail below.

Mediterranean Zoogeographic Zone

5.9.37 This is a distinct sub-region within the Palearctic Region (European Origin) and includes mountain areas that extend from the north of Jordan to the Al Naqab Mountains in the south.

5.9.38 Important mammals found in the Mediterranean Zoogeographic Zone include:

Family	*Scientific name*	*Common name*	*Status*
Erinaceidae	*Erinaceus concolor*	Common Hedgehog	Insufficient data
	Hemiechinus auritus	Long-eared Hedgehog	Insufficient data
Soricidae	*Corcidura suaveolens*	Lesser white-toothed shrew	Vulnerable
Canidae	*Canis aureus*	Golden jackal	Vulnerable
	Canis lupus	Grey Wolf	Nationally threatened
Felidae	*Felis caracal*	Caracal	Nationally endangered
	Felis silvestris	Wild Cat	Vulnerable
Herpestidae	Hepestes ichneumen	Egyptian mongoose	Vulnerable
Hyaenidae	*Hyaena hyaena*	Striped hyena	Nationally threatened
Mustelidae	*Martes foina*	Rock Marten	Nationally threatened
	Meles meles	Common Badger	Nationally threatened
	Vormela peregusna	Marbled Polecat	Vulnerable
Procaviidae	*Procavia capensis*	Hyrax	Nationally threatened
Spalacidae	*Spalax leucodon*	Mole Rat	Vulnerable
Hystricidae	*Hystrix indica*	Indian crested porcupine	Vulnerable

Saharo-Sindian Zone

5.9.39 The Saharo-Sindian Zone is located to the east of the mountain ranges, extending from south of Jordan to north-east of the country in Mafraq area. It is another sub-region within the Palearctic Region (European Origin) and includes the Sahara Desert and the Arabian Desert. The majority of the mammals in the vicinity of the Power Project belong to this Zone.

5.9.40 Important mammals found in the Saharo-Sindian Zone include:

Family	*Scientific name*	*Common name*	*Status*
Erinaceidae	*Paraechinus aethiopicus*	Desert Hedgehog	Insufficient data
	Hemiechinus auritus	Long-eared Hedgehog	Insufficient data
Soricidae	*Corcidura suaveolens*	Lesser white-toothed shrew	Vulnerable
Canidae	*Canis aureus*	Golden jackal	Vulnerable
	Canis lupus	Grey Wolf	Nationally threatened
	Vulpes cana	Blanford's fox	Nationally endangered
	Vulpes rueppelli	Sand Fox	Nationally endangered
Felidae	*Felis caracal*	Caracal	Nationally endangered
	Felis silvestris	Wild Cat	Vulnerable
	Felis margarita	Sand Cat	On the verge of extinction
Hyaenidae	*Hyaena hyaena*	Striped hyena	Nationally threatened
Mustelidae	*Vormela peregusna*	Marbled Polecat	Vulnerable
	Mellivora capensis	Honey Badger	Nationally threatened

Procaviidae	*Procavia capensis*	Hyrax	Nationally threatened
Bovidae	*Capra ibex*	Nubian Ibex	Nationally endangered
Hystricidae	*Hystrix indica*	Indian crested porcupine	Vulnerable

Birds

5.9.41 Jordan has a wide diversity of bird habitat types due to its varied topography, climate and its biogeographical location. More than 363 bird species have been recorded in Jordan, of which more than 141 species are breeding birds. However, it is also noted that this number might increase with continuous research.

5.9.42 Jordan lies on the main route of bird's migration between Africa, Asia and Europe. Millions of birds are migrating over Jordan each year. These migratory species represent the majority of Jordanian avifauna. The large number of migrant birds that visit Jordan twice a year has made the country of a great importance for the global avifauna.

5.9.43 The Power Project area is not located on a migration fly way. However, it is close to the west of the raptors and eastern desert fly way for migratory birds.

5.9.44 The important breeding birds in Jordan include:

Family	***Scientific Name***	***Common Name***	***Status***
Anatidae	*Marmaronetta angustirostris*	Marbled Duck	Globally threatened
Falconidae	*Falco naumanni*	Lesser Kestrel	Globally threatened
Otididae	*Chamydotis undulata*	Houbara Bustard	Globally threatened
Accipitridae	*Aegypius monachus*	Black Vulture	Globally threatened
Strigidae	*Ketupa zeylonensis*	Brown Fish Owl	Globally threatened
Phasianidae	*Francolinus francolinus*	Black Francolin	Regionally threatened
Accipitridae	*Gypaetus barbatus*	Lammergeier	Regionally threatened
Accipitridae	*Torgos tracheliotus*	Lappet-faced Vulture	Regionally Threatened
Passeridae	*Passer moabiticus*	Dead Sea Sparrow	Restricted to Middle East
Fringillidae	*Serinus syriacus*	Syrian Serin	Restricted to Middle East
Fringillidae	*Corpodacus synoicus*	Sinai Rosefinch	Nationally threatened
Paridae	*Parus caeruleus*	Blue Tit	Nationally threatened

5.9.45 The important migrant species of birds in Jordan include:

Family	*Scientific Name*	*Common Name*	*Status*
Ardidae	*Botaurus stellaris* 1	Great Bittern	Globally threatened
Accipitridae	*Aquila heliaca*	Imperial Eagle	Globally threatened
Rallidae	*Crex crex*	Corn Crake	Globally threatened
Accipitridae	*Buteo buteo*	Buzzard	Significant proportion of the world population
Accipitridae	*Pernis apivorus*	Honey Buzzard	Significant proportion of the world population
Accipitridae	*Aquila nipalensis*	Steppe Eagle	Significant proportion of the world population
Accipitridae	*Accipiter brevipes*	Levant Sparrowhawk	Significant proportion of the world population

Reptiles

5.9.46 Reptiles in the area are found in transition between two vegetation types. This helps in creating diversity in the herpito-fauna.

5.9.47 There are some conservation important species of reptiles that can be found in this area, such as Spinytailed Lizard and the Echis snake.

Insects

5.9.48 The insect and arachnid population in the area is considered to be low with no notable species in the study area.

Baseline Results

5.9.49 This section discusses the findings of the survey work undertaken with regard to flora and fauna.

Flora

5.9.50 The Power Project site shows clear evidence of the past and current uses of the site for agriculture practices. Agriculture practices are restricted to the annual crops (like wheat and hay) that are used for livestock feed.

5.9.51 The continuous ploughing of the Power Project site has removed the natural vegetation cover (which is now almost disappeared) and only remnants of the natural vegetation cover are found at the small depression wadies that cross the site / the side of the old road at the site. This is because these are not used for agriculture (and therefore have not been subject to continuous ploughing).

5.9.52 Only two species of natural plant found at the Power Project site are representative of vegetation types found in the surrounding area. Both of the recoded species are not of conservation importance since they are common in the surrounding area. The species of natural plant found were:

- *Rhamnus palaestinus* – The coverage of this natural plant is considered to be decreasing since it used for making fire in some nomad communities. However, at the Power Project site it was removed in the past to prepare the land for agriculture practices.
- *Anabasis syriaca* – This natural plant is common and does not have any conservation value.

Fauna

5.9.53 Due to the deterioration and the absence of the natural vegetation at the Power Project site, the faunal diversity recorded is minimal.

5.9.54 Just one species of reptile, three species of mammals and five species of birds were recorded in the study area (i.e. at the Power Project site and surrounding area within 500 m from the site boundary).

5.9.55 The recorded fauna species and their conservation importance are the following:

- *Reptiles*
  - *Acanthodactylus boskianus* – This species was observed despite its preference for natural vegetation. It is common in various habitats throughout Jordan, but is also known to be found in high numbers on agricultural lands.
- *Mammals*
  - *Lepus capensis* (Cape Hare) – This species was recorded through interviewing locals who identified the presence of the Cape Hare in the area. This is despite of the sharp decrease in species populations due to (mainly) human activities and habitat loss through agriculture. The conservation status of this species in Jordan is not well defined due to a lack of sufficient data regarding populations. However it is more common in the eastern parts of Jordan where the open desert is considered a very suitable habitat.
  - *Rattus rattus* (Common Rat) – This species was recorded during the baseline survey through borrows records, scats and foot prints. In addition, information was recorded from interviewing locals who identified the presence of this species in large numbers, especially during the harvesting seasons in the area for wheat or hay. This species has no conservation status. It is considered common in and near human settlements and its distribution is connected to the human activities, especially agriculture where it may be considered as vermin.
  - *Vulpes vulpes* (Red Fox) – This species is one of the most common large mammals in Jordan. Indeed, it is found in most of the Jordanian habitats and ecosystems. This species was recorded at the Power Project site through footprints and scats. In addition, information was recorded from interviewing locals who identified the presence of this species.
- *Birds*
  - *Streptopelia senegalensis* (Laughing Dove) – This species has been recorded at the Power Project site through direct observation. It is one of the most common birds found in numerous habitats. It has no conservation importance value.
  - *Galerida cristata* (Crested Lark) – This species is one of the most common birds in the northern half of Jordan. It is resident in almost all of the habitats in the country. Populations are especially high in cultivated areas. It has been recorded at the Power Project site by direct observation. The conservation status of this bird of Jordan is common (i.e. it is not threatened).
  - *Pycnonotus xanthopygos* (Yellow-Vented Bulbul) – This species is a very common and resident bird. It is found in mainly at semi-urban habitats, and those containing cultivated lands. It has been recorded at the Power

Project site by direct observation. It has no conservation importance value.

- *Oenanthe deserti* (Desert Wheatear) – This species is a widespread desert bird which is even found in the transitional zones (i.e. the zones between desert habitats and other habitats). The presence of this species at the Power Project site is proof of the Saharan fauna intrusion in the area. It has been recorded at the Power Project site by direct observation. It has no conservation importance value.
- *Passer domesticus* (House Sparrow) – This species is a very common resident bird which is clearly attached to human activity and settlements. It has been recorded at the Power Project site by direct observation. It has no conservation importance value.

5.10 Cultural Heritage

5.10.1 An archaeological survey was conducted in the Power Project area during the completion of the IPP1 ESIA.

5.10.2 The aims of the survey were to:

- Locate archaeological sites within the limits of the Power Project site.
- Identity those sites that may be threatened by the Power Project.
- Define the works necessary to minimize the threat to the regional cultural resources base by the Power Project.
- Provide preliminary estimates (sufficient for budgeting purpose) of the scale and scope of the cultural resources program likely to be required.
- Provide a suitable implementation structure for the Cultural Resources Management Project.

5.10.3 A team composed of two archaeologists surveyed the Power Project area and the surrounding zone. During this survey, the archaeologists registered, in addition to the mapping, all the sites located within 250 m of the Power Project area. The available maps used in the survey were 1:25 000 or 1:50 000 scale series k737.

5.10.4 The survey was conducted on foot, with the archaeologists walking at distance of between 20 to 30 m from each other.

5.10.5 Sample collections were taken at all sites and site features were recorded.

5.10.6 In brief, the archaeologists registered and mapped all features that may be affected by the Power Project. The summary of tasks undertaken is as follows:

- Jadis Searching / Department of Antiquities of Jordan (DOA).
- Library Searching / DAJ/ACOR / BCRL.
- Field Visit.
- Field Survey.
- Field Documentation.
- Data Analysis / Computer Analysis.
- Report Preparation.
- Final Report issue with recommendations.

Legal Framework

5.10.7 The Antiquities Law provides the basic legal framework for archaeological and historical concerns in Jordan. It is an all-embracing law that regulates policies and imposes penalties.

5.10.8 The Act, under Article (3), bans excavation within a distance less than 1 km from an archaeological location or premises. Furthermore, (in all cases) the Act stipulates that pre-permission from the concerned department is required before bidding for engineering services / design / drawing or preparing bidding documents for the private / public projects.

5.10.9 The Act, under Article (14), also requires that proponents ensure that the proposed project location is free from any archaeological materials before any excavations are undertaken. This is undertaken in order to avoid any penalty defined by Article (27).

5.10.10 It is considered that the Act is somewhat deficient in a number of areas that necessitate a further degree of assessment, including:

- There is no legal requirement that specify an accredited agency is to determine if there are any impacts from the proposed project on cultural heritage / archaeological recourses. Legal sanctions are only available when a cultural heritage / archaeological site is found, and even then some interpretation of the requirements is possible.
- It is, as of yet, not necessary for all agencies that carry out works to notify the Department of Antiquities (DOA), even if the works may affect archaeological or historical sites.
- There is, as of yet, no requirement for official agencies or private sector developers to make provisions for archaeological works in development contracts.

5.10.11 These deficiencies have, and will continue to be, mitigated as the Power Project ESIA is required to meet World Bank / IFC Performance Standards (PS). Therefore, this Power Project ESIA has considered the World Bank / IFC PS 8 (Cultural Heritage) (PS 8) which requires that due consideration of impacts is given to cultural heritage / archaeological property in World Bank financed projects. Therefore, as required by PS 8, a Desk Based Assessment and site walk over has been undertaken by a competent archaeologist. As stated above, this has confirmed that no visible surface cultural heritage / archaeology exists at the Power Project site.

SECTION 6

ENVIRONMENTAL IMPACT

6 ENVIRONMENTAL IMPACT

6.1 Introduction

6.1.1 This Section discusses the environmental and social impact assessment for the Power Project based on the existing environmental and social baseline (presented in Section 5).

6.2 Air Quality

6.2.1 This Section presents the assessment of the potential impacts of the Power Project on air quality.

6.2.2 The objectives of the air quality assessment are to:

- Quantify the worst case impact of operation of the Power Project on local air quality against the environmental baseline (see Section 5);
- Determine the significance of the anticipated impacts; and
- Outline recommendations for suitable mitigation measures to avoid, reduce or remedy significant adverse effects.

Impact Assessment

Impacts during Construction

6.2.3 Dust may be generated during several activities associated with construction if preventative measures not be taken. Emissions of dust could arise from:

- Earth moving operations for site levelling;
- Back filling and foundations;
- Removal of spoil, site stripping, blow-off and spillage from vehicles;
- Concreting operations;
- Site reinstatement;
- Road construction; and,
- During wind blow over bare dry construction areas.

6.2.4 Only with high wind speeds, where more dust would be created at the source, would long distance transport of dust and the potential for soiling of buildings occur. The extent of any such emissions of dust is very dependent on wind speed, ground conditions, the prevalence of hot, dry conditions and the use of preventative measures.

6.2.5 The dust particles that may be emitted during construction would be of large diameter and would therefore tend to resettle on the ground within 100 to 500 m of the site. Approximately 70 per cent of the dust would generally settle out of the atmosphere within 200 m of the source, and less than 10 per cent could be expected to remain at a distance of 400 m. There should be minimal impact on local residents from emissions of dust during the construction phase.

6.2.6 In addition, the use of wheel and chassis washing units will also help to prevent the transport of mud and dust onto off-site routes.

6.2.7 Dust emissions from the Power Project site will not be more onerous than those normally encountered on construction sites. Nevertheless, the Construction Contractor will be required to conduct activities to minimize the generation and spread of emissions of dust. Based on correct implementation of the mitigation measures outlined in Section 7 (Environmental Mitigation and Monitoring Programme),

emissions of dust are unlikely to result in any significant environmental impacts during the construction phase.

6.2.8 It is possible that during commissioning, emissions from the Power Project will be temporarily higher than those during normal operation. The purpose of commissioning is to adjust the performance of the newly installed equipment to achieve all required operational and environmental performance criteria. Firing of the engine units will be intermittent during this period and operational periods are often short and at low load. Therefore, the total mass emissions during commissioning will be low and are unlikely to result in any significant environmental impacts.

Impacts during Operation

6.2.9 The Power Project will produce of the order of upto250 MW utilising HFO, DFO and natural gas. The focus has been placed on HFO and DFO as back-up given that natural gas is the cleaner fuel.The combustion of the HFO and DFO oils will result in the emission of oxides of nitrogen (NO_x), sulphur dioxide (SO_2), carbon monoxide (CO) and particulate matter (PM_{10}/$PM_{2.5}$), Total Suspended Particulates (TSPs), Hydrogen Sulphide (H_2S) and hydrocarbons.

6.2.10 The anticipated operating regime of the Power Project will be to provide short-term support to the NTS.

6.2.11 Accordingly, the potential impacts on local air quality will be limited to short-term averaging periods.

Assessment – Atmospheric Dispersion Modelling Overview

6.2.12 When flue gases are discharged from a stack they have two sources of momentum.

- Velocity of Discharge

  The first is related to the velocity of discharge. This is usually designed to be in excess of 15 m/s as this value has been found to be sufficient to avoid immediate downwash of the plume. The momentum from the velocity of discharge is soon dissipated.

- Discharge Temperature of the Flue Gases

  The flue gases, being warmer than the surrounding atmosphere into which they are discharged, are buoyant and thus rise. This process continues until the flue gases have cooled to the same temperature as the surrounding air.

6.2.13 Mathematical models calculate the effects of these two sources of momentum and determine the height to which the flue gases will rise. This height plus the height of the stack gives an 'effective stack height'.

6.2.14 The mathematical model then determines the dispersion of the flue gases from this effective stack height[13].

6.2.15 Dispersion occurs as a result of turbulence, and turbulence can result from both buoyancy effects and wind shear (also called mechanical) effects.

6.2.16 Atmospheric dispersion modelling has been used to predict the increments to ground level concentrations of any release of emissions from the stack. The contribution to ground level concentrations have been quantitatively assessed using the second generation dispersion modelling software AERMOD, developed in conjunction with the US Environmental Protection Agency.

[13] *It should be noted that the effective stack height can be many times greater than the actual stack height due to the large amount of heat present in the flue gases.*

6.2.17 A conservative view of the operation of the Power Project has been adopted in the atmospheric dispersion modelling so that a worst case is presented. The purpose is to ensure that the absolute maximum predicted impact within the potential operating regime of the Power Project is considered. This ensures that there is a 'factor of safety' built into all of the air quality impact assessment, giving a high degree of confidence that the actual impacts will be less than those presented.

6.2.18 The results of the atmospheric dispersion modelling have been compared to the World Bank / IFC Guidelines for ambient air quality..

Assessment – Determining the Conversion of Nitric Oxide (NO) to Nitrogen Dioxide (NO_2)

6.2.19 NO_x emissions from the Power Project will consist of the gases NO and NO_2. Whilst it is only NO_2 that is of concern in terms of direct health and environmental effects, NO is a source of NO_2 in the atmosphere. The two gases are in equilibrium in the air, with NO predominating at the stack exit. The equilibrium changes as the plume cools resulting in a predominance of NO_2.

6.2.20 NO is oxidised to NO_2 mainly by reaction with ozone. Within 5 km of the source approximately 25 per cent of the NO will have converted to NO_2 under stable conditions. Under unstable conditions with more atmospheric mixing up to approximately 60 per cent of NO may have converted to NO_2. The rate of conversion of NO to NO_2 increases with rising ozone concentration, wind speed and solar radiation.

6.2.21 For assessing the impacts on air quality from large combustion sources, such as the Power Project, it is important that realistic estimates are made of how much NO would be oxidised to NO_2 at all receptors considered.

6.2.22 The rate of oxidation of NO to NO_2 depends on both the chemical reaction rates (which in turn is dependent upon the prevailing concentration of ozone) and the dispersion of the plume in the atmosphere (which in turn is dependent upon the wind speed and the atmospheric stability).

6.2.23 Between 1975 and 1985, approximately 60 sets of measurements were made of the concentrations of NO and NO_2 in various power plant plumes. These measurements were carried out under widely varying weather conditions at altitudes between 200 m and 700 m. From the data collected, an empirical relationship for the percentage oxidation in a power plant plume (based on: downwind distance; season of the year; wind speed; and, ambient ozone concentration) may be described by the following equation (which is sometime referred to as Janssen's equation):

$$NO_2 / NO_x = A\left(1 - \exp^{(-\alpha x)}\right)$$

Where:

x is the distance downwind (km) of the emission point; and,

α and A are constants dependent on time of year and derived from the measurements of wind speed and ozone concentrations.

6.2.24 For a typical power plant, the peak ground level concentration of the NO_x will occur within a few kilometres. The above equation has been used to estimate the percentage oxidation for each hour for downwind distances from the Power Project. These estimates were made using hourly average meteorological data. Table 6.1 shows the minimum, maximum and annual average estimates of NO_2 in the plume for selected distances downwind of the stack. It should be noted that the figures take into account the ratio of NO to NO_2 upon exit from the stack.

TABLE 6.1: ESTIMATES OF THE PERCENTAGE OF NO_2 IN NO_X

Downwind Distance (km)	*Percentage Nitrogen Dioxide (NO_2)*		
	Lowest	*Highest*	*Average*
1	5.9	16.0	9.3
2	11.4	29.0	17.5
3	16.5	39.7	24.7
5	25.7	55.6	36.5
10	43.8	76.1	56.1

6.2.25 Based on the principles outlined above, the average proportion of NO_2 in the dispersed flue gases within 2 km of the stack will be 17.5 per cent. The highest percentage oxidation for any hour for increments that occur within 2 km of the stack is 29 per cent.

6.2.26 The maximum conversion factor calculated for each receptor has been applied to the predicted levels of NO_x from the Power Project to give a conservative estimate of NO_2 contributions at each individual receptor.

Assessment – Dispersion Model Inputs

6.2.27 The World Bank / IFC Guidelines for Thermal Power Plants[14], prescribes emission limit values for a range of pollutants for various types of thermal power plant. The relevant emissions limits standards for the Power Project are presented in Table 6.2.

TABLE 6.2: WORLD BANK / IFC EMISSION GUIDELINES (mg/Nm^3)

Parameter	*Liquid Fuels**	*Natural Gas**
NO_x	740	400
SO_2	585 or use of 1% or less S in fuel	N/A
PM_{10} (including $PM_{2.5}$)	50	N/A
CO	---	

** Corrected to 15 per cent O_2 (dry), 273.15 K and 1 atm*

6.2.28 The World Bank / IFC Guidelines for Thermal Power Plants states that plants should meet emission targets for at least 95% of the time that the plant unit is operating. The remaining 5% is assumed to be for start up, shut down, emergency fuel use and unexpected incidents. The IPP4 plant will be capable of rapid start-up and shut downs and is thus considered to meet these regulations.

6.2.29 No limits are prescribed in the above set of standards for the maximum emissions concentration of CO. Guidance[15] for similar sized compression ignition engines in the UK states that a maximum concentration of 150 mg/Nm^3 is achievable for individual units with a thermal input of between 20 to 50 MW. This concentration is considered appropriate for this assessment.

[14] *World Bank / IFC Environmental, Health and Safety Guidelines for Thermal Power Plants, December 2008*

[15] *Environmental Protection Act 1990, Part I - PG1/5 95: Secretary of State's Guidance Compression Ignition Engines*

Assessment – Contribution of the Power Project

6.2.30 The air dispersion modelling has assumed the maximum emissions concentration permitted by the World Bank / IFC Guidelines for reciprocating engines using liquid fuels, supplemented by the UK guidance relating to the emissions of CO from small diesel engines. The maximum emissions parameters for each unit of the proposed plant are shown in Table 6.3.

TABLE 6.3: POWER PROJECT EMISSIONS CHARACTERISTICS

Parameter	*Units*	*Per Unit*
NO_x emission level	mg/Nm^3	740*
NO_x flow rate	g/s	24.02
SO_2 emission level	mg/Nm^3	585**
SO_2 flow rate	g/s	18.99
Particulate matter (PM_{10}) emission level	mg/Nm^3	50**
Particulate matter (PM_{10}) flow rate	g/s	1.62
Particulate matter ($PM_{2.5}$) emission level	mg/Nm^3	50***
Particulate matter ($PM_{2.5}$) flow rate	g/s	1.62
TSP emission level	mg/Nm^3	5
TSP flow rate	g/s	0.16
CO emission level	mg/Nm^3	150
CO flow rate	g/s	4.87
H_2S emission level	mg/Nm^3	<1
H_2S flow rate	g/s	0.03
Unburned Hydrocarbons	mg/Nm^3	20****
Unburned Hydrocarbons	g/s	0.65
Temperature	°C	270 / 525*****
Actual flue gas volume	m^3/s	48.8 / 71.7*****

Note: All concentrations are corrected to 15 per cent O_2 (dry), 273.15 K and 1 atm
** Emission level assumes the installation of SCR.*
***Based on maximum fuel sulphur content of 1 per cent w/w and assumed ash content of 0.05 per cent w/w*
**** Assumed worst case that all PM_{10} is $PM_{2.5}$ in absence of relevant guidelines or performance data*
***** Jordanian Standard emission limit for Volatile Organic Chemicals assumed; more typical emission will be <5 mg/Nm^3*
******Exhaust with Heat Recovery / No Heat Recovery*

6.2.31 In order to assess the likely impacts from the Power Project, the atmospheric dispersion modelling has assumed that the Power Project will be constructed such that the flues from four individual units will share a common stack (wind shield) with a total of four stacks installed on-site. Therefore, whilst the mass emissions from each stack will be four times those shown in Table 6.3, the emissions levels will be the same and in full accordance with the World Bank / IFC Guidelines and Jordanian Standards.

6.2.32 The HFO to be utilised at IPP4 will have a typical fuel ash content of 0.05 per cent w/w depending upon the composition and availability of HFO fuel. Table 6.3 quotes an emission concentration for particulate matter of 50 mg/Nm^3 (typical ash content of 0.05 per cent w/w). In order to fully assess the environmental impact of any potential variations in the fuel composition, initial calculations suggest that particulate matter may be emitted from the proposed plant at a concentration of up to 58 mg/Nm^3 should fuel with an ash content of 0.08 per cent be used as fuel for the Power Project, although it should be noted that the anticipated liquid fuels will have an ash content of less than 0.05 per cent. This sensitivity analysis and its impacts are discussed later in this Section.

6.2.33 Each stack is assumed to comprise two flues that form part of the plant heat recovery system and two flues without heat recovery. The flue gas exit parameters are shown in Table 6.4.

TABLE 6.4: ATMOSPHERIC DISPERSION MODEL INPUTS

Parameter	*Units*	*Per Stack*
Temperature	°C	397
Actual Flue Gas Volume	m^3/s	241.0
Flue Gas Velocity	m/s	24.0
Effective Stack Diameter	M	3.6

6.2.34 The AERMOD model calculates time averaged ground level concentrations over any set of distances from the source. The study used a 20 km by 20 km Cartesian grid with 500 m spacing and a 4 km by 4 km Cartesian grid with 100 m spacing to predict the ground level concentrations associated with the operation of the proposed plant. The grids were centred on the centre of the four proposed stacks at Grid Reference 223630, 3532673.

6.2.35 The effect of the local terrain was included in the dispersion modelling exercise.

Assessment – Determination of Stack Height

6.2.36 A stack height sensitivity analysis was undertaken as part of the air dispersion modelling exercise in order to determine the most suitable stack height for the Power Project. Dispersion model runs were undertaken for 5 m increments to the stack heights between 35 m and 85 m (inclusive). The stack height calculation is shown in Appendix E.

6.2.37 The suitability of the stack height has been determined based upon compliance with the World Bank / IFC Guidelines on ambient air quality and any additional environmental benefit of increases in the stack height. For the Power Project, the determination process has been based on the hourly average process increment to ground level concentrations of NO_2 together with the 24-hourly average increment to ground level concentrations of SO_2. The World Bank / IFC Guidelines have been used as they are more stringent than the Jordanian Standards for ambient air quality.

6.2.38 The results of the stack height sensitivity analysis are presented in Table 6.5.

TABLE 6.5: STACK HEIGHT SENSITIVITY

Stack Height (m)	*Maximum Hourly Average NO_2 ($\mu g/m^3$)*	*Maximum 24-hourly Average SO_2 ($\mu g/m^3$)*
35	486.0	835.3
40	415.6	655.0
45	340.4	469.4
50	317.0	165.1
55	288.1	141.0
60	244.8	121.2
65	200.7	104.8
70	159.3	90.9
75	123.5	78.6
80	95.0	69.8
85	71.3	63.7

6.2.39 The above data is shown graphically in Figure 6.1 and Figure 6.2.

FIGURE 6.1: STACK HEIGHT SENSITIVITY FOR NITROGEN DIOXIDE

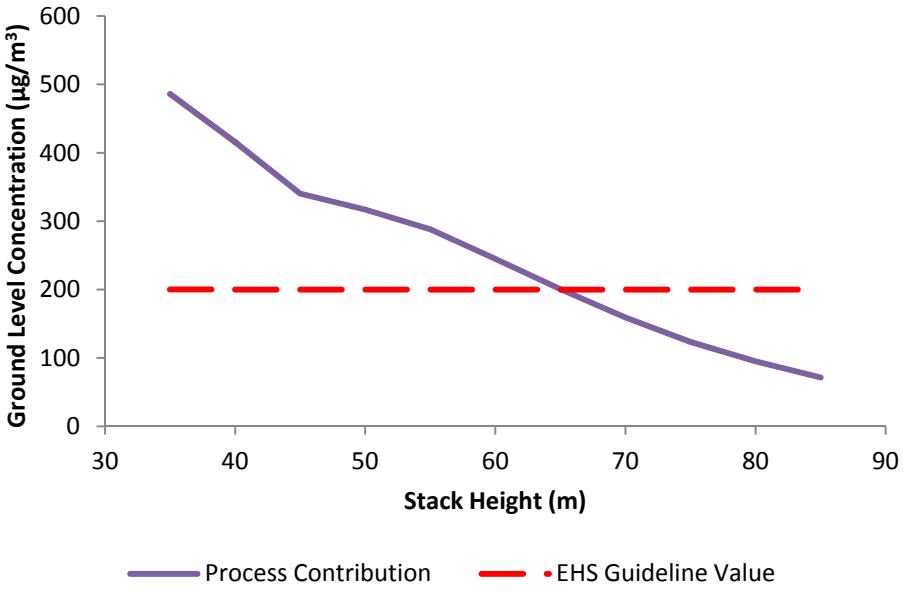
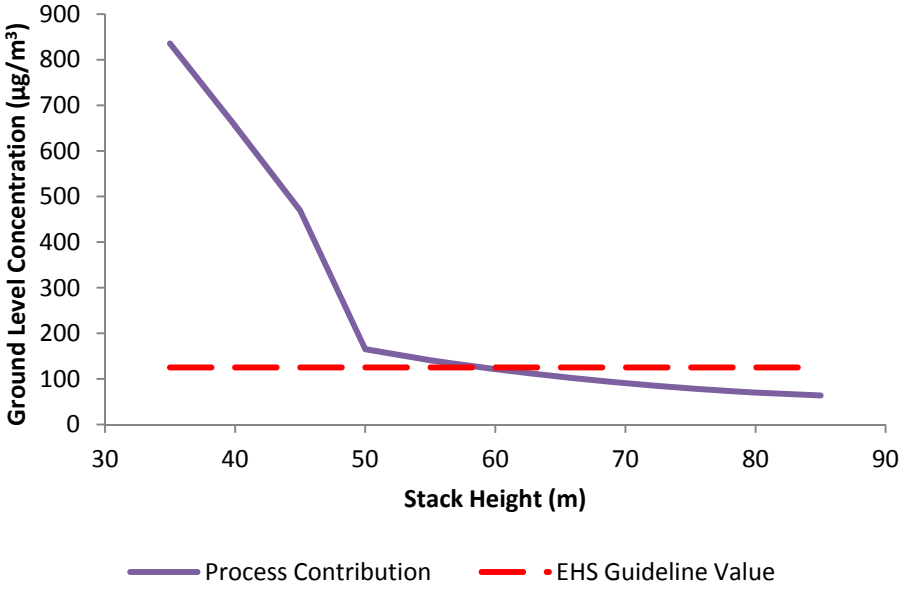


FIGURE 6.2: STACK HEIGHT SENSITIVITY FOR SULPHUR DIOXIDE



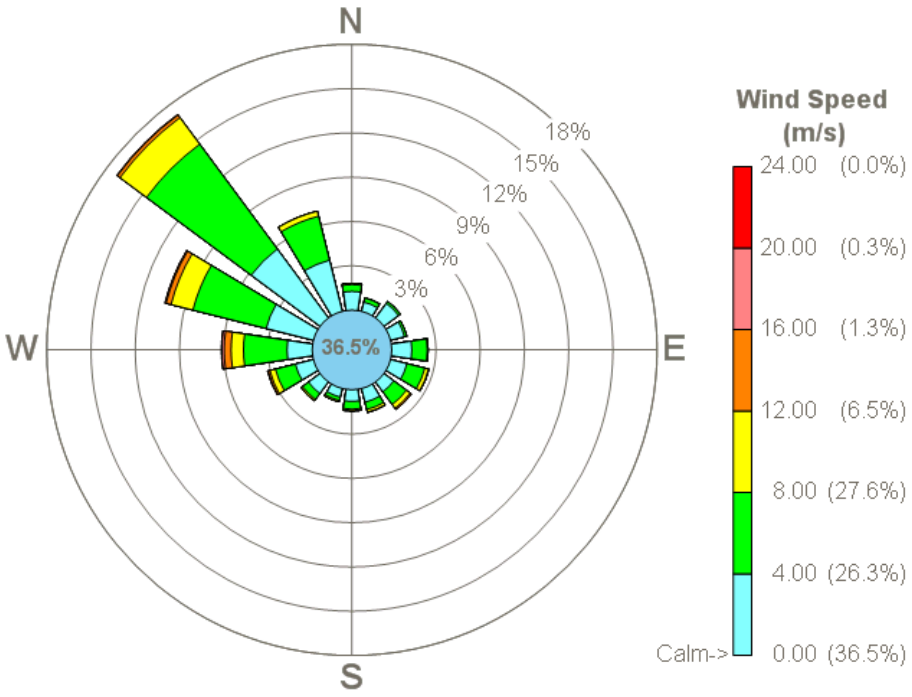
6.2.40 In terms of NO_2, the above Tables and Figures show that a stack height of approximately 70 m would result in a process contribution less than the World Bank / IFC Guidelines limit for the hourly average of NO_2 and that there are additional environmental benefits that could be realised by a further increase in the stack height.

6.2.41 In terms of SO_2, Figure 6.2 indicates a sudden reduction in the environmental benefits to be gained from increasing the stack height to 50 m. However, it is also noted that the predicted maximum SO_2 concentrations are higher than the World Bank / IFC Guideline Interim Target 1 value of 125 $\mu g/m^3$ at this height. The above data indicates that a stack height of greater than 60 m would ensure compliance with the World Bank / IFC Guideline for SO_2.

6.2.42 A stack height of at least 70 m is therefore recommended for the Power Project to ensure compliance with World Bank / IFC Guideline for NO_2.

6.2.43 The meteorological data (including wind speed and direction, temperature and cloud cover) used for this modelling exercise was that from the station at Queen Alia International Airport. It is considered that this data will be representative of the conditions experienced at the Power Project site. The data period considered was 2001 to 2005 (inclusive). For each year the predominant wind direction was from the northwest; the wind rose for 2004 can be seen in Figure 6.3.

FIGURE6.3: QUEEN ALIA INTERNATIONAL AIRPORT WIND ROSE 2004



Assessment – Short Term Process Contributions

6.2.44 AERMOD has been used to calculate the maximum increments to the short-term average ground level concentrations as a result of operation of the Power Project.

6.2.45 The predicted maximum increments for all weather conditions included within the meteorological data are shown in the Table 6.6. The distance shown refers to the location of the maximum concentration in relation to the centre of the study area (Grid Ref: 223630, 3532673).

TABLE 6.6: INCREMENTS TO GROUND LEVEL CONCENTRATIONS (µg/m^3)

Pollutant	*Averaging Period*	*Maximum Process Contribution*	*Guideline*	*Distance (km)*	*Bearing (°)*
NO_2	1-hour	159.3	200	10.0	276
	24-hour	115.0	150	0.8	97
SO_2	1-hour	193.9	786	1.1	355
	24-hour	90.9	125	1.1	350
PM_{10}	24-hour	7.8	50	1.1	350
$PM_{2.5}$	24-hour	7.8	65	1.1	350
TSP	24-hour	0.8	260	1.1	350
H_2S	1-hour	0.3	0.030 ppm (42 µg/m^3)	1.1	355
	24-hour	0.2	0.010 ppm (14 µg/m^3)	1.1	350
Hydrocarbons	1-hour	6.6	No Standards	1.1	355
	24-hour	3.1		1.1	350
CO	1-hour	49.7	26 ppm (30279 µg/m^3)	1.1	355
	8-hour	41.0	9 ppm (10481 µg/m^3)	0.9	355

6.2.46 Three isopleths have been prepared to show the above distribution of the pollutant gases over the surrounding area during operation of the Power Project. These are shown in Figures 6.4 to 6.6.

FIGURE 6.4: MAXIMUM PROCESS CONTRIBUTION OF SHORT-TERM NO_2

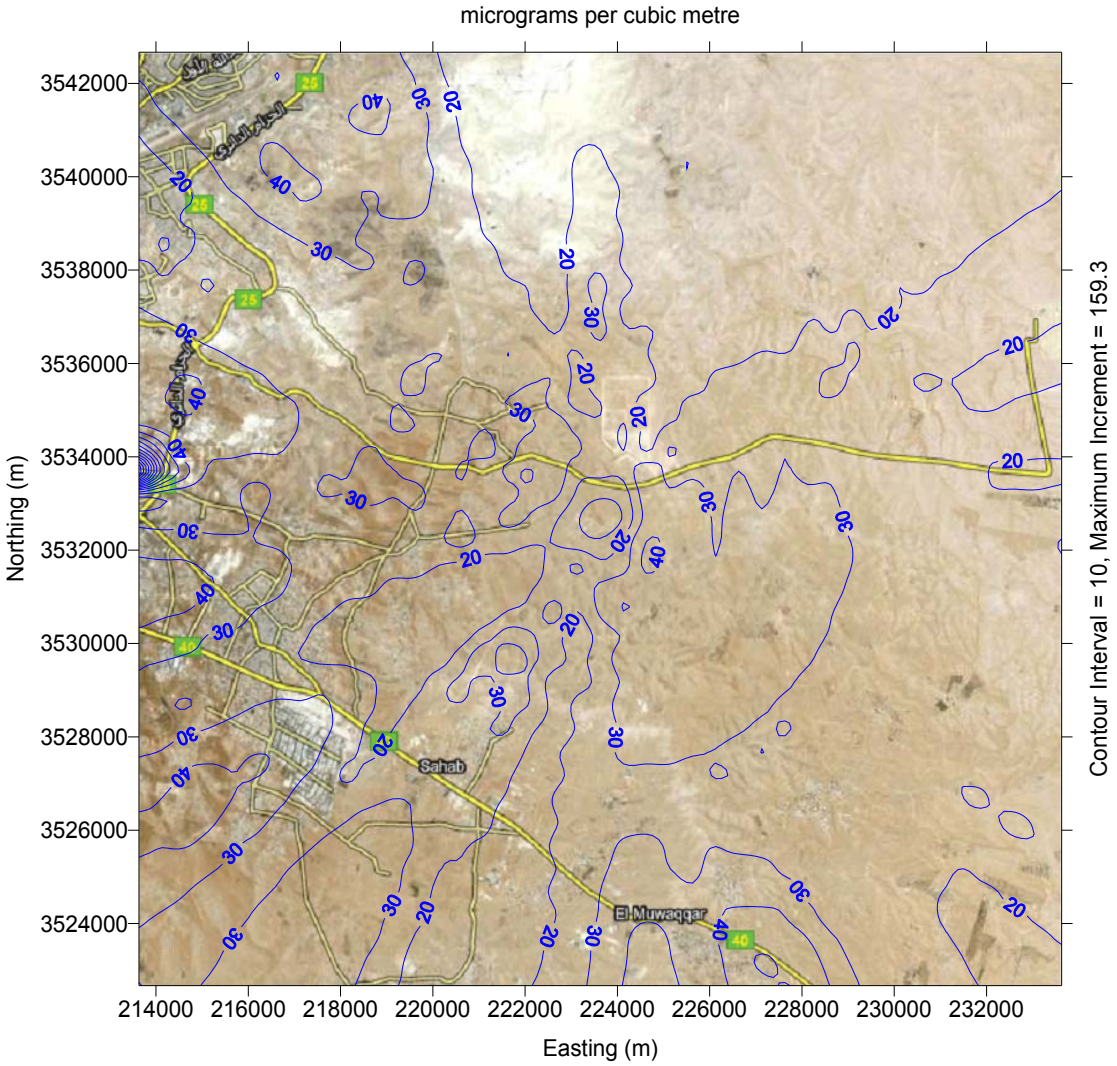


FIGURE 6.5: MAXIMUM PROCESS CONTRIBUTION OF SHORT-TERM SO_2

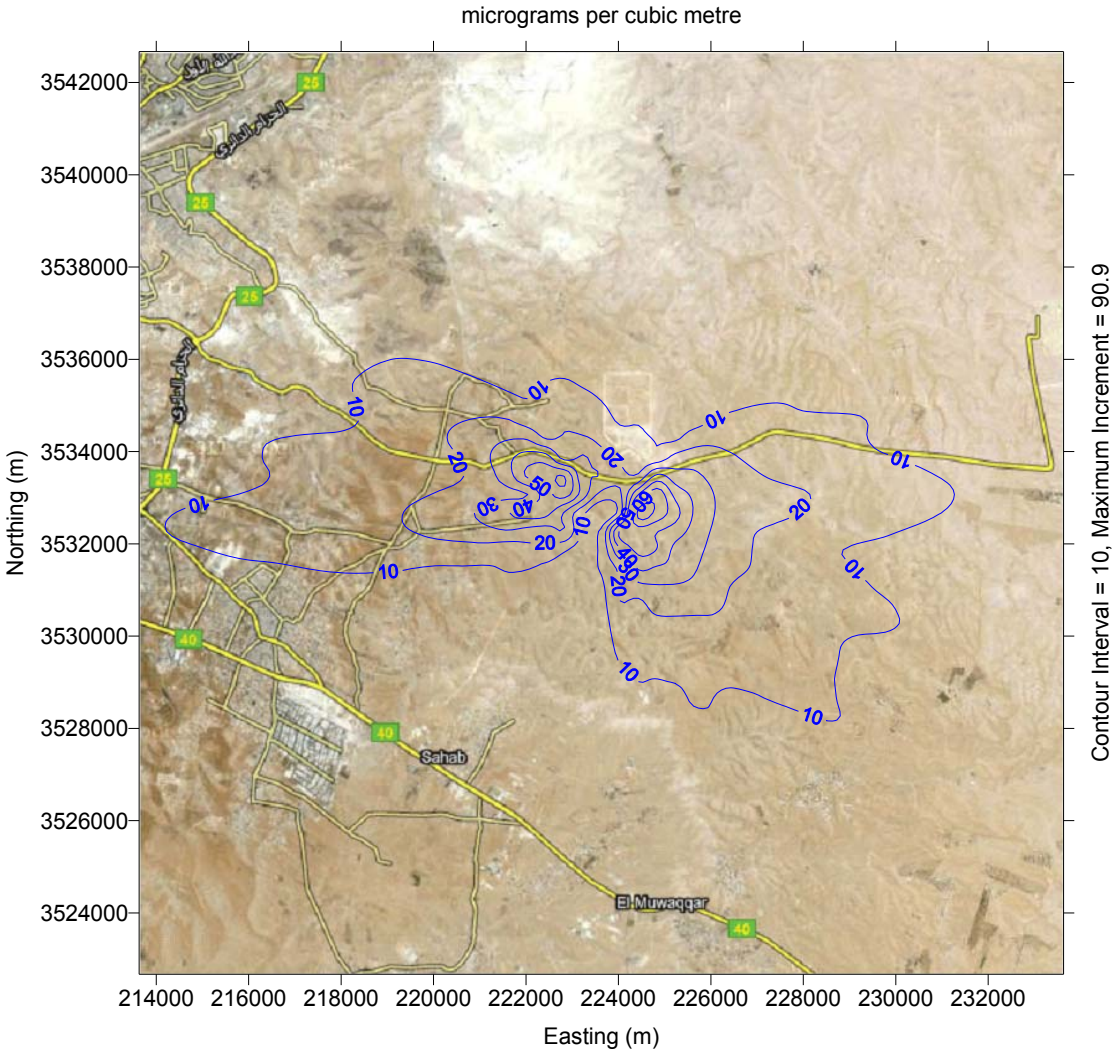
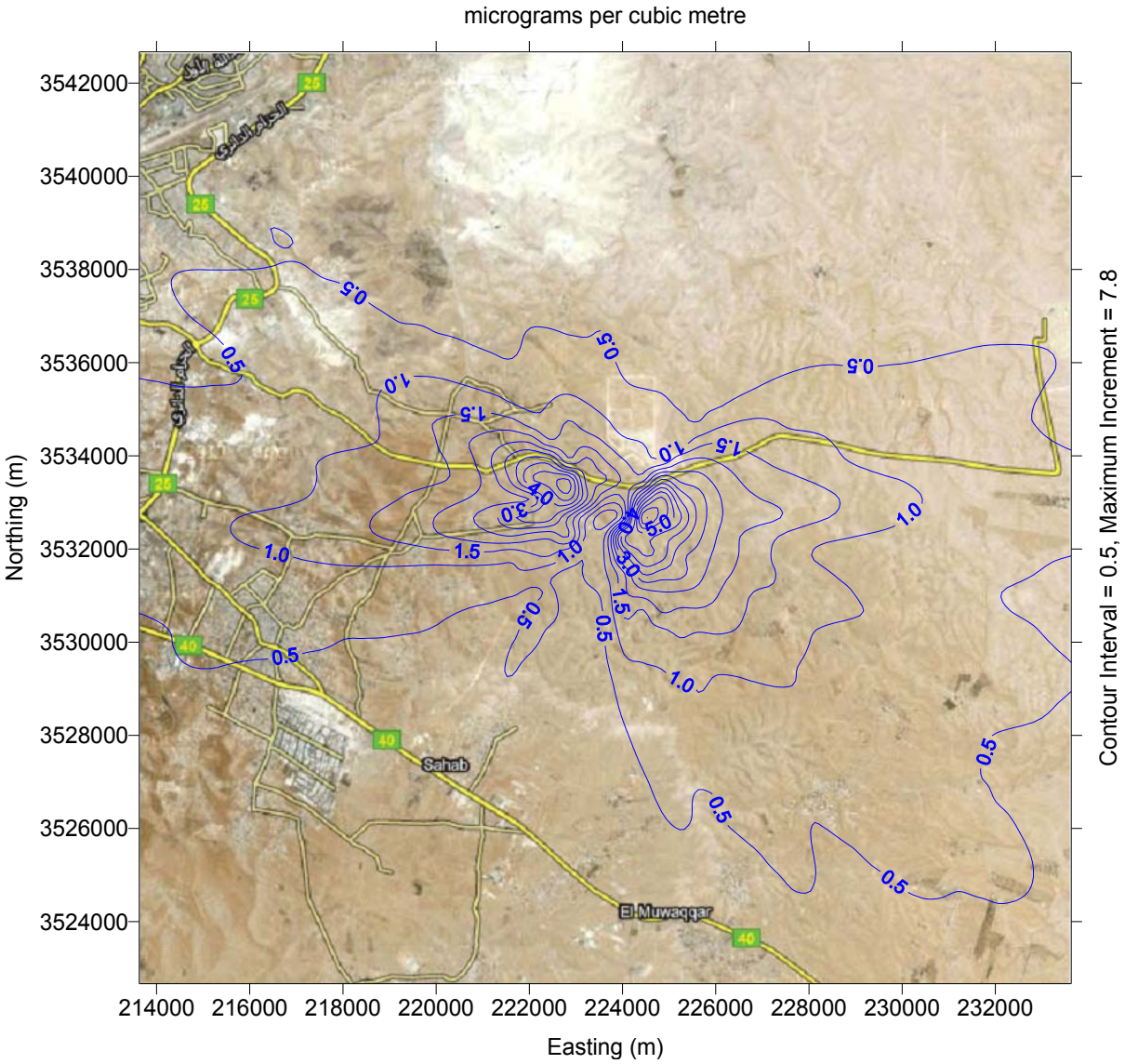


FIGURE 6.6: MAXIMUM PROCESS CONTRIBUTION OF SHORT-TERM $PM_{10}/PM_{2.5}$



Assessment – Analysis of Results

6.2.47 The results of the atmospheric dispersion modelling have been compared to the air quality objectives presented in the World Bank / IFC Guidelines. Key findings from the analysis of normal operation of the Power Project, in isolation, are:

- The predicted maximum process contribution to short term NO_2 concentration is 159.3 µg/m^3 and is within the short term limit of 200 µg/m^3.
- The predicted maximum increase to short-term PM_{10}/$PM_{2.5}$ concentration is 7.8 µg/m^3 and is well within the prescribed limits for a 24-hour averaging period.
- The predicted maximum increases to short-term SO_2 concentrations is 90.9 µg/m^3 and within the prescribed limit for a 24-hour averaging period.
- The predicted maximum concentrations of CO, TSPs, H_2S and hydrocarbons are negligible.

6.2.48 The location of maximum increments is indicative of the prevailing meteorological conditions (i.e. predominately north-westerly winds). The predicted maximum short term concentrations of NO_2, SO_2, CO and PM_{10}/$PM_{2.5}$ are below the applicable air quality objectives in all locations.

6.2.49 The air dispersion modelling described above has assumed that particulate matter will be emitted at a maximum of 50 mg/Nm^3, in accordance with the World Bank / IFC Guidelines.. As discussed, this is based upon a typical ash content of 0.05 per cent w/w in the HFO fuel.

6.2.50 In order to ensure that the assessment of the impacts to air quality as a result of operation of the Power Project is robust, an additional dispersion modelling run was undertaken as a sensitivity test to assess the environmental impact of operation at the potential maximum ash content of 0.08 per cent; the associated emission value for particulate matter will be 58 mg/Nm^3. In this case, the predicted maximum increases to short-term PM_{10}/$PM_{2.5}$ concentrations, at the higher emissions rate, is 9.0 µg/m^3 and is still well within the prescribed ambient air quality limits for a 24-hour averaging period.

6.2.51 The World Bank/IFC EHS Guidelines for Thermal Power Plants state:

"[the environmental assessment] *may justify more stringent or less stringent* [emissions] *limits due to ambient environment, technical and economic considerations provided there is compliance with applicable ambient air quality standards and incremental impacts are minimized*"

Impacts during Decommissioning

6.2.52 During decommissioning, the potential impacts to air quality will be similar to those experienced during the construction phase.

Impact of Electrical Connection / Gas Pipeline / Water Pipeline

6.2.53 The air quality impacts relating to the electrical connection / gas pipeline / water pipeline would be limited to the construction phase where there may be some generation of airborne dust. However, this is likely to be over a small area. Impacts to air quality could be minimized by using dust suppression measures where necessary.

Cumulative Impacts

6.2.54 The existing IPP1 (a CCGT power plant) has also been included within the atmospheric dispersion modelling in order to determine the potential cumulative impacts of the operation of IPP1 in conjunction with the Power Project.

Cumulative Assessment – Contribution of IPP1

6.2.55 IPP1 operates predominantly on natural gas. However, where natural gas is unavailable IPP1 fires DFO. IPP1 is capable of operating in CCGT mode or Bypass operation should the Heat Recovery Steam Generators (HRSGs) be unavailable.

6.2.56 The combustion of natural gas in a gas turbine does not generate significant emissions of either SO_2 (given the absence of sulphur in the fuel) or $PM_{10}/PM_{2.5}$ (given nature of the fuel and combustion conditions within the turbine). Therefore, when firing on natural gas, only the emissions of NO_x from IPP1 have been considered within this assessment. The assessment of the emissions of NO_x, SO_2 and $PM_{10}/PM_{2.5}$ from IPP1 during DFO-firing are discussed within this section. The emissions of CO, TSP, H_2S and unburned hydrocarbons have been calculated to result in negligible process contributions to ambient air quality in isolation and are therefore considered to make a negligible contribution to the cumulative impact.

6.2.57 The emissions parameters for each IPP1 unit are presented in Table 6.7 and Table 6.8.

TABLE 6.7: IPP1 CCGT EMISSIONS CHARACTERISTICS (PER UNIT)

Parameter	*Units*	*Natural Gas*	*DFO*
NO_x emission level	mg/Nm^3	125	165
NO_x flow rate	g/s	41.37	53.25
SO_2 emission level	mg/Nm^3	-	106*
SO_2 flow rate	g/s	-	34.20
PM_{10} / $PM_{2.5}$emission level	mg/Nm^3	-	50
PM_{10} / $PM_{2.5}$flow rate	g/s	-	16.14
Temperature	°C	112	145
Actual flue gas volume	m^3/s	379.56	396.40
Flue gas velocity	m/s	19.3	20.2
Effective stack diameter	m	5.0	
Stack Height	m	45	

** Based on fuel sulphur content of 0.2 per cent w/w*

TABLE 6.8: IPP1 BYPASS EMISSIONS CHARACTERISTICS (PER UNIT)

Parameter	*Units*	*Natural Gas*	*DFO*
NO_x emission level	mg/Nm^3	125	165
NO_x flow rate	g/s	41.37	53.25
SO_2 emission level	mg/Nm^3	-	106*
SO_2 flow rate	g/s	-	34.20
PM_{10} / $PM_{2.5}$emission level	mg/Nm^3	-	50
PM_{10} / $PM_{2.5}$flow rate	g/s	-	16.14
Temperature	°C	565	550
Actual flue gas volume	m^3/s	826.12	780.36
Flue gas velocity	m/s	29.5	27.9
Effective stack diameter	m	6.0	
Stack Height	m	45	

** Based on fuel sulphur content of 0.2 per cent w/w*

Cumulative Assessment – Analysis of Results

6.2.58 Accordingly, the ground level concentrations for the operation of IPP1 in conjunction with the Power Project are shown in Table 6.9.

TABLE 6.9: CUMULATIVE INCREMENTS TO GROUND LEVEL CONCENTRATIONS (µg/m^3)

IPP1 Fuel	*Pollutant*	*Averaging Period*	*Cumulative Contribution*		*Guideline*
			CCGT	*Bypass*	
Natural Gas	NO_2	1-hour	245.2	253.5	200
DFO	NO_2	1-hour	230.7	252.8	200
	SO_2	24-hour	120.6	111.2	125
	PM_{10} / $PM_{2.5}$	24-hour	28.9	25.8	50

6.2.59 These results indicate, as before, that the operation of both the Power Project and the existing IPP1 plants will result in process contributions less than the World Bank / IFC Guideline values for SO_2 and $PM_{10}/PM_{2.5}$.

6.2.60 The cumulative impact assessment is based on particulate emissions at an emission concentration of 50 mg/Nm^3. As part of the environmental sensitivity test in regards to the operation of the Power Project at the higher 58 mg/Nm^3 emissions level, as a result of utilising HFO with an ash content of 0.08 per cent w/w, an additional dispersion modelling run was undertaken to assess the potential cumulative impact. In this case, the predicted maximum cumulative process contributions to short-term $PM_{10}/PM_{2.5}$ concentrations are 29.9 µg/m^3 (in conjunction with the CCGT operation of IPP1) and 26.7 µg/m^3 (in conjunction with the Bypass operation of IPP1). These values are still well within the prescribed ambient air quality limits for a 24-hour averaging period.

6.2.61 However there are exceedances predicted for the increments to ground level concentrations of NO_2 when IPP1 operates on either natural gas or DFO. It should be noted that, for short term averaging periods, the likelihood of coincidence of contributions from several different types of sources is low. This is due to the difference in weather conditions associated with the maximum contribution to ground level concentrations. Further examination of the modelling results has indicated that, as shown in Figure 6.4, the maximum location of the ground level concentration of NO_2 is to the west of the study area. The exceedance of the objective value of 200 µg/m^3 for NO_2 occurs for only one receptor in the air dispersion model, and only for two non-consecutive hours in the entire 5-year study period[16].

6.2.62 If the maximum process contribution from the Power Project to ground level concentrations of NO_2 at the above isolated location is replaced with the second highest process contribution at that location, the resultant maximum cumulative process contributions to short term NO_2 concentrations are 194.1 µg/m^3 (in conjunction with CCGT operation of IPP1) and 193.3 µg/m^3 (in conjunction with the Bypass operation of IPP1). These are within the World Bank / IFC Guideline value.

6.2.63 The Power Project will be used to rapidly assist in meeting temporary generating demands of the NTS. As such, the anticipated operating regime of the Power Project is expected to be in the region of40 per cent load factor.

6.2.64 A conservative view of the Power Project operating for 8760 hours (baseload as opposed to peaking operation) per year has been adopted in the atmospheric dispersion modelling so that a worst case is presented. Actual operation of the plant is anticipated to be for around 40 per cent of the year and will thus result in a significant number of hours per year where the plant does not operate. The results

[16] Jordanian Standard 1140:2006 permits three exceedances in any consecutive 12 month period.

presented above do not allow for the high probability that the plant may not actually be in operation during hours where the meteorological conditions associated with the maximum increase to ground level concentrations occur. This ensures that there is a 'factor of safety' built into all of the air quality impact assessment, providing comfort that the stack height selection will be more than adequate to achieve good dispersion of the plant flue gases, and represents a likely over-estimate of the process contribution to ground level concentrations of the pollutants considered.

6.2.65 In addition, the modelling has assumed that both the Power Project and IPP1 will operate at the maximum permitted limits at the stack exits for the concentrations of the pollutants considered under the relevant World Bank / IFC Guidelines. Typical operation of either plant is likely to see the actual average achievable emissions levels being significantly less the prescribed limits; any process contribution to ground level concentration from either the Power Project or IPP1 will thus be less than that predicted above.

Mitigation Measures and Monitoring Programmes

Construction

6.2.66 During construction, good site management practices will be in place to minimise / prevent the generation of airborne dust.

6.2.67 The Consortium will require the Construction Contractor to take sufficient precautionary measures to limit dust generation as part a Construction Environmental Management Plan (CEMP) to be implemented at the Power Project site.

Operation

6.2.68 The following mitigating measures have been 'built-into' the design of the Power Project:

- The potential use of Selective Catalytic Reduction (SCR), which will control NO_x emissions levels;
- The use of stacks of sufficient height and flue gases of sufficient temperature and velocity to ensure good dispersion; and,
- The reservation of a development area for the installation of Flue Gas Desulphurisation (FGD) equipment.

6.2.69 The Consortium will require a manufacturer's guarantee regarding the performance of the NO_x abatement system. If NO_x values are outside the permitted levels, the operation and calibration of the instrument will be checked. If proved to be accurate, corrective action shall be taken immediately to identify cause and to reduce emissions level to within the permitted levels.

6.2.70 Emissions will be controlled during operation in accordance with the manufacturer's recommendations, taking account of the Technical Guidance and Local Legislation and Guidance applicable. Efficient operation and maintenance of the engine units will ensure that the emissions of CO are controlled.

6.2.71 Whilst the design of the Power Project allows for the reservation of development area for the installation of FGD equipment, it is considered that the primary method for the control of SO_2 emissions (from any thermal power plant) is to reduce the sulphur content of the fuel.

6.2.72 The stack will be fitted with continuous emissions monitors for NO_x and O_2. The measured values will be recorded and displayed both remotely and in the control room. Routine calibration checks will be carried out as recommended by the manufacturer and as agreed with the Relevant Authorities. Any other ad-hoc calibration checks required by such Authorities will be carried out. An oxygen monitor

will also be supplied and results from this will be used to correct the measured values to the required reporting formats.

6.2.73 Sampling points and safe access adjacent to the continuous monitoring points will be installed.

6.2.74 Regular observation of chimney emissions will also be made.

6.2.75 In combination, these measures will ensure that the impact of operation of the Power Project, both in isolation and in conjunction with IPP1, will have an insignificant impact on local air quality.

Decommissioning

6.2.76 During decommissioning, the potential impacts to air quality will be similar to those experienced during the construction phase.

6.2.77 As such, similar mitigation measures and monitoring programmes will be in place and all decommissioning works will be undertaken with all the Industry Standards and Guidelines that will be in effect at that time.

Conclusion

6.2.78 The construction impacts would potentially comprise emissions of dust and emissions during commissioning. Due to the distance from the Power Project site to the nearest receptor dust impacts will not be noticeable. Emissions during commissioning will be of short duration and low mass; the impact will therefore not be significant.

6.2.79 The predicted short-term process contributions from the proposed plant are well within the World Bank / IFC Guidelines and Jordanian Standards for ambient air quality concentrations of NO_2, SO_2, CO and PM_{10}/$PM_{2.5}$. The process contributions of TSP, H_2S and unburned hydrocarbons from IPP4 are negligible. Therefore, it is considered that the impact of the Power Project will be insignificant both in isolation and in conjunction with the existing IPP1.

6.3 Water Quality

6.3.1 The Power Project has the potential to impact on water quality in the local area during the construction, operation and decommissioning phases.

Impact Assessment

Impacts during Construction

6.3.2 A small amount of water will be required each day for the general construction works. This will be taken from either the water supply to be provided by Water Authority of Jordan (WAJ) or from portable water tanks. It is not proposed that water will be removed from on-site bore holes or local wells.

6.3.3 Several construction activities could require the disposal of water from the site. The discharge of any effluents during construction, including site drainage, will be the responsibility of the Construction Contractor. The Construction Contractor will be required by the Consortium to manage and dispose of any construction effluents in a responsible manner. Standard good working practices should ensure that any impacts due to the water discharging from the site would be insignificant.

6.3.4 Portable toilets will be provided for use by construction personnel. The resulting effluent will be removed from site for disposal to a sewer or sewage treatment plant. All domestic and solid wastes arising from the construction activities will be collected and removed from site so as to remove any potential source of impact to ground or surface waters.

6.3.5 Should a temporary diesel storage tank be necessary on-site, this will be double skinned and / or contained within a suitably sized impermeable bund to prevent any release of oil-contaminated water to the environment.

6.3.6 Major maintenance of construction machinery will be avoided on-site unless absolutely necessary and only in specific suitably prepared areas, to help to prevent the accidental leakage of lubricating and hydraulic fluids.

6.3.7 Storage of construction materials will be in assigned areas and will follow standard good working practices. Any disposal of excavated materials will either be off-site at an appropriate landfill site or in areas of the site that will not give rise to surface run off during wet periods to local surface water courses. Any on-site disposal will be undertaken in such a manner as to minimize the potential for impact to the recharge of aquifers.

6.3.8 The proponent will, in accordance with 'Underground-Water Monitoring By-law (No 85, 2002)', report the appearance of underground water to the General Secretariat within seven days. The potential for this to occur given the depth of the water table at the site is considered to be negligible.

6.3.9 No polluted construction related waste waters will be disposed of to water courses in the area therefore complying with 'Water Authority's Act (No. 62, 2001)'.

Impacts during Operation

6.3.10 All water required by the Power Project will be provided by the WAJ through a connection point just outside the boundary of the existing IPP1 site. The water pipeline will likely be made of steel and will be buried such that it is an appropriate depth below ground level. The agreement with WAJ will allow the Power Project of the order of240 m^3 of water per day. However, the Power Project may ultimately use less that this during operation.

6.3.11 It is not proposed that water will be removed from on-site bore holes or local wells. Therefore, the Power Project will not impact on the water resource or water quality of the local community. Furthermore, the quantities of water to be taken from the Jordanian water pipeline network will be easily accommodated by WAJ and will not impact on the availability of water to other users.

6.3.12 On a day-to-day basis, the primary requirements for water will be as make-up water for the waste heat recovery boiler and Selective Catalytic Reduction (SCR) system. The make-up water must be of high purity and will be treated in a new on-site Water Treatment Plant.

6.3.13 The Water Treatment Plant will consist of two trains. Each train will be capable of treating approximately 6 m^3/h of raw water. The Water Treatment Plant will consist of: a raw water tank; treated water (de-mineralized water) storage tanks; sand filters; active carbon filters; ion exchange streams; an acid storage tank; a caustic storage tank; an automatic effluent neutralising system; a control panel; and, all interconnecting pipe work. The make-up water for the waste heat recovery boilers will be treated in mixed bed units before being used.

6.3.14 Water supplies will also be required for make-up water for the closed cooling system and the boiler feed water system as well as for service water (e.g. drinking / washing water).

6.3.15 Together with the miscellaneous minor process requirements the total quantity of raw water required by the Power Project will be of the order of 3.1 kg/s.

Drainage Systems

6.3.16 The Power Project will comprise four drainage systems in order to maintain the effective monitoring and treatment of each specific effluent stream. The four systems

will separate: process effluent; sanitary effluent; oily water drainage; and, general uncontaminated surface water run-off. These effluent streams are further described below.

Process Effluent

6.3.17 Process effluents from the Power Project are summarised below in Table 6.10. In addition, the quantities of the process effluents are provided. However, it should be noted that these quantities represent worst case scenarios that may not ultimately reflect the normal day to day operation of the Power Project.

TABLE 6.10: DESCRIPTION OF PROCESS EFFLUENTS FROM THE POWER PROJECT

Process Effluent	***Quantity***
Boiler Blowdown	0.3 kg/sec
Water Treatment Plant Effluent	1.3 kg/sec
SCR Effluent	1.4 kg/sec

6.3.18 Further discussion of some of the process effluents are provided here:

- *Boiler Blowdown* –

  The boiler blowdown will essentially be pure water with some trace anti-corrosion chemicals used to prevent fouling in the energy recovery systems.

  During commissioning, and at infrequent intervals during the lifetime of the Power Project, it will be necessary to chemically clean the water side of the boiler tubes. All effluents will be tankered off-site by a Licensed Contractor for treatment and disposal at an appropriately licensed disposal facility. This will be undertaken in close co-operation with the Ministry of Environment (MoE).

  During maintenance it may be necessary to drain down the boiler, the closed circuit cooling water system and / or parts of these systems. All such wastes will be discharged to the on-site collection pond after treatment. The cooling water will be identical to boiler blowdown and will be high purity water containing only small amounts of corrosion inhibitor.

- *Water Treatment Plant Effluent* –

  The effluent from the Water Treatment Plant will contain salts removed from the raw water. In addition, the effluent from the Water Treatment Plant will contain some additional sodium sulphate produced by neutralisation of the spent regenerants. The effluent will discharge to the on-site collection pond.

  Sample points will be provided on the Water Treatment Plant effluent, outlet of the oil separators, and in any drains on the Power Project site prior to discharge.

Sanitary Effluent (Domestic Waste / Sewerage)

6.3.19 All sanitary effluents will be discharged to a dedicated storage facility and removed from site by a Licensed Waste Disposal Contractor.

Oily Water Drainage

6.3.20 Areas that have the potential for contamination of the surface water (such as: the fuel unloading bays; fuel storage areas; and, outdoor transformers) will drain to a suitably sized oil interceptor and / or trap system.

6.3.21 This will ensure that the final discharge to the on-site collection pond will contain no visible oils or greases.

General Uncontaminated Surface Water

6.3.22 Uncontaminated surface water will drain directly to the on-site collection pond.

Water Usage and Recovery

6.3.23 The potential for effluent water re-use will be constantly monitored as part of the Environmental Mitigation and Monitoring Programme (EMMP) that will be implemented at the Power Project site.

6.3.24 Where re-use within the Power Project is not possible, the potential to re-use the water in the vicinity of Power Project site (e.g. for duties such as irrigation) will be examined and discussed with the Relevant Authorities. The collected effluent water quality will be tested for compliance with the Jordanian Waste Water Standards Non-Organic Chemicals Affecting General Health (Irrigation) (JS 202/2007) prior to potential off-site use.

6.3.25 Furthermore, the quality of all effluents will be monitored in order to ensure compliance with the relevant Jordanian and World Bank / IFC Standards prior to re-use. Due to the use of HFO and DFO, all fuels are always enclosed. `

6.3.26 Fire detection and protection systems will be provided throughout the Power Project and Power Project site area. The Power Project will include dedicated fire water storage. In the event of a fire, fire water will be retained on-site by a kerb around the site boundary. Such water will be removed and disposed of by suitably Licensed Contractors.

Flood Risk

6.3.27 There is a risk of flash floods in the area of the Power Project (the Amman East Area) which occur during the rainy season. The rainy season lasts from October to May.

6.3.28 Flash floods have to potential to undermine the foundations of the Power Project. This could potentially result in structural damage to the plant / equipment / infrastructure as well as potentially overwhelming any on-site drainage system. To ensure that the Power Project is not impacted on by such weather events, the Power Project will be designed taking in to consideration the likely worst case weather conditions.

Impacts during Decommissioning

6.3.29 During decommissioning, the potential impacts of the Power Project will be similar to those during construction.

6.3.30 All reasonable measures required to prevent any future pollution of the site will be carried out. This will include measures such as emptying / cleaning / removal of storage tanks and the removal from site of all materials / liquids liable to cause contamination.

6.3.31 The surface water drainage system for the Power Project will continue to operate through the decommissioning phase. Any areas where oil spillage could occur will continue to drain to an oil interceptor, which will continue to be maintained.

Impact of Electrical Connection / Gas Pipeline / Water Pipeline

6.3.32 There will be some disturbance of soil in the immediate area around the electrical connection / gas pipeline / water pipeline due to excavation and compaction. However, it is not expected that this will have an impact on water quality.

6.3.33 To reduce the impacts of flooding, the electrical connection / gas pipeline / water pipeline should be protected against flash floods. This protection should take into consideration soil type and ground stability.

6.3.34 The aquifer beneath the Power Project site is deep. As such, it is not anticipated that the construction of the electrical connection / gas pipeline / water pipeline will interfere or have any major impacts on the ground water quality.

6.3.35 During construction and maintenance of the electrical connection / gas pipeline / water pipeline, it should be ensured that any fuel storage is suitably bunded to minimise the risk of contamination of ground waters.

6.3.36 Maintenance of construction equipment / machinery should not be allowed other than in designated maintenance areas.

Cumulative Impacts

6.3.37 No cumulative impacts of the Power Project, in conjunction with the existing IPP1 are anticipated.

Mitigation Measures and Monitoring Programmes

Construction

6.3.38 During construction, mitigation measures / monitoring programmes may include, as appropriate, that:

- The Construction Contractor dispose of any construction effluents in a responsible manner;
- The storage tanks are located on an impervious base provided with bund walls to give a containment capacity of at least 110 per cent of the tank volume, with all valves and couplings to be contained within the bunded area;
- Portable toilets are provided during construction and any effluent arising tinkered off-site and disposed of in an appropriate manner;
- Any surface water contaminated by hydrocarbons to be passed through an oil / grit interceptor(s) prior to collection and removal off-site to an appropriate disposal site;
- Silt traps to be used where necessary to ensure that there is no significant suspended solid loading of any surface water leaving the site;
- Spill kits are kept on-site to clean up any spills / leaks of fuels or oils;
- Spills / leaks to be reported and responded to as quickly as possible;
- Measures are taken to ensure that no leachate (or any surface water that has the potential to be contaminated) is allowed to enter directly or indirectly any watercourse, underground strata or adjoining land;
- Provisions are made so that any existing drainage systems continue to operate;
- Disposal of excavated materials will either be off-site at an appropriate landfill site or in areas of the site that will not give rise to surface run off during wet periods;
- Water inflows to excavated areas are minimised by the use of lining materials, good housekeeping techniques and by the control of drainage and construction materials in order to prevent the contamination of ground water;
- Refuelling of construction equipment / machinery / vehicles is restricted to a designated area with properly designed fuel tanks and bunds, and proper operating procedures;
- No materials will be disposed of in the wadies to the north-west of the site;

- Maintenance of construction equipment / machinery is not be allowed on-site unless absolutely necessary to help to prevent the accidental leakage of lubricating and hydraulic fluids; and
- Site personnel are made aware of the potential impact on ground and surface water associated with certain aspects of the construction works to further reduce the incidence of accidental impacts.

Operation

6.3.39 All oil / chemical storage tanks and areas where drums are stored will be surrounded by an impermeable bund. Single tanks will be within bunds sized to contain 110 per cent of the single tank capacity. Multiple tanks or drums will be within bunds sized to contain 110 per cent of the capacity of the largest tank.

6.3.40 Permanent fixed taps, filler pipes, pumping equipment, vents and sight glasses will also be located within the bunded area. Taps and valves will be designed to discharge downwards and will be shut and locked in that position. Manually started electrically operated pumps will remove surface water collected within the bund and its composition will be verified prior to disposal. Daily visual inspection of bunded areas will be made to ensure the effectiveness of these systems.

6.3.41 Adequate facilities for the inspection and maintenance of the interceptors will be provided and the interceptors will be regularly emptied to ensure efficient operation. A suitably qualified Licensed Contractor will dispose of all sludges off-site. In addition, any waste oils will be removed by a Licensed Contractor and disposed of at an appropriate disposal site in the event that the oil cannot be recovered / reused / recycled.

6.3.42 The on-site collection pond will be appropriately bunded to ensure that no water leaches in to the ground.

6.3.43 All elements of the treatment systems will be regularly monitored to ensure optimum performance and maintenance.

6.3.44 Designated waste areas will be used to store the minimal amounts of solid waste (generally office / domestic waste) generated by the Power Project.

6.3.45 Emergency Response Plans will be developed outlining the measures in the event of a leak / spill of hazardous chemicals / substances stored / used on the Power Project site.

6.3.46 The Power Project will be designed taking into consideration the danger of flash floods. This may include such measures as construction of a diversion channel or berm surrounding the facilities.

Decommissioning

6.3.47 A Site Closure Plan will be prepared for the Power Project as it approaches the end of its lifetime. The Site Closure Plan will include consideration of the best way to manage waste water issues using the best engineering practices at the time.

Conclusion

6.3.48 The discharge of any effluents during construction, including site drainage, will be the responsibility of the construction contractor, who will be required by the developer to dispose of any construction effluents in a responsible manner. Standard good working practices should ensure that any impacts due to the water discharging from the site would be insignificant.

6.3.49 During operation the water will be supplied from the WAJ water supply and there will be no abstraction from local water courses. The only discharge to local water

resources will be surface (rain) water to the wadi to the north-west of the site that will not present a significant impact.

6.3.50 The plant will comply with all relevant Jordanian legislation and World Bank / IFC guidance with regard to water use and quality.

6.3.51 The environmental impact of the Power Project on water resources is not considered to be significant.

6.4 Geology, Soils and Wastes

6.4.1 The Power Project has the potential to impact on geology during the construction, operation and decommissioning phases.

6.4.2 However it is likely that the principal impacts will be during the construction phase.

Impact Assessment

Impacts during Construction

6.4.3 The Power Project site will be levelled prior to the commencement of the main construction works.

6.4.4 Wherever practical, the re-use of any excavated material from within the site boundary would reduce the volume of excavated material going off-site to landfill.

6.4.5 Concrete and cement will be brought to site in order to create the foundations. If concrete and cement are not handled with due care and attention or are not designed to be in line with ground conditions, then there is the potential to cause pollution of watercourses. However, there are limited amounts of groundwater and surface water associated with the Power Project site. Furthermore, the ground has been tested and found not to be aggressive towards concrete or cement. Therefore, as due care and attention will be paid when handling all materials, this risk is considered to be very low.

6.4.6 There is a potential for spills / leakage of oil associated with the construction vehicles, machinery and equipment.

6.4.7 Construction activities may give rise to the emissions of dust.

Impacts during Operation

6.4.8 During operation, there will be no impacts to on-site geology or soils.

6.4.9 There is minimal risk to the general chemistry of regional soils as a result of air emissions from the Power Project, for example through acid deposition during times of heavy rainfall.

6.4.10 If the concrete foundations are in contact with a water supply, there is the potential for the surface structure to be attacked, for example through the leaching of calcium carbonate (i.e. lime). Alternatively, concrete leaching can occur when the concrete mix used is not of sufficient grade to resist any contaminants, which can attack the concrete surface. However, given that the ground has been tested and found not to be aggressive towards concrete (e.g. low levels of sulphates and phosphates) and there are limited amounts of groundwater in the area, this risk is considered to be very low.

6.4.11 A summary of the expected quantities of these wastes is provided in Table 6.11.

TABLE 6.11: TYPICAL WASTE ARISING FROM THE POWER PROJECT

Material	Source	Expected Annual Quantity (m^3)	Recovery / Disposal Methods
Fuel oil sludge	Fuel oil storage, storage tank residues	9100	Removed from site
Used spill kit material, oily rags etc	On-site maintenance	1	Removed from site
Waste mineral oils	Plant maintenance	10	Removed from site
Oil filters	Lube and fuel oil systems maintenance	10	To be determined by Contractor
Paper filters	Air inlets	10	To be determined by Contractor
Batteries	Switchgear systems	< 1 tonne	Returned to supplier
Fluorescent lighting	Engine hall, control building, stores, switchgear	2 tonnes	Removed from site
General office wastes	Control building, stores	5	Removed from site
Sanitary waste / Sewage	Wash room facilities	3600	Removed from site
Scrap metal	Workshop, general maintenance	5 tonnes	Recycled
Empty drums	Chemical deliveries	Variable (infrequent activity)	Returned to supplier
Wooden pallets	Deliveries	Variable (infrequent activity)	Recycled / returned to supplier

Impacts during Decommissioning

6.4.12 During decommissioning, impacts to geology will be temporary and minor in nature. Impacts would be similar to those described above for construction.

6.4.13 At the end of the useful life of the Power Project, approximately 30 years, the Power Project will be decommissioned in accordance with Legislative Guidelines current at that time. Alternatively, if market conditions and / or electricity supply constraints at that time indicate that it would be appropriate to extend the life of the Power Project, then decommissioning may be deferred to a later date.

6.4.14 In order to ensure continuing adequate conditions and environmental performance, the Power Project would be re-engineered and re-permitted as required, dependent of the Legislative Requirements at that time.

Impact of Electrical Connection / Gas Pipeline / Water Pipeline

6.4.15 The electrical connection / gas pipeline / water pipeline will travel a relatively short distance to the Power Project site and the intervening land is not considered to represent any significant difficulties with regard to the existing ground conditions.

6.4.16 The intervening land is similar to that of the Power Project site and does not represent an important habitat for local flora or fauna.

6.4.17 It is not considered that the electrical connection / gas pipeline / water pipeline will cause an unacceptable impact to geology / soils / ground conditions in the area.

Cumulative Impacts

6.4.18 No cumulative impacts of the Power Project, in conjunction with the existing IPP1 are anticipated due to the current mitigation measures at the existing plant and the mitigation measures for this Power Project.

Mitigation Measures and Monitoring Programmes

Construction

6.4.19 During construction, to limit any impacts, the area will be delineated. Vegetation, topsoil and subsoil will be removed to expose a suitable sub-grade. The excavated soils will be stockpiled for use in the re-instatement of the site. Any vegetation, topsoil or subsoil remaining will be removed from site or spread across the site surface and reseeded with suitable planting.

6.4.20 In the unlikely event that soils are brought to site, these will be tested for their chemical concentrations to ensure that contaminative materials are not being introduced to the area.

6.4.21 Care will be taken to ensure that run off from construction activities using concrete and cement does not reach the wadi to the west of the site and result in any contamination of local surface waters.

6.4.22 The roads and hard surfaces will be constructed to appropriately manage drainage of surface water.

6.4.23 A temporary site compound and laydown area would be constructed for the parking of construction vehicles and staff vehicles, and the storage of equipment, materials and components. This site compound and laydown area where possible is tobe accommodated within the site boundary.

6.4.24 Dust creation will be minimized through the use of bowsers to damp down roads and stockpiles (as necessary). Further details are given in Section 6.2 (Air Quality).

6.4.25 The storage of fuel, equipment and construction materials will be designed so as to minimize the risk of soil contamination or water pollution for example through the use of bunds, drip trays and oil interceptors. Storage of fuel would be limited and secure. Temporary diesel storage tanks will be double skinned or contained with an impermeable bund of an adequate size.

6.4.26 Sulphate, pH and magnesium testing will be undertaken by the selected Construction Contractor. Establishing the concentration of corrosive and organic contaminants (such as Sulphate, pH and magnesium) allows the identification of the appropriate concrete and cement, such that the concrete mix specified will resist corrosive attack.

6.4.27 Construction machinery will be checked regularly. Any maintenance required should occur over hardstanding or on a suitable impermeable ground cover. Refuelling will be limited to a designated area, on an impermeable surface, away from any drains or watercourses. Spill kits, absorbent pigs and absorbent sands will be available on-site at all times. Any spills will be cleaned up as soon as possible.

Operation

6.4.28 The potentially hazardous substances stored on-site will include: HFO, DFO; lubricating oils; greases; and, water treatment plant chemicals (including acid, caustic and boiler de-scalant). No significant problems are anticipated in dealing with any of these substances as they will be handled and stored with due regard for all health and safety requirements.

6.4.29 As has been discussed in Section 4 (Power Project and Site Description), storage areas will be suitably bunded to ensure that these chemicals cannot escape to soils and ground waters.

6.4.30 Transformers are sealed units, with negligible leakages. The transformer oils will not contain polychlorinated biphenyls (PCBs).

6.4.31 Disposal of all waste materials generated on-site (ranging from metal wastes to office refuse, whether hazardous or not) will only be via appropriate and authorized routes, i.e. by an appropriate Licensed Contractor in close cooperation with the MoE.

6.4.32 Deposition of NO_2, SO_2, PM_{10} / $PM_{2.5,}$ CO, H_2S, TSP, and hydrocarbons during operation will have an insignificant impact to geology / local soils.

Decommissioning

6.4.33 Independently validated closure / demolition methodologies have been developed for power plants that are at the end of their useful life. The closure / demolition methodologies cover: demolition of plant and buildings; and, removal of any contaminated and hazardous material from the site.

6.4.34 When demolishing the Power Project, it will be a matter of policy to ensure that the site is left with no environmental risks.

6.4.35 In order to facilitate decommissioning, much of the plant on-site will be made of materials suitable for recycling. In addition a large proportion of the buildings will be constructed of pre-fabricated steel and will therefore also be of interest to a scrap metal merchant. After the removal of the main items of plant and steel buildings, the remaining buildings will be demolished to ground level. All underground structures will either be removed or made safe. All debris to be removed off-site will be sent to a Licensed Disposal Facility.

6.4.36 During decommissioning, all reasonable measures required to prevent any future pollution of the site will be carried out. This will include measures such as:

- The emptying / cleaning and removal of storage tanks; and
- The removal from site of all materials / liquids liable to cause contamination.

6.4.37 The surface water drainage system for the Power Project will continue to operate through the decommissioning phase. Any areas where oil spillage could occur will continue to drain to an oil interceptor, which will continue to be maintained.

6.4.38 Decommissioning is likely to take place over several months.

6.4.39 The results of the pre-construction contaminated land survey will be used as a basis for a further contaminated land survey to be performed when the Power Project is closed. The aim of the further contaminated land survey will be to assess whether or not any contamination of the site has taken place during the lifetime of the Power Project.

6.4.40 A full Environmental Departure Audit will be carried out. This will examine, in detail, all potential environmental risks existing at the site and make comprehensive recommendations for remedial action to remove such risks. Following completion of the demolition, a final Environmental Departure Audit will be carried out to ensure that all remedial work has been completed. The Audits will be made available to future users of the site.

6.4.41 The site will be returned to a condition suitable for reuse. The subsequent uses of the site would be discussed with the Relevant Authorities as part of the decommissioning process.

Conclusion

6.4.42 The environmental impact of the Power Project to geology is not considered to be significant.

6.4.43 As the Power Project site has not been used for industrial purposes in the past, the likelihood of encountering significant soil contamination during the construction works

will be negligible. As such, the potential of exposing any significant soil contamination to the human / natural environment will be negligible.

6.4.44 Throughout the construction, operation and decommissioning of the Power Project, the Consortium will ensure that emission to soils / ground waters are negligible. This will be achieved though good engineering practises which will ensure that the Power Project has and insignificant impact to these receptors.

6.5 Noise and Vibration

6.5.1 The following impact assessment focuses on three Noise Sensitive Receptor (NSR) locations in close proximity to the Power Project, and ten locations on the Power Project boundary. Existing baseline conditions at each location have been determined by an attended noise survey. The baseline noise results are presented in Section 5 of this ES.

6.5.2 A prediction of the impact during construction is undertaken following the methodology of BS 5228: 2009: *'Noise and vibration control on construction and open sites*[17]*'* and information regarding the noise output of specific items: the information utilised for specific items of plant have been taken from this standard. The noise and vibration impacts during operation are predicted using a noise propagation model, using the noise data for the proposed plant items included in Table 6.18, and considering directional and screening effects.

6.5.3 This Section also suggests noise limits for the Power Project, and recommends mitigation options to control construction and operational impacts.

Legislative Framework

Power Project Boundary Noise Emission Limits

6.5.4 The receptors on the Power Project boundary are classified as 'industrial'. There are limits of equivalent (L_{Aeq}) for 'industrial receptors' set out by the World Bank / IFC Guidelines and by the Jordanian Guidelines for the Prevention of Noise. The limits are presented in Table 6.12 and Table 6.13 respectively.

TABLE 6.12: PROJECT BOUNDARY NOISE EMISSION LIMITS - WORLD BANK / IFC NOISE LIMITS (2007)

Receptor	Maximum allowable hourly measurements L_{Aeq} (dB)	
	Day (07:00 - 22:00)	Night (23:00-07:00)
Industrial, commercial	70	70

TABLE 6.13: PROJECT BOUNDARY NOISE EMISSION LIMITS - JORDANIAN GUIDELINES FOR THE PREVENTION OF NOISE (2003)

Area	Highest Permissible L_{Aeq} (dB(A))	
	Day	Night
Industrial	75	65

6.5.5 The relevant noise limits for the receptors on the Project boundary are therefore 70 dB(A) during the day and 65 dB(A) at night.

[17] BS5228: Part 1 - 2009 - Code of Practice for Noise and Vibration Control on Construction Sites

Noise Sensitive Receptor Noise Emission Limits

6.5.6 NSRs are classified as sensitive receptors outside the Power Project boundary e.g. residential and educational. The World Bank / IFC Guidelines and the Jordanian regulations set out noise limits for NSRs. The limits are presented in Table 6.14 and Table 6.15 respectively.

TABLE 6.14: NSR NOISE EMISSION LIMITS - WORLD BANK / IFC NOISE LIMITS (2007)

Receptor	Maximum allowable hourly measurements L_{Aeq} (dB)	
	Day (07:00 - 22:00)	Night (23:00-07:00)
Residential, institutional, educational	55	45

TABLE 6.15: NSR NOISE EMISSION LIMITS - JORDANIAN GUIDELINES FOR THE PREVENTION OF NOISE (2003)

Area	Highest Permissible L_{Aeq} (dB(A))	
	Day	Night
Residential in urban	60	50
Residential in Sub-urban	55	45
Residential in rural	50	40
Residential having small industries, offices and public buildings. City centres	65	55
Schools, hospitals, mosques and churches	45	35

6.5.7 Under the Jordanian regulations the residential receptors in the vicinity of the plant have been classified as 'residential in suburban'. The relevant Power Project noise limits for the residential NSRs are therefore 55 dB(A) during the day and 45 dB(A) at night. There is also a school in the village of Al-Manakher and therefore the relevant Power Project noise limit for this NSR is 45 dB(A) during the day. The night-time noise is not deemed to be relevant for the school as it will be closed at night.

6.5.8 The World Bank / IFC allows for an increase of up to 3 dB above the existing background levels outside the Project property boundary. The Jordanian regulations do not allow for any increase above the existing background levels.

Assessment Methodology

Construction Noise

6.5.9 The significance of construction noise impacts will be assessed based on the fixed noise limit of 75 dBA for urban areas near main roads in heavy industrial areas - taken from British Standard (BS) 5228: 2009. The significance of construction noise relates to the degree of exceedance of the threshold value detailed in Table 6.16.

TABLE 6.16: CRITERIA FOR DETERMINING CONSTRUCTION NOISE IMPACTS

Exceedance of Threshold Value (dB)	*Likely Significance*
< 1	Negligible
1 to 3	Minor
3 to 5	Moderate
5 to 10	Major
> 10	Severe

Construction Impact – Vibration

6.5.10 BS 5228:2009 Part 2: Vibration; gives recommendations for basic methods of vibration control relating to construction and open sites where work activities/operations generate significant vibration levels.

6.5.11 Human beings are known to be very sensitive to vibration, the threshold of perception being typically in the peak particle velocity (PPV) range of between 0.14mms^{-1} and 0.30mms^{-1}. BS 5228-2:2009 provides guidance on the effects of vibration shown in Table 6.17.

TABLE 6.17: GUIDANCE ON THE EFFECTS OF VIBRATION

Vibration Level	***Effect***
0.14 mms^{-1}	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mms^{-1}	Vibration might be just perceptible in residential environments.
1.0 mms^{-1}	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10 mms^{-1}	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

Source: derived from BS 5228

6.5.12 For the purposes of this assessment vibration levels 0.14 mms^{-1} to 0.29 mms^{-1} are considered to be of negligible significance, 0.3 to 0.99 mms-1 are of minor significance, 1.0 to 9.99 mms^{-1} are of moderate significance and vibration levels in excess of 10 mms^{-1} are of major significance.

6.5.13 In extreme conditions, vibration from construction operations such as piling has the potential to damage nearby buildings. However, no piling is anticipated in the construction of the Power Project. Limits on suitable vibration levels are presented in Table 6.18. These levels are based on the criteria within BS 5228.

TABLE 6.18: CONSTRUCTION VIBRATION LIMITS

Type of Building	*Peak component particle velocity in frequency range predominant pulse*	
	4Hz to 15 Hz	*15Hz and above*
Reinforced or framed structures	50mm/s at 4Hz and above	50mm/s at 4Hz and above
Industrial / Commercial Buildings		
Un-reinforced or light framed structures	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz
Residential or light Commercial		

Source: derived from BS 5228

Operational Noise

6.5.14 Noise from the Power Project has been assessed for 100 per cent maximum output. A conservative view of the Power Project operating for 8760 hours (baseload as opposed to peaking plant) per year has been adopted in the noise modelling so that a worst case is presented. However, the plant will actually be designed to operate in peaking mode and will therefore only operate at approximately 40 per cent of base load (which would likely be achieved by reducing the total number of engines in operation). It is anticipated that, at 40 per cent of base load, noise levels generated by the plant will be significantly lower than those predicted by the assessment.

6.5.15 It is considered that start-up and shut-down events would be of short-duration and unlikely to cause a nuisance to nearby NSR's. The likely significance of operational noise will relate to the degree of exceedance of the World Bank / IFC Guidelines or Jordanian regulations as identified in Table 6.19.

TABLE 6.19: CRITERIA FOR DETERMINING OPERATIONAL NOISE IMPACTS

Exceedance of Threshold Value (dB)	*Likely Significance*
< 1	Negligible
1 to 3	Minor
3 to 5	Moderate
5 to 10	Major
> 10	Severe

6.5.16 Table 6.20 details the operational equipment noise sources which have been used in the Cadna A noise model to predict the operational noise from the Power Project.

TABLE 6.20: OPERATIONAL NOISE SOURCES

Equipment	Hz / kHz									Total dB(A)
	31.5	63	125	250	500	1	2	4	8	
Total of 16 Engines (Based on 110dB(A) spatial average level)	85	99	105	105	105	105	103	102	99	110
Attenuated Exhaust Sound Power (per 4 engines)	76	74	75	81	66	70	56	40	0	75
Attenuated Intake Sound Power (per engine)	64	75	68	58	57	75	85	81	79	88
Attenuated Radiator Sound Power Level (16 banks of radiators)	74	74	72	72	71	71	70	69	69	77

Impact Assessment

Impacts during Construction

6.5.17 Construction activity inevitably leads to some degree of noise disturbance at locations in close proximity to the construction activities. It is, however, a temporary source of noise.

6.5.18 Noise levels at any one location will vary as different combinations of plant machinery are used, and throughout the construction phase as the construction activities and locations change.

6.5.19 A worst-case prediction of the highest noise level likely at each receptor during the construction phase has been using the distance attenuation prediction method based on the methodology outlined in BS 5228: 2009 '*Noise and vibration control on construction and open sites'*.

6.5.20 In the absence of specific information regarding the proposed construction plant and activities, noise levels for typical items of plant and machinery have been taken from the library within BS 5228.

6.5.21 The closest NSR to the Site is NSR 13, which is approximately 80 m from the Power Project boundary.

6.5.22 Table 6.21 displays the sound pressure level of typical items of plant from the BS 5228 library at 25 m, 100 m and 700 m.

TABLE 6.21: SOUND PRESSURE LEVELS ASSOCIATED WITH TYPICAL CONSTRUCTION ACTIVITIES

Construction Activity/ Associated Plant	*Typical A-weighted Sound Pressure Level (L_A) at 10m*	*Estimated Sound Pressure Level (LA) at 25m*	*Estimated Sound Pressure Level (LA) at 80m*	*Estimated Sound Pressure Level (LA) at 250m*
Site Preparation				
Dozer	75	71	66	61
Tracked Excavator	78	74	69	64
Wheeled Backhoe Loader	68	64	59	54
Excavation				
Dozer	81	77	72	67
Tracked Excavator	79	75	70	65
Loading Lorry	80	76	71	66
Articulated Dump Truck	81	77	72	67
Rolling and Compaction				
Roller	79	75	70	65
Vibratory Plate	80	76	71	66
Piling				
Hydraulic Hammer Rig	89	85	80	75
Large Rotary Bored Piling Rig	83	79	74	69
Welding/Cutting Steel				
Welder (Welding Piles)	73	69	64	59
Generator for welder	57	53	48	43
Cutter (Cutting Piles)	68	64	59	54
Other				
Large Lorry Concrete Mixer	77	73	68	63
Concrete Pump (Discharging)	67	63	58	53
Tower Crane	77	73	68	63

6.5.23 The impact of construction noise has the potential to exceed the 75 dBA threshold for construction and decommissioning at times during the construction phase due to the proximity of the nearest NSR, location 13. However, this will only be as a result of any piling activities during the construction phase, which are not envisaged. In the event that pilling does occur, it is unlikely to occur for long periods of time. The construction noise predictions have not taken into account any mitigation, and have not been averaged over a 12-hour working day to give the $L_{Aeq,12h}$ in accordance with BS 5228.

Construction Vibration

6.5.24 Surface plant such as compressors, generators and cranes are not recognised as sources of high levels of vibration. Even at a close distance of 10 m, peak particle velocities (ppv) of significantly less than 5 mms^{-1} is generated by such plant. For example, a bulldozer would generate a ppv of approximately 0.6 mms^{-1} and a 'heavy lorry on poor road surface' would generate a ppv of less than 0.1 mms^{-1}.

Impacts during Operation

6.5.25 The prediction of noise levels at the Power Project boundary and NSRs is based on an acoustic propagation model. The modelling is made according to the method described in International Standard ISO 9613-2 Acoustics – Attenuation of sound during propagation outdoors – Part 2: general calculation method. The actual software implementation of the method is Cadna A version 4.0. The model has been created to estimate the contribution to noise levels from each major identified plant source, at the Power Project boundary and NSR locations. These locations have been assessed against the set noise limits provided by the World Bank / IFC Guidelines and Jordanian regulations as detailed earlier in this Section.

6.5.26 All the noise sources are defined as point or area noise sources. The source properties are defined as source noise emissions or sound power level data at standard 1/1-octave band frequencies 31.5Hz to 8kHz with corresponding attenuations due to silencers and structures. From these, the overall A-weighted equivalent sound pressure levels at receiver locations are calculated.

6.5.27 The model is intended to provide a worst-case assessment of the noise level likely to be experienced at the Power Project boundary and NSR locations.

6.5.28 A number of assumptions are made with regards to the noise control likely to be installed on major plant items, and these are stated below.

6.5.29 The following assumptions with regards to noise control have been made:

- The model assumed in this document is for a W18V50DF tri-fuel engine, running at 100 per cent load;
- Due to the impracticality of screening stack noise, discharge noise will be controlled using silencers tuned to attenuate low frequencies from the gas turbine exhausts;
- Engine air intakes are to be fitted with high performance silencers;
- Engines will be housed in an appropriate engine hall enclosure, to provide full screening to NSRs;
- The model considers maximum operational noise. As such, noise due to non-normal operation plant items has not been considered; and
- The noise model predicts noise levels assuming moderate down-wind noise propagation conditions

- The attenuation of sound propagating outdoors between a fixed source and receiver fluctuates due to variations in the meteorological conditions along the propagation path. Restricting attention to 'moderate downwind conditions' of propagation limits the effect of variable meteorological conditions on attenuation to reasonable values. These acoustic and atmospheric variables, i.e. frequency of the sound, ambient atmospheric temperature, the concentration of water vapour and ambient atmospheric pressure, result in an estimated degree of accuracy for noise predictions using the ISO 9613-2 standard (+ / - 3dB between 100 m and 1000 m).

6.5.30 Table 6.22 presents the predicted noise levels at the Power Project boundary and NSR locations assuming 100 per cent of maximum output of the Power Project when considered in isolation.

TABLE 6.22: SUMMARY OF PREDICTED NOISE LEVELS AT POWER PROJECT BOUNDARY AND NSR LOCATIONS IN ISOLATION

Measurement Locations	*Power Project Noise Limit L_{Aeq}, dB*	*Predicted Noise Level from the Power Project L_{Aeq}*	*Variance of Power Project Noise Level and Noise Limit*	*Exceedances*
1	65	44.2	-20.8	N
2	65	43.5	-21.5	N
3	65	40.3	-24.7	N
4	65	45.3	-19.7	N
5	65	47.2	-17.8	N
6	65	40.4	-24.6	N
7	65	40.3	-24.7	N
8	65	38.8	-26.2	N
9	65	39	-26.0	N
10	65	26.8	-38.2	N
11 (School)	45	37.7	-7.3	N
12 (Residential)	45	40.5	-4.5	N
13 (Residential)	45	41.7	-3.3	N

6.5.31 Table 6.22 demonstrates that the Power Project noise limit of 65 dB is met for all Power Project boundary locations when the Power Project is considered in isolation.

6.5.32 The predicted Power Project noise levels at all NSR locations meet 45 dB when the Power Project is considered in isolation.

Operational Vibration

6.5.33 It is predicted that on-site vibration sources will include the following:

- Balanced rotating equipment, such as engines; and
- Wind induced vibrations in the tall buildings and structures, if any, to be transmitted to the foundations.

6.5.34 It is not anticipated that the level of induced vibration will be sufficient to propagate to the nearest sensitive receptors, the closest of which is approximately 130 m from the centre of the proposed site. Hence the impact of operational vibration is not assessed further.

Cumulative Impact Assessment

6.5.35 This Section assesses the impacts of the Power Project in combination with the likely impact to the noise climate arising from the adjacent IPP1 Power Station.

6.5.36 It should be noted that locations 6, 7, 8 and 10 have measured background noise readings (taken in June 2011), that are lower than the measured background noise readings taken in 2006. The 2006 background readings have therefore been noted for comparison in the cumulative assessment.

6.5.37 Table 6.23 presents the predicted cumulative noise levels and background noise levels at the Power Project boundary and NSR locations assuming 100 per cent of maximum output of the Power Project.

6.5.38 Table 6.23 demonstrates that the predicted cumulative noise levels at the Power Project boundary locations meet the noise limit of 65 dB.

6.5.39 The measured background noise readings taken in June 2011 show that NSR noise levels at the village of Al-Manakher are already higher than the Jordanian regulations and World Bank / IFC Guidelines. The predicted cumulative noise levels at the NSR locations 11 to 13 do not meet the Power Project noise limits. The Power Project increases the current ambient noise levels by 0.2 dB at NSR locations 12 and 13, and does not impact on the current background noise levels at the school NSR location.

6.5.40 The existing background noise levels at all NSR locations already exceed the required noise limits. The predicted exceedance of the existing noise levels at NSR locations 12 and 13 due to the Power Project of 0.2 dB, and a worst case of 1 dBA above the existing background noise level depending on final site layout and mitigation measures available to the EPC contractor at the time of construction, is considered a negligible increase , with no increase at NSR 11 (school). This is because the noise modelling has been undertaken in accordance with ISO9613-2, which has a stated accuracy between 100 m and 1000 m of +/- 3 dB. Also, as noise changes of 1 dB are not perceptible by humans, there is no demonstrable environmental impact associated with a noise increase of 1 dB. World Bank /IFC Guidelines also allow for an increase of up to 3dBA above the existing background levels. Even at the worst case, IPP4 will operate well within this limit.

6.5.41 It should also be noted that this noise assessment has not taken into account any screening offered by the new plant in between the existing IPP1 and the NSRs identified in this report, that is, the 2011 measured noise levels at NSRs have been included in the noise impact of the new Power Project, when in fact, the Power Project plant will offer significant screening at all NSRs detailed in this report with the exception of boundary locations 1 and 10. In addition, it should be noted that with the Power Project in isolation the noise levels are in compliance with the regulations as shown in Table 6.22.

TABLE 6.23: SUMMARY OF PREDICTED CUMULATIVE NOISE LEVELS AND BACKGROUND NOISE LEVELS AT EACH POWER PROJECT BOUNDARY AND NSR LOCATIONS*

Measurement Locations	Lowest Measured (2006) L_{Aeq}, dB	Lowest measured (June 2011) L_{Aeq}, dB	Power Project / Ambient Noise Limit L_{Aeq}, dB	Predicted Noise Level after construction of the Power Project, including background noise sources June 2011 (L_{Aeq}, dB)	Variance of Cumulative Power Project Noise Level and Power Project Noise Limit L_{Aeq}, dB	Exceedances from Power Project / Ambient Noise Level Limit	Exceedance from Lowest Measured (June 2011) Values
Power Project Boundary							
1	60.4	58.6	65	58.8	-6.2	N	N/A
2	48.1	49.1	65	50.2	-14.8	N	N/A
3	48.1	52.1	65	52.4	-12.6	N	N/A
4	48.1	49.4	65	50.8	-14.2	N	N/A
5	48.1	52.5	65	53.6	-11.4	N	N/A
6	47.6	47.5	65	48.3	-16.7	N	N/A
7	47.6	48.5	65	49.1	-15.9	N	N/A
8	47.6	46.1	65	46.8	-18.2	N	N/A
9	47.6	47.7	65	48.2	-16.8	N	N/A
10	56.7	46.3	65	46.3	-18.7	N	N/A
NSR							
11 (School)	48.1	60.9	45	60.9	15.9	N/A	N
12 (Residential)	48.1	54.4	45	54.6	9.6	N/A	**Y (0.2 – 1.0dB)
13 (Residential)	48.1	54.4	45	54.6	9.6	N/A	**Y (0.2 – 1.0dB)

Notes:
Proxy for number 2, 3, 4, 5 was measurement location 5 from the old IPP1 ESIA
Proxy for 6, 7, 8, 9 is location 4 from the old IPP1 ESIA
Proxy for location 10 is location 1 from the old IPP1 ESIA
Proxy for location 1 is location 2 from the old IPP1 ESIA

** NB. The noise levels displayed in Table 6.23 above represent a worst case scenario, as they are derived from the plant running at 100 per cent base load. However, the plant will actually be designed to operate in peaking mode and will therefore operate at approximately only 40 per cent of base load (which would likely be achieved by reducing the total number of engines in operation). It is anticipated that at 40 per cent of base load, noise levels generated by the plant will be significantly lower than those reported in the table above.*

Additionally, where predicted noise changes as a result of the introduction of IPP4 are less than 1 dB, this is not considered to be significant. This is because the noise modelling has been undertaken in accordance with ISO9613-2, which has a stated accuracy between 100 m and 1000 m of +/- 3 dB. Also, as noise changes of 1 dB are not perceptible by humans, there is no demonstrable environmental impact associated with a noise increase of 1 dB.

*** The predicted exceedance in background levels at receptors 12 and 13 will be at a best case 0.2 dB but at a worst case have also been modelled at up to 1.0 dB. The exact level of exceedance will be dependent on the final design layout of the plant and mitigation measures available to the EPC contractor. Even if there was a 1.0 dB increase from background levels this would not be considered as a significant impact to nearby receptors and is within World Bank Guidelines.*

Mitigation Measures

6.5.42 An assessment has been made using the Power Project noise limits for the site in order to minimise potentially disruptive noise levels impacting on residential areas. To minimise the likelihood of complaints, the equipment procured for use in the installation will need to be specified to ensure that the Power Project limits are met.

Construction

6.5.43 In order to keep noise impacts from the construction phase to a minimum, all construction activities would be carried out in accordance with the recommendations of BS 5228. In addition, the following mitigation measures would be implemented through the Construction Environmental Management Plan (CEMP):

- All vehicles and mechanical plant used for construction would be fitted with effective exhaust silencers, and regularly maintained;
- Inherently quiet plant would be used where appropriate. All major compressors would be sound-reduced models fitted with properly lined and sealed acoustic covers which would be kept closed whenever the machines are in use, and all ancillary pneumatic percussive tools would be fitted with mufflers or silencers of the type recommended by the manufacturers;
- All ancillary plant such as generators, compressors and pumps would be positioned so as to cause minimum noise disturbance. If necessary, temporary acoustic barriers or enclosures would be provided.

Operation

6.5.44 The following measures would serve to continually monitor and minimise the impact of noise from the Power Project:

- A computer model of the proposed plant items should be produced at the detailed design stage, to calculate the predicted noise levels at the NSR locations, and ensure that planning limits are adhered to. Detailed design will ensure that site noise is mitigated as far as possible, through site layout and orientation of noisy plant items.
- Since tonal or impulsive noises are considered more annoying than continuous noise sources, plant items should be silenced or otherwise controlled through regular maintenance to ensure no such emissions are audible at NSR locations.
- Inherently quiet plant items should be selected wherever practicable. High performance silencers should be fitted to achieve maximum noise attenuation on plant and ductwork. Acoustic lagging and low noise trims will be fitted to all pipe-work and noise generating steam valves.
- High performance acoustic enclosures should be considered for plant items where reasonably practicable and deemed to be required, Internal surfaces within the Engine enclosures should be treated to control internal reverberant noise levels. An appropriate treatment would consist of dense mineral wool panel behind perforated sheet steel, or a spray on cellulose fibre treatment.
- All noisy plant can be positioned such that it faces towards the existing plant or towards new plant such that all sensitive receptors benefit from screening and/or directivity corrections.

Residual Impacts

6.5.45 Noise during the construction phase of the Power Project has been identified as having the potential to cause disturbance however the impact will be temporary and

with mitigation and controlling the use of the noisiest plant during the construction phases, noise levels can be reduced to below the 75 dBA threshold for construction at NSRs.

6.5.46 An assessment of the likely noise impact of the Power Project has been conducted. The Power Project site is in an area already populated with a power facility of comparable size. Noise from the existing plant, and the heavy traffic flows on the new highway along with a variety of other nearby noise sources leads to relatively high baseline noise levels. Due to high baseline noise levels, predicted noise exceeds the Jordanian regulations at two NSRs to a degree of 0.2 dB, but a worst case of 1 dBA above the existing background noise level depending on final site layout and mitigation measures available to the EPC contractor at the time of construction, above the existing baseline. The noise modelling has been undertaken in accordance with ISO9613-2, which has a stated accuracy between 100 m and 1000 m of +/- 3 dB. Also, as noise changes of 1 dB are not perceptible by humans, there is no demonstrable environmental impact associated with a noise increase of 1 dB. World Bank /IFC Guidelines also allow for an increase of no more than up to 3dBA above the existing background levels. Even at the worst case, IPP4 is will operate well within this limit. This impact is of negligible significance.

Conclusion

6.5.47 The impact of construction noise has the potential to exceed the 75 dBA threshold during the construction phase due to the proximity of the nearest NSRs. However, mitigation can be implemented to reduce noise levels to below the 75 dBA threshold.

6.5.48 The impact of predicted operational noise has been assessed for the Power Project against background noise levels obtained during the attended noise survey. It is predicted that the noise impact at all Power Project boundary locations meet the noise requirements for the Power Project.

6.5.49 Predicted operational noise levels at two NSRs are in the order of 0.2 dB(A) to 1 dBA at worst case above the existing background noise level recorded. The current background level is already exceeding the required noise regulation limits at these locations and the increase is negligible as noise changes of less than 1 dB are not perceptible by humans, there is no demonstrable environmental impact associated with a noise increase of 1 dB. World Bank /IFC Guidelines also allow for an increase of up to 3dBA above the existing background levels. Even at the worst case, IPP4 will operate well within this limit.

6.6 Landscape and Visual

6.6.1 This Section assesses the landscape and visual impact of the Power Project.

Impact Assessment

Impacts during Construction

6.6.2 During construction of the Power Project, the site will have the appearance of a typical construction site. The area surrounding the Power Project site is characterised as a desert with rare vegetation cover.

6.6.3 Based on the anticipated construction activities, there may be temporary adverse landscape and visual impacts.

Impacts during Operation

6.6.4 The substantial buildings envisaged on the Power Project site are the engine hall; air blast radiators, and stacks.

6.6.5 There will also be a Control Room and Storage Tank Area, expected to be up to 20 m in height. The remaining equipment and plant will be housed in relatively low buildings, of the order of 3 to 6 m in height.

6.6.6 The indicative plant dimensions of the substantial buildings are provided in Table 6.24.

TABLE 6.24: INDICATIVE PLANT DIMENSIONS (M)

	Height	***Length***	***Breadth***
Engine Hall	12	150	30
Air Blast Radiators	16	2	2
Stacks	70	-	-

6.6.7 A 3-dimensional rendering of a typical plant is shown in Figure 6.7.

Assessment Methodology

6.6.8 The significance of the landscape and visual impacts of a development may be considered to reflect the extent to which the proposal is compatible with the character and perceived quality of the local area.

6.6.9 A range of factors including the scale of the local landform, the pattern of landscape features and general sensitivity of the landscape in relation to the scale and layout of the Power Project will influence the degree of compatibility. Accordingly the assessment considers: the environmental baseline of the landscape (presented in Section 5); the extent of predicted visibility; and, the magnitude of change associated with the construction of the proposed Power Project.

Assessment

6.6.10 Changes to landscape occurring within the Power Project site boundary would be both direct (physical alteration) and indirect (visual influence).

6.6.11 The Power Project would essentially introduce the substantial buildings (engine hall, air blast radiators and stacks), control room, storage tank area and other miscellaneous items to the landscape. However, the Power Project would likely be screened by local topography, and it may be that only the tops of the stacks would be visible from areas outside a few kilometres away.

6.6.12 Based on this information, the landscape and visual impacts associated with the operation of the Power Project will be similar to that of the existing IPP1.

6.6.13 The Power Project would be seen within the context of the environmental baseline, including the existing IPP1, and therefore is it likely that any landscape and visual impacts would ultimately be insignificant.

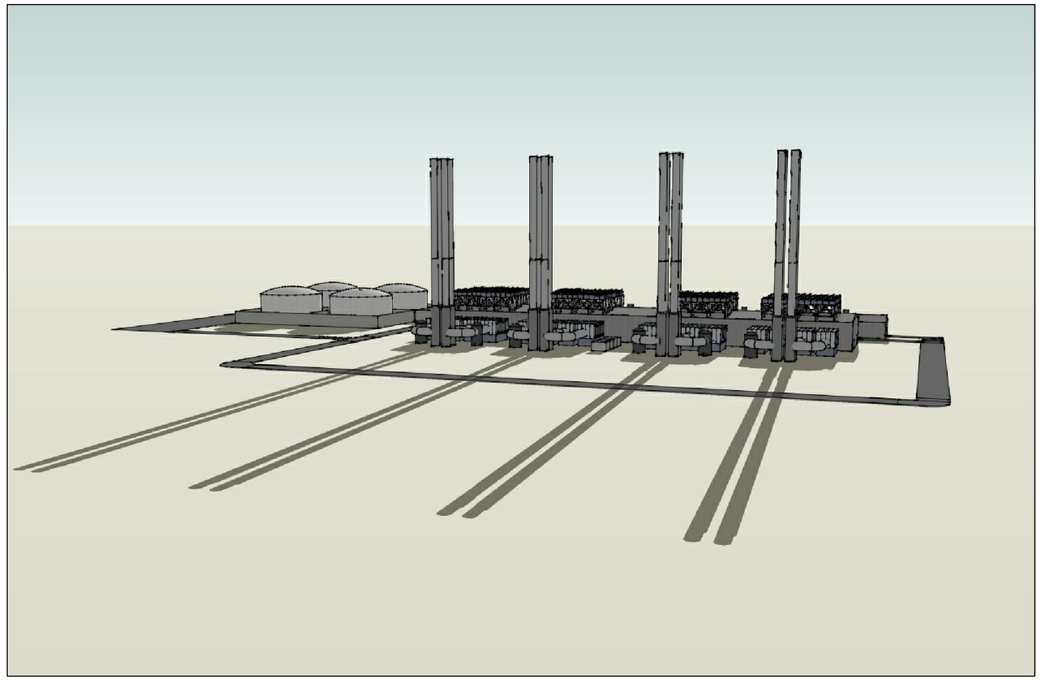
<u>Impacts during Decommissioning</u>

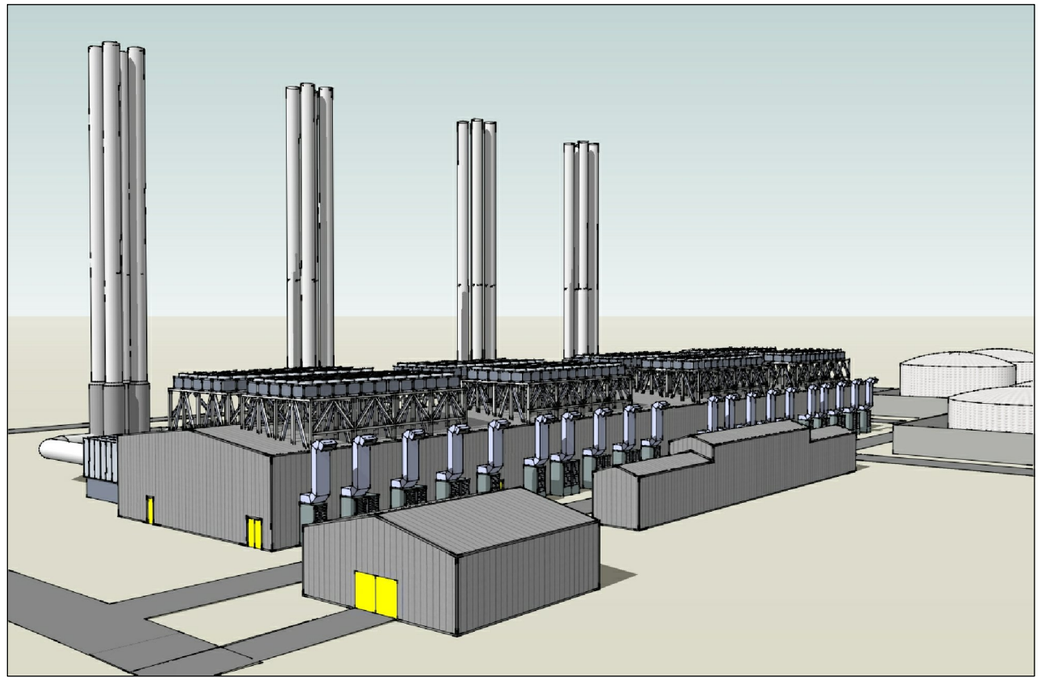
6.6.14 During decommissioning, impacts are anticipated to be similar to those experienced during construction.

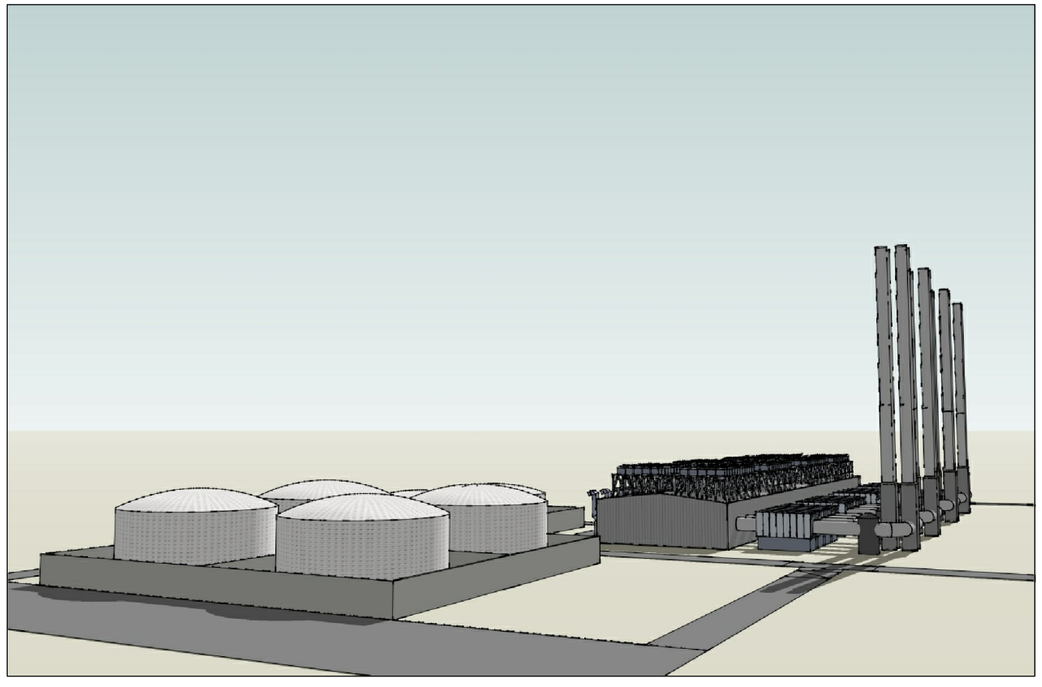
<u>Impact of Electrical Connection / Gas Pipeline / Water Pipeline</u>

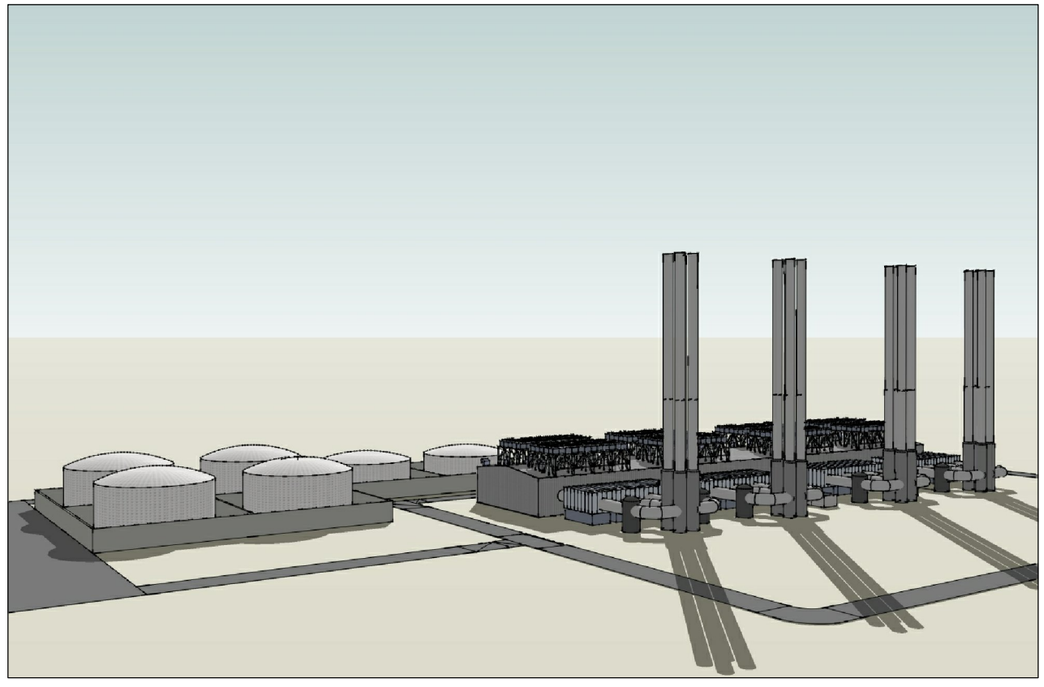
6.6.15 During construction of the electrical connection / gas pipeline / water pipeline, there will be the presence of construction equipment, materials and construction personnel. This will lead to temporary adverse landscape and visual impacts during the construction phase.

6.6.16 There will be no visual impacts during operation as all features will be underground.









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Project: AL-MANAKHER POWER PROJECT

Title: INDICATIVE 3D MODEL

Drawn:		Checked:		
Designed:		Approved:		
Date: 05/08/2011	Scale: NTS	A3	Sheet:	
Project Number:	Drawing Number:			Revision
3511309A	FIGURE 6.7			

Login: Donnelly, David
Plot Date: 15/08/2011 17:35:26
File Name: K:\Projects\62671 - Amman East IPP\Z. Drawings\1. Current\Environmental\FIGURE 6.7.dwg

Cumulative Impacts

6.6.17 Based on the fact that IPP1 is an existing power plant, no cumulative impacts are anticipated.

Mitigation Measures and Monitoring Programmes

Construction

6.6.18 The construction site will be screened to an extent by the undulating topography of the area.

6.6.19 Furthermore, the Power Project will seek to use construction equipment (such as cranes) that are sized to serve their intended purposes without presenting an overly intrusive visual impact.

6.6.20 In addition, the Construction Contractor will be required to provide areas for the disposal of waste so as to prevent these wastes escaping to the surrounding area and becoming unsightly.

Operation

6.6.21 The architectural design of the Power Project (and its associated plant, buildings and enclosures) will be carefully considered to provide a high standard of visual amenity. Overall, it is likely that the proposed architectural design will be modern in appearance, with a clean outline and a simple bold structure.

6.6.22 The materials selected / used for the Power Project (and its associated plant, buildings and enclosures) will, wherever possible, match those of the existing IPP1. At upper levels, colours will be neutral and subdued to provide the least visual intrusion and minimize contrasts with the existing environment.

6.6.23 The Power Project shall be designed to withstand extreme ambient conditions to which it may be exposed and to continue to function normally, within appropriate range of de-rating factors to account for such ambient conditions.

6.6.24 The design of the plant, buildings and enclosures will aim to minimize regular and long term maintenance, with also ensuring there will be no deterioration in the power station's appearance over its lifetime. The steel structures of the plant, buildings and enclosures will be painted with surface protected suitable for local conditions in accordance with the Standards and Practices of the Steel Structures Painting Council.

6.6.25 The stacks will be designed to be of sufficient height to maximize dispersion of the atmospheric pollutants, whilst being as low as possible to minimize adverse landscape and visual impacts. A height of 70 m has been determined through atmospheric dispersion modelling.

6.6.26 All external lights would be switched off when not required, although some may remain (e.g. for safety / security). Directional lighting will be used to minimise light pollution.

6.6.27 Wherever appropriate, planting / landscaping will be undertaken to provide additional screening.

Conclusion

6.6.28 The architectural design of the Power Project (and its associated plant, buildings and enclosures) will be carefully considered to provide a high standard of visual amenity.

6.6.29 Wherever appropriate, planting / landscaping will be undertaken to provide additional screening.

6.6.30 The landscape and visual impact of the Power Project is considered to be insignificant.

6.7 Transport and Infrastructure

6.7.1 The Power Project has the potential to impact on local traffic and transport infrastructure during the construction, operation and decommissioning phases.

6.7.2 The information used in making the below assessment with regard to vehicle movements etc is based on PB's experience of similar peaking plant developments.

6.7.3 However, it is likely that the principal impacts will be during the construction phase.

Impact Assessment

Impacts during Construction

6.7.4 Road access to the proposed site will be via a new site access road that will link to the Zarqa to Sahab road immediately to the north of the Power Project site.

6.7.5 The 17 month construction phase of the Power Project will give rise to additional traffic movements. At the peak of construction it is anticipated that up to 1000 construction personnel may be required to visit the site, and this has the potential for the generation of a high volume of private vehicle trips both to and from the site. Car sharing and the use of minibuses and public transport will be encouraged. In addition the Construction Contractor appointed will be encouraged to provide a minibus service for construction personnel. Based on this information, there would be up to 200 staff vehicles travelling to the site during the morning peak hours and 200 staff vehicles leaving the site during the evening peak hours.

6.7.6 In addition to staff transport movements, construction traffic will consist of: civil works traffic; mechanical works traffic; and, a small number of abnormal loads for components such as the engines.

6.7.7 Materials used during the civil works will include ready mixed concrete and / or raw materials for the on-site manufacture of concrete, reinforcing bars, structural steelwork, cladding and road materials. Materials brought to site for the mechanical works will comprise all items of plant / equipment. The traffic associated with the delivery of materials will consist of light and heavy commercial vehicles. Approximately 10 light vehicles and 100 heavy commercial vehicles per day will be expected on average. During the peak construction period 200 heavy commercial vehicles per day are expected. Vehicles bringing deliveries to site are likely to be spread throughout the working day.

6.7.8 During the construction phase, the Azraq-Zarqa Road will be used for transporting the abnormal loads (machinery and heavy equipment). The exact number of abnormal loads would depend on the configuration of the Power Project. This will only be finalised during the tendering process. However, it is likely to be of the order of 30 individual loads over the entire 17 month construction period. The transport of abnormal loads, which may lead to delays and cause inconvenience to other road users, would be timed to minimise disruption to the other road users. During the operational phase, the Zarqa-Sahab Road will be used to transporting normal loads (HFO and DFO). The good quality of the existing Zarqa-Sahab Road should remove the need for any road improvement works that are sometimes associated with power plant developments.

6.7.9 The transportation of construction material has the potential to increase the daily number of vehicles utilising the Zarqa-Sahab Road by less than 1 per cent in both directions, and the Azraq-Zarqa Road by less than 5 per cent. Thus, it is expected that a slight increase in traffic flow will take place during the construction period. The negative impact of traffic congestion will be limited by the relatively low number of vehicles required and the implementation of appropriate mitigation and monitoring measures.

6.7.10 It is anticipated that the road traffic generated by the construction of the Power Project will not be sufficient to significantly affect traffic related air quality or noise in the area, especially when considered against current traffic levels and the lack of sensitive receptors along the main roads.

6.7.11 Given the Power Project's fairly isolated location, no impacts to pedestrians or cyclists are anticipated. Any impact to public transport in the area could generally be considered to be positive as the Power Project could potentially see an increase level of public transport to the area to allow for the transportation of construction staff to the site.

6.7.12 Given the timing, nature and management of any increased traffic levels during the construction period, in that it will be slight and of short duration, the impact on the local roads and infrastructure will be insignificant.

Impacts during Operation

6.7.13 Operation of the Power Project will naturally result in fewer traffic movements than those associated with construction. Traffic movements during operation are expected to be of the order of 80 per day. This includes traffic movements due to the 40 to 50 staff operating the Power Project, and (as such) the majority of the journeys are expected to be local.

6.7.14 The Power Project will operate on a shift basis. The maximum number of vehicles arriving at site during each shift change would be less than 20 and would have no significant impact on the traffic flow in the area.

6.7.15 During the operational phase, HFO and DFO will be brought to site by road tankers which will result in an increase in traffic movements in the vicinity of the site. NEPCO will be responsible for the fuel until delivered to site. In the event the given specification of fuel can be sourced in country then it shall be sourced locally. If this is not possible, fuels will be imported into Aqaba and delivered by road to the Project site via the Aqaba Back Road, Primary Trunk Road (No.15) and the new Amman Ring Road. The new Amman Ring Road is anticipated to be in operation at the time of Project commissioning.

6.7.16 HFO and DFO will be stored onisite in dedicated storage tanks that will allow for approximately 30 days continuous operation of HFO and 10 days continuous operation of DFO at maximum capacity. Given the proposed operating regime of providing short term electricity generation, the large storage capacity will reduce the urgency of any fuel delivery following a period of operation. This means that the tanks can be refilled over a longer period of time and allow the deliveries to be timed to coincide with periods of reduced traffic volumes.

6.7.17 It is estimated that the total number of transporting deliveries to the Power Project site would be on average 15 per day, assuming each tanker has a capacity of c.40 tonnes.

6.7.18 If the Power Project were to be run at full load, approximately 40 tankers per day would be required to deliver HFO to site. This would be over a period of 10 hours and would deliver to 6 unloading bays on-site. The transportation of HFO will increase the daily number of vehicles using the Zarqa-Sahab Road by 0.19 per cent (on each side). Therefore, this represents a negligible increment to the existing traffic movements along to road during the operational period. The transportation of HFO from Aqaba will increase the daily number of vehicles using the Primary Trunk Road (No.15) by less than 1 per cent. This also represents a negligible increment on the existing traffic movements on this road.

6.7.19 There will also be additional traffic movements concerned with the removal of waste during the operational phase. One road tanker per day would remove waste from the site and therefore this increase would have a negligible impact.

6.7.20 As with the construction phase, the Power Project's fairly isolated location means that fuel deliveries and staff traffic movements are not predicted to be an impact to pedestrians, cyclists etc. Similarly, any impact to public transport in the area could potentially be positive as the Power Project could see a potential increased level of public transport to the area to allow for the transportation of staff to the site.

6.7.21 The traffic movements associated with this operational phase of the Power Project will therefore not represent a significant increment to this baseline and are not predicted to represent an inconvenience to local road users.

Impacts during Decommissioning

6.7.22 Decommissioning will generate traffic of similar nature to that generated during the construction phase. However there will be no requirements for abnormal loads during decommissioning as any items of large plant / equipment will be dismantled on-site and transported off-site by heavy commercial vehicles for appropriate disposal.

6.7.23 It is therefore considered that the impact of decommissioning traffic on the local highway infrastructure will be insignificant.

Impact of Electrical Connection / Gas Pipeline / Water Pipeline

6.7.24 The amount of traffic generated by the construction of the electrical connection / gas pipeline / water pipeline will be significantly less than that associated purely with the construction of the Power Project, and indeed may be included within it. Therefore the impact of the electrical connection / gas pipeline / water pipeline to local traffic and infrastructure will be minimal.

6.7.25 Interruption of traffic flow on the main roads will be avoided by the electrical connection / gas pipeline / water pipeline being on the existing IPP1 site.

Cumulative Impacts

6.7.26 At the time of the preparation of this ESIA, the only development in the vicinity of the Power Project that has the potential to give rise to cumulative impact is the existing IPP1.

6.7.27 The existing IPP1 is fired on natural gas and therefore the majority of vehicle movements are concerned with staff movements to the site. Staff movements are similar to those being proposed for the Power Project site. Therefore, the maximum number of vehicles arriving at both sites during each shift would be less than 40 and would not have a significant impact on traffic flow in the area.

6.7.28 When there is an interruption in the natural gas supply, the existing IPP1 fires on DFO. This is transported in diesel trucks from the Jordanian Petroleum Refinery in Zarqa. The vehicle movements concerned with DFO delivery are included in the baseline data collected for Zarqa-Sahab Road. Therefore, the additional movements concerned with the Power Project are still regarded as negligible.

Mitigation Measures and Monitoring Programmes

Construction

6.7.29 During construction regular servicing and maintenance of vehicles will be employed to help minimise emissions to air. All vehicles will be well maintained and remain with the applicable Jordanian / International Standards and Guidelines for noise and exhaust emissions.

6.7.30 Wheel washing may be employed to help prevent mud and earth being carried from the site on to local roads. In dry periods on-site roads may be dampened to reduce the potential for dust creation. Signs will be put in place as necessary to warn of the presence of construction traffic entering and leaving the site.

6.7.31 Car sharing and the use of minibuses and public transport will be encouraged by all staff. In addition the contractors appointed would be encouraged to provide a minibus service for construction staff.

6.7.32 A Traffic Management Plan will be prepared to help minimise the volume of additional traffic requiring use of the local traffic network. The Traffic Management Plan will include plans for the movement of any heavy plant, equipment or machinery which could include timing of the transport to outside of the hours of peak demand. If appropriate, assistance from authorities will be sought.

6.7.33 Duties will be designated to all parties involved in the transportation of oils / fuels up to and including the receipt of the deliveries at the site. These duties may include:

- Correct labelling and classification of the substance;
- Ensuring that all consignments are fully documented;
- The use of suitable transport vehicles including the provision of all necessary safety equipment, such as fire extinguishers, spill kits and warning signs; and
- All drivers must hold a valid and appropriate licence for driving the particular delivery vehicles.

6.7.34 A Safety Advisor will monitor all of the above (including the compliance of suppliers). Safety training will be provided to vehicle drivers and all drivers will be instructed to obey all relevant speed limits and other relevant laws.

6.7.35 Construction traffic movements will avoid sensitive receptors such as schools and residential areas to reduce the potential for impact on local traffic safety. Signs will be provided to warn of heavy vehicles using roads in the area of the site.

Operation

6.7.36 The anticipated additional traffic generated by operation of the Power Project is minimal compared to the capacities of the local road network.

6.7.37 The delivery of fuels and oils to the site would be timed to avoid the peak traffic congestion rush hours at 6:30 am and 4.30 pm, as far as is practical, to minimise the impact to the local traffic network.

6.7.38 As per the construction phase, similar duties will be designated to all parties involved in the transportation of oils / fuels and a Safety Advisor will monitor the compliance of all staff and suppliers / contractors throughout the operating lifetime of the Power Project.

Decommissioning

6.7.39 The mitigation and monitoring during the decommissioning phase is anticipated to be similar to the construction phase with the emphasis on: safety; compliance with all appropriate driving / road regulations; and, the management of the timing of vehicle trips to outside of the hours of peak demand.

Conclusion

6.7.40 It is considered that the Power Project will have an insignificant impact to local traffic and infrastructure due to the good standard of the existing road network and the proposed mitigation measures and monitoring programmes for all phases of the Power Project.

6.8 Socio-Economics and Land Use

6.8.1 The main objective of the socio-economic impact assessment is to evaluate the long-term effects that are expected from activities relating to the Power Project, and investigate how the Power Project would change the quality of life of current and future residents of communities in the area.

6.8.2 In addition, the impact assessment aims to recommend appropriate mitigation measures and monitoring programmes to reduce any identified negative impacts and enhance positive impacts.

Impact Assessment

Impacts during Construction

6.8.3 The issues associated with the construction of the Power Project are those related to:

- *Employment and Training*

  The construction workforce will likely peak at approximately 1 000 personnel, with an average of between 600 to 700 personnel. This will likely have a positive social and economic impact.

- *Business Prosperity*

  It is expected that the Power Project will enhance business prosperity in Al-Manakher Village, where the construction personnel will represent a new purchase power to be injected into the local market. The construction personnel are expected to increase the demand for several goods and services in the market, small shops and beverage stores. This will likely have a positive social and economic impact.

  However, the Power Project may increase the demand on spare parts / vehicle maintenance workshops in the area. This may have a minor adverse social and economic impact.

- *Resettlement*

  As the Power Project does not involve the resettlement of indigenous peoples / the removal of land from ownership of individuals used for crops, it is not considered that World Bank / IFC Performance Standard 5 (Land Acquisition and Involuntary Resettlement) and Performance Standard 7 (Indigenous People) are relevant.

- *Support for Local Communities*

- *Grievance*

Impacts during Operation

6.8.4 The issues associated with the operation of the Power Project are those related to:

- *Employment and Training / Availability of Benefit Packages for Employees*

  The permanent skilled operational personnel for the Power Project will be of the order of 40. In addition, AES will be responsible for providing social security and health insurance to their employees. This will likely have a positive social and economic impact.

- *Business Prosperity*

  It is expected that the Power Project will enhance business prosperity in Al-Manakher Village, where the operational personnel will represent a new purchase power to be injected into the local market. The operational personnel are expected to increase the demand for several goods and services in the

market, small shops and beverage stores. This will likely have a minor positive social and economic impact.

However, the Power Project may increase the demand on spare parts / vehicle maintenance workshops in the area. This may have a minor adverse social and economic impact.

- *Support for Municipalities and Improvements in Landscaping / Support for Local Communities / Social Development*

  Through the existing IPP1, AES have supported the local community by providing the following services:

  - Purchasing new computers for the Al-Manakher Village School;
  - Purchasing new printer and photo-copier for the Al-Manakher Village School;
  - Giving awards to outstanding students; and,
  - Giving a yearly support to the value of 5000 JD.

  In addition, AES support the local community by lighting one of the village streets and by giving material support to the poorer families.

- *Grievance*

Impacts during Decommissioning

6.8.5 The issues associated with the decommissioning of the Power Project are those related to:

- *Reuse / Recycle of the Dis-assembled Machines*
- *Employment Termination / Loss of Business*
- *Grievance*

Impact of Electrical Connection / Gas Pipeline / Water Pipeline

6.8.6 It is not anticipated that there will be any significant impacts to socio-economics or land use due to the electrical connection / gas pipeline / water pipeline.

Cumulative Impacts

6.8.7 The Power Project, in conjunction with the existing IPP1, is anticipated to have positive cumulative impacts.

Mitigation Measures and Monitoring Programmes

Construction

6.8.8 The mitigation measures and monitoring programmes relating to construction are those associated with:

- *Employment and Training*

  The Power Project is expected to create temporary jobs for both skilled and non-skilled workers. Therefore it is highly recommended that AES gives priority to the local community (i.e. Al-Manakher and then the Sahab District). This can be done in cooperation with the Labour Directorate in the Amman Governorate.

  In order to make the local employment more successful it is possible that AES will arrange (in cooperation with the Vocational Training Centre in the Amman Governorate) to help create adequate training so that a larger percentage of the local population has the basic qualifications needed for the Power Project.

The job application procedure should be established according to an approved set of criteria (i.e. such as those relating to appropriate qualifications).

The Consortium shall follow the Jordanian / International Regulations regarding child labour.

- *Business Prosperity*

  The Consortium should, wherever possible, obtain supplies / food / spare parts (if available) from local stores.

  The Consortium should give priority for a Local Contractor to provide construction personnel with suitable transport / other services on a competitive rates basis.

- *Resettlement*

  No mitigation measures or monitoring programmes are necessary.

- *Support for Local Communities*

  It is recommended that AES study the needs of the local community, and continue to provide support.

- *Grievance*

  In order to minimise the potential negative impacts of construction and to maximise positive impacts, AES should establish a Grievance Mechanism as part of the overall Management System to ensure that proper consultation, disclosure and community engagement is included throughout the Power Project lifecycle.

  As a policy, mechanism or process for handling grievances cannot be effective if no one knows about it, the Grievance Mechanism should be documented and publicised and should be readily available to the relevant Stakeholder Groups.

  In addition, the Grievance Mechanism Document should be simple, such that people know where to go to, who to talk to and the process for handling grievances.

Operation

6.8.9 The mitigation measures and monitoring programmes relating to operation are those associated with:

- *Employment and Training / Availability of Benefit Packages for Employees*

  The Power Project is expected to create permanent and temporary jobs for both skilled and non-skilled workers. Therefore it is highly recommended that, wherever possible, the Consortium gives priority to the local community (i.e. Al-Manakher and then the Sahab District). This can be done in cooperation with the Labour Directorate in the Amman Governorate.

  In order to make the local employment more successful it is possible that AES will arrange (in cooperation with the Vocational Training Centre in the Amman Governorate) to help create adequate training so that a larger percentage of the local population has the basic qualifications needed for the Power Project.

  The job application procedure should be established according to an approved set of criteria (i.e. such as those relating to appropriate qualifications).

  The Consortium shall follow the Jordanian / International Regulations regarding child labour.

- *Business Prosperity*

The Consortium should, wherever possible, obtain supplies / food / spare parts (if available) from local stores.

The Consortium should give priority for a Local Contractor to provide construction personnel with suitable transport / other services on a competitive rates basis.

- *Support for Municipalities and Improvements in Landscaping / Support for Local Communities / Social Development*

  It is recommended that AES study the needs of the local community, and continue to provide support.

- *Grievance*

  In order to minimise the potential negative impacts of operation and to maximise positive impacts, AES should establish a Grievance Mechanism as part of the overall Management System to ensure that proper consultation, disclosure and community engagement is included throughout the Power Project lifecycle.

  As a policy, mechanism or process for handling grievances cannot be effective if no one knows about it, the Grievance Mechanism should be documented and publicised and should be readily available to the relevant Stakeholder Groups.

  In addition, the Grievance Mechanism Document should be simple, such that people know where to go to, who to talk to and the process for handling grievances.

Decommissioning

6.8.10 The mitigation measures and monitoring programmes relating to decommissioning are those associated with:

- *Reuse / Recycle of the Dis-assembled Machines*
- *Employment Termination / Loss of Business*

  It is recommended that AES help terminated employees to find new jobs, and pay them fair compensation.

- *Grievance*

  In order to minimise the potential negative impacts of decommissioning and to maximise positive impacts, AES should establish a Grievance Mechanism as part of the overall Management System to ensure that proper consultation, disclosure and community engagement is included throughout the Power Project lifecycle.

  As a policy, mechanism or process for handling grievances cannot be effective if no one knows about it, the Grievance Mechanism should be documented and publicised and should be readily available to the relevant Stakeholder Groups.

  In addition, the Grievance Mechanism Document should be simple, such that people know where to go to, who to talk to and the process for handling grievances.

Public Consultation

6.8.11 Further to the scoping exercise, in order to obtain a representative view of public perception of the expected impacts of the Power Project on the local communities, public consultation was conducted in Al-Manakher Village.

6.8.12 Al-Manakher Village was selected as the most appropriate location for the public consultation as it represents the nearest community to the Power Project site and, as a result, its residents will be the most affected.

6.8.13 Al-Manakher is a small village with a population of approximately 436 people who depend mainly on governmental jobs and agricultural activities for their livelihoods.

Consultation Methodology

6.8.14 The public consultation process was conducted by two methods.

1. House to house meetings with local people to explain the nature of the Power Project and its expected impacts and benefits.
2. Public meeting in Al-Manakher Village.

House to House Meetings

6.8.15 A Questionnaire was developed for house to house meetings, in order to examine the potential socio-economic impacts of the Power Project on the societies and economic performance. Also, a brief description of the Power Project was written as an introduction.

6.8.16 People who were unable to complete the questionnaire (illiterate) were interviewed and their responses were recorded.

6.8.17 The aim of the house to house meetings was to investigate and to obtain the opinion of Al-Manakher residents toward the Power Project and explore how differences in livelihood, cultural and socio-economic conditions influence the attitude and perceptions of people in the community.

6.8.18 A sample of 15 houses out of approximately 35 houses (approximate numbers of Al-Manakher village houses) was obtained. 20 per cent of the interviewed residents were women.

6.8.19 The questionnaire results showed that the residents close to the Power Project were unsatisfied due to the level of noise generated from the existing IPP1. They expected that the same level of noise would be generated from the Power Project.

Analysis and Results

6.8.20 A breakdown of the questionnaire results are shown in Table 6.25 to 6.31.

6.8.21 33.3 per cent of the interviewed residents think that the Power Project will increase employment opportunities in the area.

TABLE 6.25: PROBABILITY OF INCREASING JOB OPPORTUNITY

Cumulative Percent	*Percent*	*Frequency*	*Answer*
66.7	66.7	10	No
100	33.3	5	Yes
100	100	15	Total

6.8.22 85.7 per cent of the interviewed residents think that the Power Project will contribute in increasing the area prosperity and will encourage establishing of shops and new economic activities.

TABLE 6.26: PROBABILITY OF AREA PROSPERITY

Cumulative Percent	*Percent*	*Frequency*	*Answer*
14.3	14.3	2	No
100	85.7	12	Yes
100	100	14	Total

6.8.23 73.3 per cent of the interviewed residents think that the introduction of the Power Project to the area will reduce their land price.

TABLE 6.27: PROBABILITY OF INCREASING LAND PRICE

Cumulative Percent	*Percent*	*Frequency*	*Answer*
73.3	73.3	11	No
100	26.7	4	Yes
100	100	15	Total

6.8.24 35.7 per cent of the interviewed residents think that the introduction of the Power Project to the area will improve the water, electricity and telephone networks in the area.

TABLE 6.28: PROBABILITY OF IMPROVING THE WATER, ELECTRICITY AND TELEPHONE NETWORKS

Cumulative Percent	*Percent*	*Frequency*	*Answer*
64.3	64.3	9	No
100	35.7	5	Yes
100	100	14	Total

6.8.25 28.6 per cent of the interviewed residents think that the Power Project will raise their living standards.

TABLE 6.29: PROBABILITY OF INCREASING LIVING STANDARDS

Cumulative Percent	*Percent*	*Frequency*	*Answer*
71.4	71.4	10	No
100	28.6	4	Yes
100	100	14	Total

6.8.26 All of the interviewed residents think that if the company plants the empty areas around the Power Project, it would improve the landscape of the area.

6.8.27 50 per cent of the interviewed residents think that the Power Project will attract other industries and businesses to the area.

TABLE 6.30: PROBABILITY OF BRINGING OTHER INDUSTRIES AND BUSINESSES TO THE AREA

Cumulative Percent	*Percent*	*Frequency*	*Answer*
50	50	7	No
100	50	7	Yes
100	100	14	Total

6.8.28 Finally, 46.7 per cent of the interviewed residents support the construction of the Power Project.

TABLE 6.31: PERCENTAGE OF INTERVIEWED RESIDENTS WHO SUPPORT THE POWER PROJECT

Cumulative Percent	*Percent*	*Frequency*	*Answer*
53.3	53.3	8	No
100	46.7	7	Yes
100	100	15	Total

6.8.29 Based on the above, the issues and concerns are summarised as follows:

- Negative Concerns:
  - Dust emissions and noise during construction and operation of the Power Project which may negatively affect residents and their health.
  - Home cracks from construction and operation activities.
  - AES not giving priority of employment to the local community during the construction and operational phases.
  - Reducing the price of the land.
- Positive Issues:
  - The Power Project will attract other industries and businesses to the area.
  - The Power Project will help in raising the living standards for the residents of Al-Manakher Village and the surrounding areas.

Public Meeting

6.8.30 A public meeting was held at Al-Mankher village on August 4 2011 by the RSS Team and the AES Jordan Team. The meeting aimed to identifying the concerns of the residents regarding the Power Project and the associated activities in relation to the major environmental and social aspects.

6.8.31 Approximately 75 people attended the public meeting including the Deputy Parliament of the area, Chairman of Al-Manakher Village and police station staff of Al-Manakher.

FIGURE 6.8: PARTICIPANTS WITH DEPUTY PARLIAMENT

6.8.32 An opening speech was given by the RSS Team describing the Power Project and its associated activities / facilities. After that, the participants were asked to identify their environmental / social issues and concerns related to all phases of the Power Project.

FIGURE 6.9: OPENING SPEECH BY THE RSS TEAM

6.8.33 According to the participants, the main issues and concerns from the existing IPP1 and the Power Project are:

- Decreasing the price of their land.
- Non-expansion of the village as no one wants to buy a land next to a power plant.
- Air pollution, especially when the Power Project uses diesel as a fuel.
- High levels of noise.
- Cracks in their buildings from construction and operation activities.
- Concern from some participants that discharge of treated wastewater outside the Power Project site boundary may cause problems to their livestock.
- There would be no recruitment / employment (for either skilled or unskilled labour) from the local community.
- Dissatisfaction of the contribution provided by the existing IPP1 Project Company to the local community (e.g. provision of electrical subsidies).

FIGURE 6.10: PARTICIPANTS EXPLAINED THEIR ISSUES AND CONCERNS

6.8.34 Based on the outcomes of the Public Meeting, and in response to the issues and concerns raised by the participants, the following are the residents' requirements:

- Suitability of site location.
- Addressing and solving the noise problem.
- Stopping discharging the treated wastewater outside the Power Project site boundary.
- Providing the village with water directly from the company water pipeline.
- Supporting the Al-Manakher Village School by building three class rooms for the village girls.
- Purchasing air conditioners and water coolers for the Al-Manakher Village Mosque.
- Providing recruitment / employment opportunities for the local community.

Conclusion

6.8.35 During the construction period it is expected that the Power Project will enhance business prosperity in Al-Manakher Village, where the construction personnel will represent a new purchase power to be injected into the local market.

6.8.36 The Power Project does not involve the resettlement of indigenous peoples / the removal of land from ownership of individuals used for crops.

6.8.37 During operation, the Power Project is expected to create permanent and temporary jobs for both skilled and non-skilled workers.

6.8.38 It is also anticipated that priority will be given to Local Contractors to provide construction personnel with suitable transport / other services on a competitive rates basis.

6.8.39 The concerns of the participants at the Scoping Meeting and Public Consultation Event have been identified.

6.8.40 The provision of additional electricity generation / supply to the country as a whole has an overall positive impact on the socio-economic conditions of Jordan.

6.8.41 Operation of the Power Project will be vital to avoid supply disruptions and to secure the needed power. This is of utmost importance for economic growth in Jordan.

6.8.42 Through the existing IPP1, AES have supported the local community by providing the following services:

- Purchasing new computers for the Al-Manakher Village School;
- Purchasing new printer and photo-copier for the Al-Manakher Village School;
- Giving awards to outstanding students; and,
- Giving a yearly support to the value of 5000 JD.

6.8.43 In addition, AES support the local community by lighting one of the village streets and by giving material support to the poorer families

6.8.44 AES will continue to support the local community in the form of various schemes deemed to be appropriate.

6.9 Ecology and Biodiversity

6.9.1 The Power Project has the potential to impact on ecology and biodiversity during the construction, operation and decommissioning phases.

6.9.2 However it is likely that the principal impacts will be during the construction phase.

Impact Assessment

Impacts during Construction

6.9.3 The construction of the Power Project will result in the loss of the existing vegetation on the site. However, the Power Project site does not contain any plant species that are notable or rare.

6.9.4 Indirect impacts which could result from aqueous effluent and runoff from site activities during construction will be carefully monitored and kept to an absolute minimum. This will ensure that there is no contamination of habitats and ecosystems outside the Power Project boundary.

6.9.5 The Power Project is bordered to the east by an existing Road that will allow for access to the site with minimal additional on-site road creation. This Road shall be the only connection between the Power Project and the outside, while other necessary roads shall be maintained inside the proposed site borders. As the Power Project does not include the creation of large lengths of new roads the impact associated with site access is negligible.

Statutory and Non-Statutory Sites

6.9.6 There are no statutory or non-statutory sites within the Power Project site or within the immediate vicinity. Therefore, impacts are considered to be negligible.

Flora

6.9.7 The study area does not support any ecologically important habitat types nor has it been found to support rare plant species.

6.9.8 According to the baseline results it was clear that the natural vegetation at the Power Project site has been removed due to the past and current agriculture practices.

6.9.9 As a result any site clearance during construction will have a minimal impact to vegetation when considered in the local context.

Fauna

6.9.10 Cultivation of the Power Project site has removed any suitable microhabitats for the fauna species that have small home ranges (i.e. reptiles and rodents). However, the Power Project site is still considered part of a larger ecosystem, which could support such species.

6.9.11 Despite the agricultural activity that dominates the surrounding area there are small depression and wadies that have the potential to act as safe corridors for wildlife.

6.9.12 However, if care is taken to avoid damage, it is not considered that the Power Project plant will significantly impact on these areas.

Impact on Habitat

6.9.13 The habitats of the area are highly fragmented.

6.9.14 The Power Project site will no longer be used for agricultural purposes or as a laydown area for the existing IPP1 Power Pant. However this is not considered to represent the removal of habitat for any sensitive species.

6.9.15 The construction activities will have negligible impact on habitats, as the impact of the activities will be confided to the Power Project site, which is not home to any sensitive habitat.

Impacts during Operation

6.9.16 Operation of the Power Project is expected to have minor impacts through noise disturbance.

6.9.17 However, ultimately the local species will likely develop a tolerance in this regard and therefore only migrant visitors may be affected once the Power Project has become established.

Impacts during Decommissioning

6.9.18 Decommissioning activities are not expected to have a significant impact since natural habitats will have been completely removed before the installation of the Power Project.

6.9.19 A Site Closure Plan will be prepared prior to decommissioning that will detail the manner in which the Power Project will be decommissioned. This will ensure that the site is left in an appropriate state to allow for any intended future use.

Impact of Electrical Connection / Gas Pipeline / Water Pipeline

6.9.20 The electrical connection will be via underground cable buried within the boundaries of the Power Project site and existing IPP1 site, which will connect to the 132 kV substation to the north of the IPP1 site. The gas pipeline and water pipeline will be supplied by connections on the IPP1 site.

6.9.21 Based on this information, and the information provided for the construction of the Power Project, it is not anticipated that there will be any significant impacts to ecology and biodiversity due to the electrical connection / gas pipeline / water pipeline.

Cumulative Impacts

6.9.22 No cumulative impacts of the Power Project, in conjunction with the existing IPP1 are anticipated.

Mitigation Measures and Monitoring Programmes

Construction

6.9.23 Indirect impacts resulting from potential aqueous effluent and runoff from site activities during construction of the Power Project will be carefully monitored and kept to an absolute minimum. This will ensure that there is no contamination of habitats / ecosystems outside the Power Project site boundary.

6.9.24 The Construction Contractor will be obliged to avoid any unnecessary removal of existing natural vegetation. Construction Workers will be required not to cut down natural plants in the surrounding area for fire.

6.9.25 Use of machinery will be restricted to the Power Project site, as will the parking of vehicles. Any maintenance of vehicles or machinery will be performed off-site unless strictly necessary.

6.9.26 Disposal of any kind of solid and liquid wastes will not be allowed on the Power Project site. All wastes will be removed by a Licensed Contractor and disposed of in an appropriate manner.

6.9.27 The Construction Contractor will not allow workers to hunt or kill animals. Any accidents resulting in the death of wildlife will be reported to the Ministry of Environment and the Royal Society for Conservation of Nature.

6.9.28 The destruction of bird nests will be prohibited. Any ground nests found inside the site boundary will be moved to an appropriate area in coordination with Ministry of Environment and the Royal Society for Conservation of Nature.

6.9.29 Construction activity will be kept to a minimum during night-time to decrease disturbance on wildlife in the area.

6.9.30 The planting of exotic or invasive plants for landscaping inside and around the Power Project site boundary will be prohibited.

6.9.31 A preference will be given to the planting of native species where landscaping is deemed necessary.

Operation

6.9.32 Operation of the Power Project site may lead to the disturbance of created habitats through noise, movement and lighting. This may limit the value of these habitats to some species (e.g. small mammals and birds). However these effects will be minimized by directional lighting and buffer planting.

6.9.33 Workers will be prevented from hunting or killing local wildlife. Any accidents resulting in the death of wildlife will be reported to the Ministry of Environment and the Royal Society for Conservation of Nature.

6.9.34 Disposal of domestic / industrial wastes will be to appropriate disposal sites. The disposal of wastes on-site, and in the in the surrounding area especially at the near shallow wadies, will not be allowed.

6.9.35 All parking for the Power Project will be within the site boundary. Parking on areas outside the site boundary will not be allowed unless strictly necessary.

Decommissioning

6.9.36 A site closure plan will be prepared prior to decommissioning that will detail the manner in which the Power Project will be decommissioned. This will ensure that the site is left in an appropriate state to allow for any intended future use.

Conclusion

6.9.37 From the ecology and biodiversity assessment undertaken it can be concluded that whist the construction of the Power Project would result in the destruction of all or much of the existing habitat on-site, the on-site habitat does not represent a source of any notable fauna or flora when considered in the context of the surrounding area.

6.9.38 Mitigation measures have been outlined that should ensure that the construction, operation and decommissioning of the Power Project will have an insignificant impact to ecology and biodiversity in the area.

6.10 Cultural Heritage / Archaeology

6.10.1 The Power Project has the potential to impact on cultural heritage and archaeology during the construction, operation and decommissioning phases.

6.10.2 However, it is likely that the principal impacts will be during the construction phase.

Impact Assessment

Impacts during Construction

Surface Archaeology

6.10.3 A previous site investigation undertaken for the existing IPP1 Power Plant undertaken in 2006 also covered the area proposed for construction of the Power Project.

6.10.4 The site investigation revealed the presence of no archaeological sites in the immediate area which may be affected by the proposed development (of either IPP1 or the proposed Power Project). Whilst there are some archaeological sites in the area which have been afforded protection measurements by the Department of Antiquities (DOA), these are located all around the Power Project site but lie outside a

5 km radius. The Power Project therefore complies with the Archaeology Law with regard to Protected Archaeological Sites.

6.10.5 Furthermore, the site investigative observations revealed no archaeological sites. Only a few scattered flints (most likely man made) were noticed on the surface. These are likely present as a result of being washed away from the nearby hills during the winter season. The Power Project therefore complies with the Archaeology Law with regard to the disturbance of Identifiable Archaeological Sites.

6.10.6 The only concern regarding cultural heritage and archaeology would be any unseen sites or archaeological remains that might be discovered during construction.

Sub-surface Archaeology

6.10.7 Desk based studies have not identified any known sub-surface archaeology at the Power Project site. However there is the potential for unknown sub-surface archaeology to exist.

6.10.8 It will be the Construction Contractor's responsibility to notify the DOA Representative if antiquities / sites are encountered at any stage during construction.

6.10.9 If any antiquities / sites are found during construction, the DOA will be invited to attend the site to assess the discovered remains. Depending on the nature of the remains, the DOA may carry out an emergency salvage excavation in order to fully record and document the remains.

6.10.10 The Construction Contractor would be obliged to wait for a period of 10 days before commencing construction activities in the vicinity of an archaeological find to allow the DOA to respond to the sites identification.

6.10.11 The available short time for salvage excavations cannot be considered an authorization to destroy the antiquities / sites as each must be given proper consideration and analysis before its destruction can be authorized.

Impacts during Operation

6.10.12 Following the identification of any sub-surface archaeology and the employment of appropriate mitigation during the construction phase no impacts are anticipated during the operational phase.

Impacts during Decommissioning

6.10.13 Following the identification of any sub-surface archaeology and the employment of appropriate mitigation during the construction phase no impacts are anticipated during the decommissioning phase.

Impact of Electrical Connection / Gas Pipeline / Water Pipeline

6.10.14 The electrical connection will be via underground cable buried within the boundaries of the Power Project site and existing IPP1 site, which will connect to the 132 kV substation to the north of the IPP1 site. The gas pipeline and water pipeline will be supplied by connections on the IPP1 site.

6.10.15 The site walkover surveys for IPP1 also covered the proposed routes / areas for the electrical connection, gas pipeline and water pipeline. The site walkover surveys did not find any seen archaeological antiquities / sites.

6.10.16 In addition, any archaeological remains on the site would likely have been discovered during the construction of IPP1. Therefore, it is unlikely that any archaeological remains are present. However, as stated above, in the case that any suspected remains of an archaeological significance are discovered, work would be halted and the DOA immediately contacted.

Cumulative Impacts

6.10.17 No cumulative impacts of the Power Project, in conjunction with the existing IPP1 are anticipated.

Mitigation Measures and Monitoring Programmes

Construction

6.10.18 The Construction Contractor shall contact the DOA if any potentially significant archaeological antiquities / sites are encountered during the construction period.

6.10.19 Following initial consultation, the Construction Contractor will also secure the written approval of the DOA before the removal of any building / foundation / structure / fence / obstruction over 50 years old.

6.10.20 Designated salvageable material shall be removed, without causing unnecessary damage, in parts or pieces which may be readily transported. Any salvageable material removed shall be stored by the Construction Contractor at approved locations, for later use or possession by the DOA.

6.10.21 In addition, the consortium is required to Archaeological Recovery Plan to detail the mitigation measures that will ensure that there is no unacceptable impact to on-site archaeology during the construction process. This is to be submitted before the commencement of any construction activities.

Operation

6.10.22 No mitigation measures or monitoring programmes are considered necessary.

Decommissioning

6.10.23 No mitigation measures or monitoring programmes are considered necessary.

Conclusion

6.10.24 The Power Project will not impact on any known archaeological sites, and is outside 1 km of any sites protected by the Jordanian Archaeology Law.

6.10.25 In addition, as the Power Project will not damage any known archaeological remains, the Power Project is considered to satisfy “Performance Standards 8: Cultural Heritage” of the World Bank / IFC.

6.10.26 As required, a site walk over has been undertaken by a competent archaeologist. This has confirmed that no visible surface archaeology exists at the site.

6.10.27 Despite the absence of evidence for any archaeology within the vicinity of the Power Project site, there is a small (but unlikely) potential (during the construction phase) to impact on sub-surface archaeology yet to be identified. In this event, the DOA is to be invited to assess the discovered archaeological antiquities / sites and may carry out emergency excavation salvage.

6.11 Health and Safety

6.11.1 This Section includes consideration of the compliance of the Power Project with regard to the health and safety of the local community and on-site work force. In doing so, this Section considers all relevant Jordanian Legislation as well as the relevant Performance Standards and Guidance documents of the World Bank and IFC.

Community Health, Safety and Security

6.11.2 The World Bank / IFC Performance Standards on Social and Environmental Sustainability requires projects to:

- Avoid or minimize risks to and impacts on the health and safety of the local community during the project life cycle, from both routine and non-routine circumstances; and,
- Ensure that the safeguarding of personnel and property is carried out in a legitimate manner that avoids or minimizes risk to the community's safety and security.

6.11.3 It is not predicted that the health and safety of local communities will be affected during construction, operation or decommissioning of the Power Project due to the separation distances.

6.11.4 The Power Project will be located within a security fence to prevent trespass or accidental entry to the site. The Power Project site boundary will also be fitted with security cameras.

6.11.5 Construction materials will be managed safely, with any stockpiles (or similar) placed in areas to prevent any risk to local communities. For example: by materials becoming airborne through exposure to the wind.

6.11.6 During all phases of the Power Project (construction, operation and decommissioning), transport will be managed so as to minimize the impact to the local community. The transport of raw materials, and the transport / disposal of waste will be undertaken in an appropriate manner. All vehicles and equipment relating to the Power Project will be well maintained. Power Project-related traffic will be requested to travel no faster than the speed limit.

Major Hazard Assessment

6.11.7 Table 6.32 provides the results of the Major Hazard Assessment which has been undertaken for the Power Project. The Major Hazard Assessment aims to identify potential hazards that could theoretically occur at the Power Project site and the manner in which the associated risks will be mitigated. In addition, the Major Hazard Assessment has been undertaken to assess compliance with the World Bank Guidelines for identifying, analyzing, and controlling major hazards.

TABLE 6.32: MAJOR HAZARD ASSESSMENT

Potential Accident	*Preventative Design Features*	*Response*
Catastrophic failure of fuel oil tank	110 per cent capacity bund / regular inspection routine / fire protection system cooling adjacent tanks	Removal of spill by licensed contractor / implement emergency action plan to deal with fire and other health and safety hazards / attend to repair of failure
Catastrophic failure of mineral oil storage or transformer	110 per cent capacity bund / regular inspection routine	Removal of spill by licensed contractor / implement emergency action plan to deal with fire and other health and safety hazards / attend to repair of failure
Major leak of water treatment chemical	Adequate bund capacity / regular inspection routine	Removal or treatment of spill by licensed contractor / implement emergency action plan to deal with fire and other health and safety hazards / attend to repair of failure
Spill of oil or chemical at delivery point	Adequate capacity bund or kerbed area / regular inspection routine	Removal or treatment of spill by licensed contractor / implement emergency action plan to deal with fire and other health and safety hazards
Spill of oil or chemical in transit within site	Routing of drains to oily waste water pond and oil separators	Removal or treatment of spill by licensed contractor / implement emergency action plan to deal with fire and other health and safety hazards
Major leak of natural gas	Gas detectors / slam-shut valves / valves failing shut on loss of power / enclosure to stop spread of fire	Shut off gas supply / implement emergency action plan to deal with fire and other health and safety hazards in conjunction with gas supplier / attend to repair of failure

6.11.8 Table 6.32 indicates that none of the identified potential hazards are considered to represent a significant risk to human health or the environment so long as the mitigation identified is implemented.

Health and Safety Impact Assessment

6.11.9 The Health and Safety Procedures and Policies that will be prepared for the Power Project will contain the performance levels and measures that are normally acceptable to the World Bank / IFC and also those that are required by Jordanian Law.

6.11.10 Therefore, in considering the potential Health and Safety Procedures and Policies, it is necessary to consider both the safety of the on-site personnel and the general public.

Construction

6.11.11 During construction, the Construction Contractor will be responsible for the health and safety of all on-site personnel. A Health Safety and Environmental (HSE) Plan will be prepared by the Construction Contractor for the construction works prior to commencement of any activities.

6.11.12 Construction personnel will be provided with Personal Protective Equipment (PPE), which they will be required to use as necessary. In addition, construction personnel will receive training as required. Guidelines for maintaining hygienic conditions and appropriate shelter at eating, resting, drinking and washing facilities on the Power Project site will be established.

6.11.13 Site regulations will be established which set out the rules for the execution of the construction activities.

Operation

6.11.14 During operation, an Occupational Health and Safety Management System (OHSMS) for the Power Project will be established, operated, maintained and designed such that certification may be obtained.

6.11.15 The following features will be incorporated into the OHSMS:

- Occupational Health and Safety Policy.
- Organizational framework of the OHSMS, including: staffing of OHSMS; competence requirements; operating procedures; training programs; system documentation; and, communication.
- The preparation and development of arrangements for emergency prevention, emergency preparedness and emergency response.
- OHS measurable objectives (i.e. those that are realistic, achievable and focussed) for the entire organization and for individual departments.
- Hazard Prevention and Risk Assessment, including: prevention and control measures; change management; emergency procedures; and, procurement.
- Performance Monitoring and Measurements, including: hazard prevention measures; ambient working environment; and, the documentation of work related injuries, ill health, diseases and incidents.
- The provision of preventive / protective measures for hazardous conditions / substances.
- Evaluation of the OHSMS in the form of feedback, incorporating corrective measures and action plans wherever necessary.

Health and Safety Factors in the Workplace

6.11.16 The design, construction and operation of the Power Project will take into account the following factors, such that the HSE Plan and OHSMS Guidelines are observed:

- Buildings and structures will be designed according to both Local and Internationally Recognized Standards. Building and structures will: be structurally safe; provide appropriate protection against the climate; and, have acceptable light and noise conditions.
- Equipment, tools and substances will be suitable for their use and selected to minimize dangers to health and safety when used correctly.
- Wherever possible, work places will receive natural light. However, this may be supplemented with sufficient artificial illumination. Appropriate signage will be used to mark hazards, exits, materials, etc.
- Ventilation design factors will consider physical activity, substances in use and process related emissions. Temperatures will be maintained at appropriate levels which are fit for purpose. Indoor temperatures will be maintained such that they are reasonable and appropriate. Risks of heat related stress will be adequately addressed, and (if required) feasible control measures will be implemented.
- Fire prevention and protection will be adequate for the dimensions / use of the Power Project, equipment installed, physical and chemical properties of substances present and the maximum number of people present. Fire detection and protection systems will be provided throughout the Power Project and site area. These will include: fixed foam protection systems; fire alarms; and, portable appliances. The Power Project will also store firewater sufficient to meet the requirements of the Jordan Fire Department and the local fire code requirements.
- Places of work, traffic routes and passageways shall be kept free from waste and spillage, regularly cleaned, and maintained. First Aid facilities will be provided and will be easily accessible throughout the place of work. Welfare facilities will include locker rooms, an adequate number of toilets with washbasins, and a room dedicated for eating. An ample supply of drinking water will be provided at all places of work.
- PPE will be identified and provided. PPE will offer adequate protection to the worker, co-workers and occasional visitors without incurring unnecessary inconvenience. The use of PPE will be actively enforced if alternative technologies / work plans / procedures cannot eliminate or sufficiently reduce a hazard or exposure. The Consortium will ensure that all PPE is cleaned when dirty, properly maintained and replaced when damaged or worn out. Proper use of PPE shall be part of the training programs.
- Noise levels will meet the noise limits of Jordan and the relevant World Bank / IFC Guidelines.
- Exposure to vibration from equipment will be controlled through selection of equipment and limitation of time of exposure. The limits for vibration and action values will conform to those provided in the World Bank / IFC Guidelines.
- Precautions will be taken to keep the risk of exposure to hazardous materials as low as possible. Work processes and engineering / administrative control measures will be designed, maintained and operated so as to avoid / minimize the release of hazardous substances into the working environment.

6.11.17 All relevant components of the Jordanian Labour Law (No.8, 1996) will be applied to the construction, operation and decommissioning phases, as necessary.

Environmental Mitigation and Monitoring Programme

6.11.18 An Environmental Mitigation and Monitoring Programme (EMMP) has been prepared for the Power Project and is discussed in Section 7.

6.11.19 The EMMP provides information on the mitigation measures that are discussed in detail in this ESIA. The EMMP also identifies any monitoring programmes that will be necessary in order to ensure that the mitigation measures are being successfully implemented. The EMMP is provided for both the construction and operational phases.

6.11.20 An Environmental, Health and Safety Manager will be appointed for the construction and operational phases to ensure that the EMMP and other environmental policies are properly adhered to, and that all Jordanian Laws are complied with.

6.11.21 The Construction Contractors HSE Plan and the Operational Environmental Management System (EMS) will be prepared at a later date. These will include further details on the manner in which the aims of the EMMP will be implemented.

Conclusion

6.11.22 The Consortium plans to implement the mitigation measures and monitoring programmes outlined in this ES and the EMMP. Therefore the Power Project will comply fully with all relevant health and safety requirements (with regard to construction personnel, operational personnel and members of the general public) of the relevant Jordanian Legislation, as well as the requirements of the World Bank / IFC.

6.12 Cumulative Impact

6.12.1 There will be no significant cumulative impact associated with the operation of the Power Project and the Samra CCGT plant situated to the north of Al Zarqa. With reference to air quality, there is little chance of the plumes from both plants grounding in the same place with regard to a single short term event as the prevailing wind direction is from the north east dispersing the flue gases from each of the plant in a parallel, not linear direction. This prevailing wind direction also reduces any cumulative impact associated with the long term contributions from the two plants. It is not considered that the plant will have a significant cumulative impact when considered with the Hussein Thermal Power Plant or Jordan Petroleum Refinery as the ambient air quality data recorded at the monitoring site is considered to show that local pollution sources rather than large-scale industrial sources.

6.12.2 The only industrial project in the vicinity the Power Project that has the potential to give rise to a cumulative impact is the existing IPP1 Power Station. The cumulative impacts are summarised in the following Sections.

Air Quality:

6.12.3 The existing IPP1 Power Station has been included within the atmospheric dispersion modelling undertaken as part of the ESIA in order to determine the potential cumulative impacts in conjunction with the Power Project.

6.12.4 IPP1 operates predominantly on natural gas. However, where natural gas is unavailable IPP1 fires DFO.

6.12.5 The combustion of natural gas in a gas turbine does not generate significant emissions of either SO_2 (given the absence of sulphur in the fuel) or PM_{10}/$PM_{2.5}$ (given nature of the fuel and combustion conditions within the turbine). Therefore, when firing on natural gas, only the emissions of NO_x from IPP1 have been considered

within the cumulative assessment. The assessment of the emissions of NO_x, SO_2 and $PM_{10}/PM_{2.5}$ from IPP1 during DFO-firing have been considered in the cumulative assessment. The emissions of CO, TSP, H_2S and unburned hydrocarbons have been calculated to result in negligible process contributions to ambient air quality in isolation and are therefore considered to make a negligible contribution to the cumulative impact.

6.12.6 The operation of both the Power Project and the existing IPP1 plant will result in process contributions less than the World Bank / IFC Guideline values for SO_2 and $PM_{10}/PM_{2.5}$.

6.12.7 The cumulative impact assessment is based on particulate emissions at an emission concentration of 50 mg/Nm^3. As part of the environmental sensitivity test in regards to the operation of the Power Project at the higher 58 mg/Nm^3 emissions level, as a result of utilising HFO with an ash content of 0.08 per cent w/w, an additional dispersion modelling run was undertaken to assess the potential cumulative impact. In this case, the predicted maximum cumulative process contributions to short-term $PM_{10}/PM_{2.5}$ concentrations are 29.9 µg/m^3 (in conjunction with the CCGT operation of IPP1) and 26.7 µg/m^3 (in conjunction with the Bypass operation of IPP1). These values are acceptable based on the theoretical modelling and still well within the prescribed ambient air quality limits for a 24-hour averaging period. In any event the ash content of the fuel that is planned to be used is of a lower value 0.05% therefore the cumulative impact shall be lower than those indicated by the sensitivity test.

6.12.8 However, there are exceedances predicted for the increments to ground level concentrations of NO_2 when IPP1 operates on either natural gas or DFO. It should be noted that, for short term averaging periods, the likelihood of coincidence of contributions from several different types of sources is low. This is due to the difference in weather conditions associated with the maximum contribution to ground level concentrations. Further examination of the modelling results has indicated that, the maximum location of the ground level concentration of NO_2 is to the west of the study area. The exceedance of the objective value of 200 µg/m^3 for NO_2 occurs for only one receptor in the air dispersion model, and only for two non-consecutive hours in the entire 5-year study period[18].

6.12.9 If the maximum process contribution from the Power Project to ground level concentrations of NO_2 at the above isolated location is replaced with the second highest process contribution at that location, the resultant maximum cumulative process contributions to short term NO_2 concentrations are 194.1 µg/m^3 (in conjunction with CCGT operation of IPP1) and 193.3 µg/m^3 (in conjunction with the Bypass operation of IPP1). These are within the World Bank / IFC Guideline value.

6.12.10 The Power Project will be used to rapidly assist in meeting temporary generating demands of the NTS. As such, the anticipated operating regime of the Power Project is expected to be in the region of40 per cent load factor.

6.12.11 A conservative view of the Power Project operating for 8760 hours (baseload as opposed to peaking operation) per year has been adopted in the atmospheric dispersion modelling so that a worst case is presented. Actual operation of the plant is anticipated to be for around 40 per cent of the year and will thus result in a significant number of hours per year where the plant does not operate. The results presented above do not allow for the high probability that the plant may not actually be in operation during hours where the meteorological conditions associated with the maximum increase to ground level concentrations occur. This ensures that there is a 'factor of safety' built into all of the air quality impact assessment, providing comfort that the stack height selection will be more than adequate to achieve good dispersion

[18] Jordanian Standard 1140:2006 permits three exceedances in any consecutive 12 month period.

of the plant flue gases, and represents a likely over-estimate of the process contribution to ground level concentrations of the pollutants considered.

6.12.12 In addition, the modelling has assumed that both the Power Project and IPP1 will operate at the maximum permitted limits at the stack exits for the concentrations of the pollutants considered under the relevant World Bank / IFC Guidelines. Typical operation of either plant is likely to see the actual average achievable emissions levels being significantly less the prescribed limits; any process contribution to ground level concentration from either the Power Project or IPP1 will thus be less than that predicted.

Water Quality

6.12.13 No cumulative impacts of the Power Project, in conjunction with the existing IPP1 are anticipated given the sufficient supplies of water which are readily available for both projects and given the fact that neither project in isolation will have any impacts on water quality of the area.

Geology, Soils and Wastes

6.12.14 No cumulative impacts of the Power Project, in conjunction with the existing IPP1 are anticipated given that neither will give rise to any impacts in isolation.

Noise and Vibration

6.12.15 It is predicted that the cumulative noise impact at the Power Project boundary and the school NSR meet the noise requirements for the Power Project.

6.12.16 Predicted cumulative operational noise levels at the two residential NSR locations are in the order of 0.2 dB(A) to 1 dB(A), as a worst case, above the current background. However, the current background noise levels are already exceeding the required noise regulation limits and the increase is negligible as noise changes of 1 dB(A) is not perceptible by humans, there is no demonstrable environmental impact associated with a noise increase of 1 dB. World Bank /IFC Guidelines also allow for an increase of up to 3dBA above the existing background levels. Even at the worst case, IPP4 will operate well within this limit.

Landscape and Visual

6.12.17 Based on the fact that IPP1 is an existing power plant, no cumulative impacts are anticipated on the landscape or the visual amenity of receptors.

Transport and Infrastructure

6.12.18 The existing IPP1 is fired on natural gas and therefore the majority of vehicle movements are concerned with staff movements to the site. Staff movements are similar to those being proposed for the Power Project site. Therefore, the maximum number of vehicles arriving at both sites during each shift would be less than 40 and would not have a significant impact on traffic flow in the area.

6.12.19 When there is an interruption in the natural gas supply, the existing IPP1 fires on DFO. This is transported in diesel trucks from the Jordanian Petroleum Refinery in Zarqa. The vehicle movements concerned with DFO delivery are included in the baseline data collected for Zarqa-Sahab Road. Therefore, the additional movements concerned with the Power Project are still regarded as negligible.

Socio-Economics and Land Use

6.12.20 The Power Project, in conjunction with the existing IPP1, is anticipated to have positive cumulative impacts including the provision of more jobs for the local population during both the additional power supply security and the continued indirect benefits for local businesses.

Ecology and Biodiversity

6.12.21 No cumulative impacts of the Power Project, in conjunction with the existing IPP1 are anticipated given that neither will give rise to any impacts in isolation.

Cultural Heritage / Archaeology

6.12.22 No cumulative impacts of the Power Project, in conjunction with the existing IPP1 are anticipated given that neither will give rise to any impacts in isolation.

Health and Safety

6.12.23 No cumulative impacts of the Power Project, in conjunction with the existing IPP1 are anticipated given that neither will give rise to any impacts in isolation, as the plants will operate within the remit of a full health and safety plan and all health and safety legislation will be strictly adhered to.

Conclusion

6.12.24 The cumulative impacts resulting from the Power Project and the existing IPP1 Power Station will not be significant for any of the considerations listed above. Additionally, in the case of socio-economic conditions for the local population, the cumulative effect of both projects is considered to be beneficial. The existing high standards of management currently employed at the IPP1 Power Station and the mitigation measures which will be introduced as an integral part of the Power Project will further ensure that there are no cumulative impacts.

SECTION 7

ENVIRONMENTAL MITIGATION AND MONITORING PROGRAMME

7 ENVIRONMENTAL MITIGATION AND MONITORING PROGRAMME

7.1 Overview

7.1.1 An Environmental Mitigation and Monitoring Programme (EMMP) has been prepared for the Power Project.

7.1.2 The EMMP provides the management framework needed for planning and implementing the mitigation measures and monitoring programmes that are discussed in detail in this ES. The aim of the EMMP is to prevent any adverse environmental impacts arising from the Power Project during construction, operation and decommissioning. The EMMP also identifies any monitoring that will be necessary in order to ensure that these measures are successfully implemented.

7.1.3 In preparing the EMMP consideration has been given as appropriate to the IFC's Performance Standards on Social and Environmental Sustainability. Consideration has also been given to the relevant Jordanian Laws, Standards and Regulations as necessary including:

- Instruction for Hazardous Waste Management and Handling (2003);
- Civil Defence Law (No.35, 1999);
- Public Health Law (No. 47, 2008);
- Instruction for Management and Handling of Consumed Oil (2003); and
- Management, Transport and Handling of Harmful and Hazardous Substances Regulations (No. 24, 2005).

7.1.4 Adherence to the EMMP will reduce the risk of adverse impacts of the Power Project on sensitive environmental receptors and minimise social impacts. Specifically, the following issues have been addressed when developing this EMMP:

- Air emissions;
- Noise emissions;
- Impacts to surface water and groundwater;
- Impacts to ecology (flora and fauna); and
- Socio-economic impacts.

7.1.5 The EMMP forms part of the overall project management for the Power Project and as such, activities will be integrated with other quality, sustainability and health and safety management procedures.

7.2 Summary of the EMMP

7.2.1 A summary of the EMMP for the Power Project is provided in Table 7.1 to Table 7.8.

TABLE 7.1: CONSTRUCTION IMPACT MITIGATION, MONITORING, AND MANAGEMENT MEASURES

Concern	Significance	Mitigation Measure	Monitoring
Air Quality			
Dust creation from soil movements, emissions from vehicles etc	Moderate Significance	A water bowser will be used if required (following tests to determine the moisture content of material)	To ensure that atmospheric dust, contaminants or dust deposits generated by the construction do not exceed levels which could constitute a health hazard or nuisance to those persons working on the site or living nearby a dust monitoring programme will be carried out throughout the construction period.
		Excavation faces not being worked will, if required, be either sheeted or treated with a chemical dust suppressant	
		All operatives working in areas of potential dust emission will be provided with paper facemasks.	
		All stockpiles will be located away from sensitive receptors wherever possible.	
		Materials deposited on stockpiles on-site will be closely monitored for any possible emission of dust and if required they will be damped down, covered or treated with a dust suppressant.	
		All vehicles carrying bulk materials into and out of the site will be sheeted so as to contain any material that may be dispersed during transit. Minimum drop heights will be used during material transfer	Daily visual inspections will be made to ensure that good practice is employed at all times. Inspections will include monitoring of exit points and the immediate area outside the site entrance.
		If finely ground materials are delivered, these will be in bag form, enclosed lorries or stockpiled in specified locations where the material can be suitably covered.	
		Engines will be switched off when not in use.	
		All vehicles will be properly maintained to reduce air emissions	

Concern	Significance	Mitigation Measure	Monitoring
Water Quality and Soils			
Protection of ground waters	Moderate Significance	Water inflows to excavated areas to be minimized by the use of lining materials, good housekeeping techniques and by the control of drainage and construction materials in order to prevent the contamination of ground water. Site personnel to be made aware of the potential impact on ground and surface water associated with certain aspects of the construction works to further reduce the incidence of accidental impacts.	
Potential leakage of storage tanks	Moderate Significance	Refuelling of construction vehicles and equipment to be restricted to a designated area with properly designed fuel tanks and bunds and proper operating procedures.	Daily visual inspection of bunded areas will be made to ensure the effectiveness of these systems.
Protection of ground and surface waters	Moderate Significance	Spill kits will be kept on-site to clean up any spills of fuels or oils. Spills would be reported and responded to as quickly as possible.	
		Maintenance of construction machinery will not be allowed on-site unless absolutely necessary to help to prevent the accidental leakage of lubricating and hydraulic fluids.	
		Pass all site drainage and runoff through oil and silt traps	
		Conserve water use where possible	
		Construction Contractor to dispose of any construction effluents in a responsible manner.	
		Locate stockpiles away from watercourses	
		Storage of construction materials will be in assigned areas and follow standard best working practices.	
		Disposal of excavated materials will either be off-site at an appropriate landfill site or in areas of the site that will not give rise to surface run off during wet periods.	
		Portable toilets will be provided during the construction period with any waste tankered of site and disposed of in an appropriate manner.	

Concern	Significance	Mitigation Measure	Monitoring
		Water inflows to excavated areas to be minimized by the use of lining materials, good housekeeping techniques and by the control of drainage and construction materials in order to prevent the contamination of ground water.	
		Reuse excavated material within the site boundary where practicable which would reduce the volume of excavated material going off-site to landfill.	
		No materials will be disposed of in the wadi to the north-west of the site.	
		Segregation of contaminated excavated material (should this be encountered), from non-contaminated excavated material would be made with the contaminated soils removed to an appropriate disposal site.	
Noise and Vibration			
Construction noise	Moderate significance	All vehicles and mechanical plant used for construction would be fitted with effective exhaust silencers, and regularly maintained.	Daily auditory inspection/walk round to ensure best practicable means are being employed
		Inherently quiet plant would be used where appropriate	Noise monitoring undertaken at selected locations around construction site if required.
		All major compressors would be sound-reduced models fitted with properly lined and sealed acoustic covers which would be kept closed whenever the machines are in use, and all ancillary pneumatic percussive tools would be fitted with mufflers or silencers of the type recommended by the manufacturers.	
		All machines in intermittent use shall be shut down in the intervening periods between work or throttled down to a minimum.	
		All ancillary plant such as generators, compressors and pumps would be positioned so as to cause minimum noise disturbance. If necessary, temporary acoustic barriers or enclosures would be provided.	

Concern	Significance	Mitigation Measure	Monitoring
Ecology and Biodiversity			
Aqueous effluent and runoff	Moderate Significance	Potential aqueous effluent and runoff from site activities will be kept to an absolute minimum so as to ensure that there is no contamination of habitats and ecosystems outside the project boundary.	Visual inspection to ensure that construction impacts do not spread onto other land.
Removal of existing natural vegetation	Low Significance	Unnecessary removal of existing natural vegetation will be avoided.	
		Workers will be required not to cut down plants in the surrounding area for fires etc.	
Destruction of bird nests	Low Significance	The destruction of bird nests will be prohibited. Any ground nests found inside the site will be moved in coordination with MoE and the Royal Society for Conservation of Nature (RSCN) to an appropriate area.	
Disturbance to wildlife	Low Significance	Construction activity will be kept to a minimum during night-time to decrease disturbance on wildlife in the area.	
Planting of exotic or invasive plants	Low Significance	The planting of exotic or invasive plants for landscaping inside and around the plant will be prohibited	
Hunting or killing of animals	Low Significance	The contractor will not allow workers to hunt or kill animals. Any accidents resulting in the death of wild life will be reported to the MoE and RSCN.	Any accidents resulting in the death of wild life will be reported to the MoE and RSCN.
Transport and Infrastructure			
Construction traffic	Moderate Significance	Car sharing and the use of minibuses and public transport will be encouraged	
		The contractors appointed would be encouraged to provide a minibus service for construction staff	
		Car sharing and the use of minibuses and public transport will be encouraged by all staff	
Vehicle emissions	Moderate Significance	Regular servicing and maintenance of vehicles will be employed to help minimize emissions to air	

Concern	Significance	Mitigation Measure	Monitoring
Dust and dirt generation	Moderate Significance	Wheel washing may be employed to help prevent mud and earth being carried from the site on to local roads	Visual checks will be made to ensure that dust creation and mud carry are not encountered to any significant degree.
		In dry periods on-site roads may be dampened to reduce the potential for dust creation	
Road Safety	Moderate Significance	Adequate signage will be put in place as necessary.	The plant operator will check that all signage is in place as necessary.
		Drivers accessing the site will be obliged to comply with all Jordanian road safety laws	Where locals report cases of law breaking by staff with regard to speed limits etc this will be internally investigated as necessary.
Construction traffic management	Moderate Significance	A Traffic Management plan will be prepare to help minimize the impact to the local traffic network.	
Cultural Heritage / Archaeology			
Archaeological site finds	Moderate Significance	Construction staff will report any finds that may have cultural or archaeological significance.	Construction staff will be requested to report any archaeological finds to an appropriate manager.
		If any site is found during construction and will be damaged by construction activities, the DOA will be invited to assess the discovered remains and may carry out an emergency salvage excavation salvage excavation which entails that archaeological excavation is conducted during construction phase. The contractor would be obliged to wait for a period of 10 days before commencing construction activities in the vicinity of an archaeological find to allow the DOA to respond to the sites identification.	
		The Contractor shall seek the written approval of the DOA before the removal of any chance find building, foundation, structure, fence and other obstruction over 50 years old, any portion of which is in the quarrel.	
Socio-economics			
Worker rights	NA	Labour law (No. 8, 1996) will be applied and complied with throughout the duration of the project as necessary.	

Concern	Significance	Mitigation Measure	Monitoring
On-site Health and Safety			
Safety	N / A	Equipment, tools and substances will be suitable for their use and selected to minimize dangers to safety or health when used correctly.	
		Work places will where possible receive natural light and be supplemented with sufficient artificial illumination, and signage will appropriately mark hazards, exits, materials etc.	
		Ventilation design factors will consider physical activity, substances in use and process related emissions. Temperatures will be maintained at levels appropriate for the purpose of the facility.	
		Fire prevention and protection will be adequate for the dimensions and use of the premises, equipment installed, physical and chemical properties of substances present, and the maximum number of people present. Fire detection and protection systems will be provided throughout the plant and site area. These will include fixed foam protection systems, fire alarms, portable appliances, etc.	
		The plant will also store firewater sufficient to meet the requirements of the Jordan Fire Department and the local fire code requirements.	
		Places of work, traffic routes and passageways shall be kept free from waste and spillage, regularly cleaned, and maintained. First aid facilities will be provided and will be easily accessible throughout the place of work. Welfare facilities will include locker rooms, an adequate number of toilets with washbasins, and a room dedicated for eating. An ample supply of drinking water will be provided at all places of work.	

Concern	Significance	Mitigation Measure	Monitoring
		Buildings and structures will be designed according to local and internationally recognized standards. They will be structurally safe, provide appropriate protection against the climate and have acceptable light and noise conditions.	
		Personal protection equipment (PPE) will be identified and provided, that will offer adequate protection to the worker, co-workers and occasional visitors without incurring unnecessary inconvenience. The use of PPE will be actively enforced if alternative technologies, work plans or procedures cannot eliminate or sufficiently reduce a hazard or exposure. The employer shall ensure that PPE is cleaned when dirty, properly maintained and replaced when damaged or worn out. Proper use of PPE shall be part of the recurrent training programs for employees.	Daily visual inspection of use of PPE equipment would be made.
		Exposure to vibration from equipment will be controlled through selection of equipment and limitation of time of exposure. The limits for vibration and action values will conform to those provided by the IFC guidelines for Occupational Health and Safety.	
		Indoor temperatures will be maintained such that they are reasonable and appropriate for the work at site. Risks of heat related stress will be adequately addressed and feasible control measures implemented for work.	
		First aid facility adequately and appropriately stocked	A register of accidents on-site would be maintained with prevention training sessions held.
		A health and safety plan would be prepared with the aim of preventing accidents and injuries for both and construction and operation stages of the project.	Review site specific health and safety plan would be made on an appropriately regular basis.
		Sufficient training will be provided to all workers to ensure health and safety in the work place	A training register for Employees would be maintained and kept up to date with evaluation of training sessions made.

Concern	Significance	Mitigation Measure	Monitoring
Community Health and Safety			
		The plant will be located within a security fence ensuring to prevent trespass or accidental entry of the site by local peoples. The plant will also be fitted with security cameras	
		Construction materials will be managed safely with any stockpiles etc placed in areas to prevent any risk to local communities such as the materials becoming airborne through exposure to the wind.	
		Transport during all phases of the project will be managed so as to minimize impact to the local community.	Accidents and incidents involving the public will be documented and reported to management.
		The transport of raw materials and the transport and disposal of waste will be undertaken in an appropriate manner.	
		Project vehicles and equipment will be well maintained with project-related traffic will be requested to travel no faster than the speed limit.	
		The contractor will allow for a means of complaints regarding on-site activities to be made by members of the local community.	A complaints register will be maintained as necessary.

TABLE 7.2: CONSTRUCTION MONITORING PROGRAMME

Monitoring Issue	Monitoring Method	Monitoring Frequency
Air Quality		
Dust creation from soil movements, emissions from vehicles etc	Dust monitoring programme will be carried out	Upon receipt of complaint from local peoples/MoE etc
Inspections will include monitoring of exit points	Visual inspections	Daily during construction contract
Inspection of bunded areas	Visual inspections	Daily during construction contract
Noise and Vibration		
Construction noise	Auditory inspection/walk round to ensure best practicable means are being employed	Daily during construction contract
Water Quality		
Aqueous effluent and runoff	Visual inspection to ensure that construction impacts do not spread onto other land.	Daily during construction contract
Ecology and Biodiversity		
Hunting or killing of animals	Any accidents resulting in the death of wild life will be reported to the Ministry of Environment and RSCN.	As necessary
Geology, Soils and Waste		
Visual impact of construction	Visual inspections will be made to ensure that plant wastes are not escaping to the surrounding environment.	Daily during construction contract
Dust and dirt generation	Visual checks will be made to ensure that dust creation and mud carry are not encountered to any significant degree.	Daily during construction contract
Traffic and Infrastructure		
Road Safety	The plant operator will check that all signage is in place.	As necessary
	Where locals report cases of law breaking by staff with regard to speed limits etc this will be internally investigated.	As necessary

Monitoring Issue	Monitoring Method	Monitoring Frequency
Cultural Heritage / Archaeology		
Archaeological site finds	Construction staff will be requested to report any archaeological finds to an appropriate manager.	As necessary
Health and Safety		
Safety	Visual inspection of use of PPE equipment would be made.	Daily
	A register of accidents on-site would be maintained with prevention training sessions held.	As necessary
	Review site specific health and safety plan would be made on an appropriately regular basis.	Annually
	A training register for employees would be maintained and kept up to date with evaluation of training sessions made.	As necessary
	Accidents and incidents involving the public will be documented and reported to management.	As necessary
	A complaints register will be maintained.	As necessary

TABLE 7.3: OPERATIONAL IMPACT MITIGATION, MONITORING, AND MANAGEMENT MEASURES

Concern	Significance	Mitigation Measure	Monitoring
Air Quality			
Emissions to air from burning DFO, HFO and natural gas.	High significance	The use of Selective Catalytic Reduction (SCR), which ensures NO_x levels to be in accordance with World Bank / IFC requirements	Stack emissions will be monitored continuously for NO_x, O_2 and CO by the proponent. Sampling points and safe access adjacent to the continuous monitoring points will be installed.
		Operation on low sulphur fuel.	
		A stack of sufficient height and flue gases of sufficient temperature and velocity to ensure good dispersion.	
		The potential use of SCR, which will control NOx emissions levels.	
		The use of stacks of sufficient height and flue gases of sufficient temperature and velocity to ensure good dispersion.	
		The reservation of a development area for the installation of FGD equipment should this be considered necessary.	
		The Consortium will require a manufacturer's guarantee regarding the performance of the NO_x abatement system. If NO_x values are outside the permitted levels, the operation and calibration of the instrument will be checked. If proved to be accurate, corrective action shall be taken immediately to identify cause and to reduce emissions level to within the permitted levels.	

Concern	Significance	Mitigation Measure	Monitoring
		Emissions will be controlled during operation in accordance with the manufacturer's recommendations, taking account of the applicable Technical Guidance. Efficient operation and maintenance of the engine units will ensure that the emissions of CO, TSPs, H_2S and hydrocarbons are controlled.	
		Whilst the design of the Power Project allows for the reservation of an area for the installation of FGD equipment, it is considered that the primary method for the control of SO_2 emissions (from any thermal power plant) is to reduce the sulphur content of the fuel.	
		Similarly, the emission of PM should be limited by the ash content of the fuel.	
		General good housekeeping to prevent fugitive dust emissions	
Fugitive dust emissions	Low significance	General good housekeeping to prevent fugitive dust emissions	
Water Quality / Geology, Soils and Waste			
Potential leakage of storage tanks	High significance	All oil and chemical storage tanks and areas where drums are stored will be surrounded by an impermeable bund. Single tanks will be within bunds sized to contain 110 per cent of capacity and multiple tanks or drums will be within bunds sized to contain 110 per cent of the capacity of the largest tank. Permanently fixed taps, filler pipes, pumping equipment, vents and sight glasses will also be located within the bunded area.	Daily visual inspection of bunded areas will be made to ensure the effectiveness of these systems. All elements of the treatment systems will be regularly monitored to ensure optimum performance and maintenance.

Concern	Significance	Mitigation Measure	Monitoring
		Taps and valves will be designed to discharge downwards and will be shut and locked in that position. Manually started electrically operated pumps will remove surface water collected within the bund and its composition will be verified prior to disposal (for maintenance of the system)	The inspection of oil interceptors will be undertaken on a regular basis.
		An oily waste water drainage system will drain all areas where oil spillages could occur. The design will incorporate oil interceptors and traps. These will discharge with the other surface water discharge to the storm water discharge system. The discharge from each oil interceptor will contain no visible oil or grease	
		Disposal of the sludge will be undertaken by an appropriate contractor and disposed of off-site at an appropriate disposal site.	
Waste disposal	Low significance	Sludge removed in the oily waste separation will be removed by road tanker and disposed of at an appropriate disposal site.	
		Wastewater containing detergent will be discharged to the oily waste separation pond and oil separators prior to discharge to an on-site chemical wastewater collection pond.	
		All collection ponds will be appropriately bunded to ensure that no water leaches in to the ground.	
		Emergency response plans will be developed for the leaking of any hazardous substances stored/used on-site.	

Concern	Significance	Mitigation Measure	Monitoring
Hazardous substances	Moderate significance	All elements of the treatment systems will be regularly monitored to ensure optimum performance and maintenance.	
Proper waste water treatment	Moderate significance	Designated waste areas will be used to store the minimal amounts of waste (principally office wastes generated by the plant.	
Noise and Vibration			
Operational noise	Moderate significance	A computer model of the proposed plant items should be produced at the detailed design stage, to calculate the predicted noise levels at the NSR locations, and ensure that planning limits are adhered to. Detailed design will ensure that site noise is mitigated as far as possible, through site layout and orientation of noisy plant items.	Provisions to be put in place for the monitoring of noise at sensitive receptors (on and off site) in the event that there is a complaint or reason for concern. Site walkover surveys and occasional noise monitoring at sensitive receptors will be undertaken as deemed appropriate
		Since tonal or impulsive noises are considered more annoying than continuous noise sources, plant items should be silenced or otherwise controlled through regular maintenance to ensure no such emissions are audible at NSR locations.	
		Inherently quiet plant items should be selected wherever practicable. High performance silencers should be fitted to achieve maximum noise attenuation on plant and ductwork. Lagging and low noise trims will be fitted to all pipe-work and noise generating steam valves.	
		High performance acoustic enclosures should be considered for all plant items where practicable, not overlooking smaller plant items such as compressors and pumps.	

Concern	Significance	Mitigation Measure	Monitoring
		Internal surfaces within the Engine enclosures should be treated to control internal reverberant noise levels. An appropriate treatment would consist of dense mineral wool panel behind perforated sheet steel, a spray on cellulose fibre treatment, or materials providing the same level of acoustic abatement.	
		Plant items that are used for periods of shorter duration such as at the start-up and shut down should be afforded the same level of noise control as all other plant.	
		All noisy plant can be positioned such that it faces towards the existing plant or towards new plant such that all sensitive receptors benefit from screening and/or directivity corrections.	
Ecology and Biodiversity			
Removal of existing natural vegetation	Low Significance	The proponent will avoid any unnecessary removal of existing natural vegetation.	
Hunting or killing of animals	Moderate Significance	The proponent will not allow workers to hunt or kill animals.	Any accidents resulting in the death of wild life will be reported to the MoE and RSCN.
Destruction of bird nests	Low Significance	The destruction of bird nests will be prohibited.	
During night disturbance of wildlife	Low Significance	Not relevant given low level of wildlife	
Planting of exotic or invasive plants	Low Significance	The planting of exotic or invasive plants for landscaping inside and around the plant will be prohibited with a preference given to the planting of native species where landscaping is deemed necessary	

Concern	Significance	Mitigation Measure	Monitoring
Disposal of domestic or industrial wastes	Low Significance	Disposal of domestic or industrial wastes will be to appropriate disposal sites.	
	Moderate Significance	No materials will be disposed of on-site and in the in the surrounding area especially at the near shallow wadies.	
Light pollution	Moderate Significance	Directional lighting and buffer planting to screen the plant.	
Traffic and Infrastructure			
Unauthorized / inappropriate parking	Low Significance	Use of machinery will be restricted to the proposed site as will parking of vehicles unless authorised parking area provided outside proposed site	
	Low Significance	Parking on areas outside the dedicated parking area will not be allowed unless strictly necessary.	
Contamination by vehicle maintenance	Low Significance	Any maintenance of vehicles or machinery will be performed off-site unless strictly necessary.	
Vehicle emissions	Moderate Significance	Regular servicing and maintenance of vehicles will be undertaken to minimize emissions to air, noise, leaks etc.	
Safety	Moderate Significance	Safety training may be provided to vehicle drivers if considered necessary	
	Moderate Significance	Transport of HFO and DFO to the site would endeavour to avoid the peak traffic congestion rush hours at 6:30 am and 4.30 pm to minimize the impact to the local traffic network.	

Concern	Significance	Mitigation Measure	Monitoring
Traffic management	Moderate Significance	Drivers will be instructed to obey all relevant speed limits and other relevant laws.	
Socio-economics			
Worker rights	NA	Labor law (No 8, 1996) will be applied and complied with throughout the duration of the project as necessary.	
On-site Health and Safety			
		Equipment, tools and substances will be suitable for their use and selected to minimize dangers to safety or health when used correctly.	
		Work places will where possible receive natural light and be supplemented with sufficient artificial illumination, and signage will appropriately mark hazards, exits, materials etc.	
		Ventilation design factors will consider physical activity, substances in use and process related emissions. Temperatures will be maintained at levels appropriate for the purpose of the facility.	
		Fire prevention and protection will be adequate for the dimensions and use of the premises, equipment installed, physical and chemical properties of substances present, and the maximum number of people present. Fire detection and protection systems will be provided throughout the plant and site area.	

Concern	Significance	Mitigation Measure	Monitoring
		These will include fixed foam protection systems, fire alarms, portable appliances, etc. The plant will also store firewater sufficient to meet the requirements of the Jordan Fire Department and the local fire code requirements.	
		Places of work, traffic routes and passageways shall be kept free from waste and spillage, regularly cleaned, and maintained. First aid facilities will be provided and will be easily accessible throughout the place of work. Welfare facilities will include locker rooms, an adequate number of toilets with washbasins, and a room dedicated for eating. An ample supply of drinking water will be provided at all places of work.	
		Buildings and structures will be designed according to local and internationally recognized standards. They will be structurally safe, provide appropriate protection against the climate and have acceptable light and noise conditions.	
		Personal protection equipment will be identified and provided, that will offer adequate protection to the worker, co-workers and occasional visitors without incurring unnecessary inconvenience. The use of PPE will be actively enforced if alternative technologies, work plans or procedures cannot eliminate or sufficiently reduce a hazard or exposure. The employer shall ensure that PPE is cleaned when dirty, properly maintained and replaced when damaged or worn out. Proper use of PPE shall be part of the recurrent training programs for employees.	

Concern	Significance	Mitigation Measure	Monitoring
		Exposure to vibration from equipment will be controlled through selection of equipment and limitation of time of exposure. The limits for vibration and action values will conform to those provided by the IFC guidelines for OHS.	
		Indoor temperatures will be maintained such that they are reasonable and appropriate for the work at site. Risks of heat related stress will be adequately addressed and feasible control measures implemented for work.	
		First aid facility adequately and appropriately stocked	
		A health and safety plan would be prepared with the aim of preventing accidents and injuries for both and construction and operation stages of the project.	
Community Health and Safety			
		The plant will be located within a security fence ensuring to prevent trespass or accidental entry of the site by local peoples. The plant will also be fitted with security cameras	
		Construction materials will be managed safely with any stockpiles etc placed in areas to prevent any risk to local communities such as the materials becoming airborne through exposure to the wind.	
		Transport during all phases of the project will be managed so as to minimize impact to the local community.	Accidents and incidents involving the public will be documented and reported to management.

Concern	Significance	Mitigation Measure	Monitoring
		The transport of raw materials and the transport and disposal of waste will be undertaken in an appropriate manner.	A complaints register will be maintained as necessary.
		Project vehicles and equipment will be well maintained with project-related traffic will be requested to travel no faster than the speed limit.	

TABLE 7.4: OPERATIONAL MONITORING PROGRAMME

Monitoring Measure	Monitoring Method	Monitoring Frequency
Air Quality		
Emissions to air from burning of HFO,DFO and natural gas	Stack emissions will be monitored for NO_x, O_2 and CO	Continuous
Water Quality		
Potential leakage of storage tanks	Visual inspection of bunded areas will be made to ensure the effectiveness of these systems.	Daily
Poor performance of the water treatment system	All elements of the treatment systems will be regularly monitored to ensure optimum performance and maintenance.	Weekly
Effectiveness of the oil interceptors	The inspection of oil interceptors will be undertaken on a regular basis.	Weekly
Noise and Vibration		
Operational noise	Provisions to be put in place for the monitoring of noise at sensitive receptors (on and off-site) in the event that there is a complaint or reason for concern.	As necessary
	Site walkover surveys and occasional noise monitoring at sensitive receptors will be undertaken as deemed appropriate	Weekly/As necessary
Ecology and Biodiversity		
Hunting or killing of animals	Any accidents resulting in the death of wild life will be reported to the MoE and RSCN.	As necessary
Landscape and Visual		
Visual impact of power station	Visual inspection will be made to check for any degradation of the power stations appearance.	Monthly
	Visual inspections will be made to ensure that plant wastes are not escaping to the surrounding environment.	Weekly

Monitoring Measure	Monitoring Method	Monitoring Frequency
Community Health and Safety		
Community Health and Safety	Accidents and incidents involving the public will be documented and reported to management.	As necessary
	A complaints register will be maintained.	As necessary

TABLE 7.5: DECOMMISSIONING IMPACT MITIGATION, MONITORING AND MANAGEMENT MEASURES

Concern	Significance	Mitigation Measure	Monitoring
Geology, Soils and Waste			
Waste	Minor	Remove all waste from the site, recycle as many materials as possible	
Site conditions	Moderate	Site reinstated to condition prior to development	
Water Quality			
Water	Moderate	As for construction. Best Available Techniques followed at the time to account for relevant guidance.	Post-decommissioning monitoring of water quality
Noise and Vibration			
Noise	Moderate	As for construction. Best Available Techniques followed at the time to account for relevant guidance.	

TABLE 7.6: CONSTRUCTION IMPLEMENTATION SCHEDULE AND COST ESTIMATES

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
Air Quality					
Dust creation from soil movements, emissions from vehicles etc	Water Bowser	Following tests to determine the moisture content of material	Contractor	$4,500 (period of contract)	N/A
	Materials deposited on stockpiles on-site will be closely monitored for any possible emission of dust and if required they will be damped down, covered or treated with a dust suppressant.	If identified as an issue	Contractor	$3,000 (period of contract)	N/A
	All operatives working in areas of potential dust emission will be provided with paper facemasks.	Automatically applied for on-site staff as appropriate	Contractor	$3,000 (period of contract)	N/A
	All stockpiles will be located away from sensitive receptors wherever possible.	Environmental Manager will ensure that staff are made aware of the requirement as necessary and that the procedure is properly implemented.	Contractor	$500 (period of contract)	N/A
	All vehicles carrying bulk materials into and out of the site will be sheeted so as to contain any material that may be dispersed during transit. Minimum drop heights will be used during material transfer	Automatically applied to all applicable vehicles, Environmental Manager will ensure that staff are made aware of the requirement as necessary and that the procedure is properly implemented.	Contractor	$500 (period of contract)	N/A
	If finely ground materials are delivered, these will be in bag form, enclosed lorries or stockpiled in specified locations where the material can be suitably covered.	Environmental Manager will ensure that staff are made aware of the requirement as necessary and that the procedure is properly implemented.	Contractor	$1,000 (period of contract)	N/A

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	Engines will be switched off when not in use.	Environmental Manager will ensure that staff are made aware of the requirement as necessary and that the procedure is properly implemented.	Contractor	Part of best working practice Minimal cost	N/A
	All vehicles will be properly maintained to reduce air emissions	As necessary	Contractor	$15,000 (period of contract)	N/A
	To ensure that atmospheric dust, contaminants or dust deposits generated by the construction do not exceed levels which could constitute a health hazard or nuisance to those persons working on the site or living nearby a dust monitoring programme will be carried out throughout the construction period.	Daily visual inspections with implementation of dust suppression measures as necessary.	Contractor	$500 (period of contract)	N/A
	Daily visual inspections will be made to ensure that good practice is employed at all times. Inspections will include monitoring of exit points and the immediate area outside the site entrance.	Daily visual inspections with implementation of wheel washing/dust suppression measures as necessary.	Contractor	Minimal cost (part of Environmental Managers remit).	N/A
	The inspections will be made against the EPC contractors CEMP.				
Water Quality					
Water Quality	DFO storage tanks to be located on an impervious base provided with bund walls to give a containment capacity of at least 110 per cent of the tank volume. All valves and couplings to be contained within the bunded area.	Automatically applied as part of plant design	Contractor	$70,000 (single payment)	N/A

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	Portable toilets will be provided during the construction period with any waste tankered of site and disposed of in an appropriate manner.	Sufficient toilets will be provided based on the number of staff with regular tankering of waste.	Contractor	$10,000 (period of contract)	N/A
	Any surface water contaminated by hydrocarbons, which are used during the construction phase, to be passed through oil/grit interceptor(s) prior to collection and removal off-site to an appropriate disposal site.	Automatically applied as part of plant design	Contractor	$1,000 (period of contract)	N/A
	Measures to be taken to ensure that no leachate or any surface water that has the potential to be contaminated to be allowed to enter directly or indirectly any water course, underground strata or adjoining land.	Automatically applied as part of plant design	Contractor	$2,000 (period of contract)	N/A
	Provisions to be made so that any existing drainage systems continue to operate.	As necessary, where these are encountered this will be addressed.	Contractor	$10,000 (period of contract)	N/A
	Water inflows to excavated areas to be minimized by the use of lining materials, good housekeeping techniques and by the control of drainage and construction materials in order to prevent the contamination of ground water. Site personnel to be made aware of the potential impact on ground and surface water associated with certain aspects of the construction works to further reduce the incidence of accidental impacts.	Environmental Manager will ensure that staff are made aware of the requirement as necessary and that the procedure is properly implemented.	Contractor	$7,500 (period of contract)	N/A

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	Refuelling of construction vehicles and equipment to be restricted to a designated area with properly designed fuel tanks and bunds and proper operating procedures.	Environmental Manager will ensure that staff are made aware of the requirement as necessary and that the procedure is properly implemented.	Contractor	$500 (period of contract)	N/A
	No materials will be disposed of in the wadi to the north-west of the site.	Environmental Manager will ensure that staff are made aware of the requirement as necessary and that the procedure is properly implemented.	Contractor	Part of best working practice minimal cost	N/A
	Spill kits will be kept on-site to clean up any spills of fuels or oils. Spills would be reported and responded to as quickly as possible.	Staff will be required to report this as and when it occurs	Contractor	$5,000 (period of contract)	N/A
	Maintenance of construction machinery will not be allowed on-site unless absolutely necessary to help to prevent the accidental leakage of lubricating and hydraulic fluids.	Environmental Manager will ensure that staff are made aware of the requirement as necessary and that the procedure is properly implemented. If it is necessary to carry out maintenance on-site then a designated area with suitable containment shall be provided.	Contractor	$10,000 (period of contract)	N/A
	Construction contractor to dispose of any construction effluents in a responsible manner.	Environmental Manager will ensure that staff are made aware of the requirement as necessary and that the procedure is properly implemented.	Contractor	$5,000 (period of contract)	N/A
	Storage of construction materials will be in assigned areas and follow standard best working practices.	Environmental Manager will ensure that staff are made aware of the requirement as necessary and that the procedure is properly implemented.	Contractor	$500 (period of contract)	N/A

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	Disposal of excavated materials will either be off-site at an appropriate landfill site or in areas of the site that will not give rise to surface run off during wet periods.	As necessary	Contractor	$2,000 (period of contract)	N/A
	Water inflows to excavated areas to be minimized by the use of lining materials, good housekeeping techniques and by the control of drainage and construction materials in order to prevent the contamination of ground water.	Automatically applied as part of plant design	Contractor	$1,000 (period of contract)	N/A
	Reuse excavated material within the site boundary where practicable which would reduce the volume of excavated material going off-site to landfill.	Part of best working practice	Contractor	Minimal cost	N/A
	No materials will be disposed of in the wadi to the north-west of the site.	Environmental Manager will ensure that staff are made aware of the requirement as necessary and that the procedure is properly implemented.	Contractor	Part of best working practice minimal cost	N/A
	Segregation of contaminated excavated material (should this be encountered), from non-contaminated excavated material would be made with the contaminated soils removed to an appropriate disposal site.	Environmental Manager will ensure that staff are made aware of the requirement as necessary and that the procedure is properly implemented.	Contractor	$500 (period of contract)	N/A
	Daily visual inspection of bunded areas will be made to ensure the effectiveness of these systems.	Daily visual inspection of bunded areas will be made and effectiveness noted.	Contractor	Part of best working practice Minimal cost	N/A
Noise and Vibration					
	All construction activities would be carried out in accordance with the recommendations of BS 5228	Part of EPC contract requirements, any complaints would be investigated.	Contractor	$500 (period of contract)	N/A

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	All vehicles and mechanical plant used for construction would be fitted with effective exhaust silencers, and regularly maintained.	Automatically applied as best working practice.	Contractor	Part of best working practice Minimal cost	N/A
	Inherently quiet plant would be used where appropriate	Automatically applied as best working practice.	Contractor	Inherent in design	N/A
	All major compressors would be sound-reduced models fitted with properly lined and sealed acoustic covers which would be kept closed whenever the machines are in use, and all ancillary pneumatic percussive tools would be fitted with mufflers or silencers of the type recommended by the manufacturers.	Automatically applied as part of plant design	Contractor	$3,000 (one off payment)	N/A
	All ancillary plant such as generators, compressors and pumps would be positioned so as to cause minimum noise disturbance. If necessary, temporary acoustic barriers or enclosures would be provided.	Automatically applied as part of plant design	Contractor	$5,000 (period of contract)	N/A
	Daily auditory inspection/walk round to ensure best practicable means are being employed	Daily auditory inspection/walk round. Complaints would be investigated.	Contractor	Part of best working practice minimal cost	N/A
Ecology and Biodiversity					
	Potential aqueous effluent and runoff from site activities will be kept to an absolute minimum so as to ensure that there is no contamination of habitats and ecosystems outside the project boundary.	Environmental Manager will ensure that staff are made aware of the requirement as necessary.	Contractor	$800 (period of contract)	N/A
	Unnecessary removal of existing natural vegetation will be avoided.	Environmental Manager will ensure that staff are made aware of the requirement as necessary.	Contractor	Part of best working practice minimal cost	N/A

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	Workers will be required not to cut down plants in the surrounding area for fires etc.	Environmental Manager will ensure that staff are made aware of the requirement as necessary.	Contractor	Part of best working practice minimal cost	N/A
	The destruction of bird nests will be prohibited. Any ground nests found inside the site will be moved in coordination with MoE and RSCN to an appropriate area.	Environmental Manager will ensure that staff are made aware of the requirement as necessary and that the procedure is properly implemented.	Contractor	Part of best working practice minimal cost	N/A
	Construction activity generating loud noise will be kept to a minimum during night-time to decrease disturbance on wildlife in the area.	Part of project implementation plan	Contractor	Part of best working practice	N/A
	The planting of exotic or invasive plants for landscaping inside and around the plant will be prohibited	Part of plant design.	Contractor	Part of best working practice	N/A
	The contractor will not allow workers to hunt or kill animals. Any accidents resulting in the death of wild life will be reported to the MoE and RSCN.	Environmental Manager will ensure that staff are made aware of the requirement.	Contractor	Part of best working practice	N/A
	Visual inspection to ensure that construction impacts do not spread onto other land.	Visual inspection	Contractor	Part of best working practice Minimal cost	N/A
Landscape and Visual					
	The contractor will be required to provide areas for the disposal of wastes during the construction period so as to prevent these escaping to the surrounding area and becoming unsightly.	Part of EPC Contract	Contractor	Part of best working practice	N/A
	Land not required for permanent use by the power station will be reinstated to original or better condition.	Part of EPC Contract, will be checked before handover of the plant	Contractor	$1,000 (period of contract)	N/A

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	Visual inspections will be made to ensure that plant wastes are not escaping to the surrounding environment.	Visual inspections	Contractor	ca~ $100,000 part of EPC contract (period of contract)	N/A
Transport and Infrastructure					
	Car sharing and the use of minibuses and public transport will be encouraged	The EPC Contractor will encourage staff to do so	Contractor	Part of best working practice	N/A
	The contractors appointed would be encouraged to provide a minibus service for construction staff	As necessary	Contractor	$30,000 (period of contract)	N/A
	Car sharing and the use of minibuses and public transport will be encouraged by all staff	The EPC Contractor will encourage staff to do so	Contractor	Part of best working practice	N/A
	Regular servicing and maintenance of vehicles will be employed to help minimize emissions to air	As necessary	Contractor	$15,000 (period of contract)	N/A
	Wheel washing may be employed to help prevent mud and earth being carried from the site on to local roads	Visual inspections will be used to confirm or otherwise the need for this.	Contractor	$500 (period of contract)	N/A
	In dry periods on-site roads may be dampened to reduce the potential for dust creation	Visual inspections will be used to confirm or otherwise the need for this.	Contractor	$1000 (period of contract)	N/A
	A Traffic Management plan will be prepared to help minimize the impact to the local traffic network.	Part of EPC Contract	Contractor	$10,000 (one off payment)	N/A
	Visual checks will be made to ensure that dust creation and mud carry are not encountered to any significant degree.	Visual checks	Contractor	Part of best working practice Minimal cost	N/A
	The plant operator will check that all signage is in place as necessary.	Visual checks	Contractor	Part of best working practice Minimal cost	N/A

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	Where locals report cases of law breaking by staff with regard to speed limits etc this will be internally investigated as necessary.	As necessary	Contractor	Part of best working practice Minimal cost	N/A
	Visual checks will be made to ensure that, emissions and dust creation and mud carry are not encountered to any significant degree.	Visual checks	Contractor	Part of best working practice Minimal cost	N/A
Cultural Heritage / Archaeology					
	If any site is found during construction and will be damaged by construction activities, the DOA will be invited to assess the discovered remains and may carry out an emergency salvage excavation salvage excavation which entails that archaeological excavation is conducted during construction phase. The contractor would be obliged to wait for a period of 10 days before commencing construction activities in the vicinity of an archaeological find to allow the DOA to respond to the sites identification.	Environmental Manager will ensure that staff are made aware of the requirement as necessary and that the procedure is properly implemented.	Contractor	$1,500 (period of contract)	N/A
	The Contractor shall seek the written approval of the Department of Antiquities before the removal of any chance find building, foundation, structure, fence and other obstruction over 50 years old, any portion of which is in the quarrel.	As necessary	Contractor	Part of best working practice	N/A

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	Construction staff will be requested to report any archaeological finds to an appropriate manager.	Environmental Manager will ensure that staff are made aware of the requirement as necessary and that the procedure is properly implemented.	Contractor	Part of best working practice Minimal cost	N/A
Socio-economics					
	Labor law (No.8, 1996) will be applied and complied with throughout the duration of the project as necessary.	Managers will be made aware of the requirements of the law	Contractor/ proponent	Part of best working practice Minimal cost	N/A
On-site Health and Safety					
	Equipment, tools and substances will be suitable for their use and selected to minimize dangers to safety or health when used correctly.	Part of EPC Contract. Guidance and training will be provided on equipment use etc as necessary.	Contractor	$40,000 (one off payment)	N/A
	Work places will where possible receive natural light and be supplemented with sufficient artificial illumination, and signage will appropriately mark hazards, exits, materials etc.	Part of plant design and best working practice	Contractor	$10,000 (one off payment)	N/A
	Ventilation design factors will consider physical activity, substances in use and process related emissions. Temperatures will be maintained at levels appropriate for the purpose of the facility.	Part of plant design and best working practice, will be automatically applied	Contractor	Inherent in design	N/A

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	Fire prevention and protection will be adequate for the dimensions and use of the premises, equipment installed, physical and chemical properties of substances present, and the maximum number of people present. Fire detection and protection systems will be provided throughout the plant and site area. These will include fixed foam protection systems, fire alarms, portable appliances, etc. The plant will also store firewater sufficient to meet the requirements of the Jordan Fire Department and the local fire code requirements.	Part of plant design and best working practice, will be automatically applied	Contractor/ proponent	$300,000 (one off payment)	N/A
	Places of work, traffic routes and passageways shall be kept free from waste and spillage, regularly cleaned, and maintained. First aid facilities will be provided and will be easily accessible throughout the place of work. Welfare facilities will include locker rooms, an adequate number of toilets with washbasins, and a room dedicated for eating. An ample supply of drinking water will be provided at all places of work.	Visual inspections will be made as necessary to ensure that facilities remain adequate	Contractor/ proponent	$10,000 (one off payment then part of best working practice)	N/A
	Buildings and structures will be designed according to local and internationally recognized standards. They will be structurally safe, provide appropriate protection against the climate and have acceptable light and noise conditions.	Part of plant design and requirement of EPC Contract.	Contractor	Inherent in design	N/A

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	Personal protection equipment will be identified and provided, that will offer adequate protection to the worker, co-workers and occasional visitors without incurring unnecessary inconvenience. The use of PPE will be actively enforced if alternative technologies, work plans or procedures cannot eliminate or sufficiently reduce a hazard or exposure. The employer shall ensure that PPE is cleaned when dirty, properly maintained and replaced when damaged or worn out. Proper use of PPE shall be part of the recurrent training programs for employees.	Personal protection equipment will be identified and provided. The use of PPE will be actively enforced by site managers/foremen etc.	Contractor	$15,000 (initially then replaced as necessary)	$1000
	Exposure to vibration from equipment will be controlled through selection of equipment and limitation of time of exposure. The limits for vibration and action values will conform to those provided by the IFC guidelines for OHS.	Exposure to vibration from equipment will be controlled through selection of equipment and limitation	Contractor	$50,000 (one off payment)	$1000
	Indoor temperatures will be maintained such that they are reasonable and appropriate for the work at site. Risks of heat related stress will be adequately addressed and feasible control measures implemented for work.	Part of plant design.	Contractor	$150,000 (one off payment then minimal additional costs)	$1000
	First aid facility adequately and appropriately stocked	Visual inspections and reordering of supplies as necessary	Contractor	$15,000 (one off payment then minimal additional operational costs)	$500

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	A health and safety plan would be prepared with the aim of preventing accidents and injuries for both and construction and operation stages of the project.	A health and safety plan would be prepared	Contractor	$20,000 (one off payment)	N/A
	A training register for Employees would be maintained and kept up to date with evaluation of training sessions made.	A training register for Employees will be maintained	Contractor	Responsibility of Project Manager/ plant manager Zero cost	N/A
	Daily visual inspection of use of PPE equipment would be made.	Daily visual inspection by site managers/foremen etc	Contractor	Responsibility of safety Manager Zero cost	N/A
	A register of accidents on-site would be maintained with prevention training sessions held.	As necessary accidents will be registered.	Contractor	Responsibility of safety Manager (Zero cost)	N/A
	Review site specific health and safety plan would be made on an appropriately regular basis.	Annual review by safety manager/officer	Contractor	$2000	$2000
Off-site Health and Safety					
	The plant will be located within a security fence ensuring to prevent trespass or accidental entry of the site by local peoples. The plant will also be fitted with security cameras	Part of EPC contract/plant design	Contractor	$120,000 (one off payment then minimal additional operational costs)	$500
	Construction materials will be managed safely with any stockpiles etc placed in areas to prevent any risk to local communities such as the materials becoming airborne through exposure to the wind.	Environmental Manager will ensure that staff are made aware of the requirement as necessary and that the procedure is properly implemented.	Contractor	$2,000 (period of contract)	N/A
	Transport during all phases of the project will be managed so as to minimize impact to the local community.	Preparation of traffic management plan and consideration of any complaints as necessary	Contractor	Part of best working practice Minimal cost	N/A

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	The transport of raw materials and the transport and disposal of waste will be undertaken in an appropriate manner.	Best working practices will be applied and any complaints investigated.	Contractor	$7,000 (period of contract)	N/A
	Project vehicles and equipment will be well maintained with project-related traffic will be requested to travel no faster than the speed limit.	Staff will be made aware of the requirement. Preparation of traffic management plan will be made and consideration of any complaints as necessary	Contractor	Part of best working practice Minimal cost	N/A
	Accidents and incidents involving the public will be documented and reported to management.	As necessary	Contractor	Responsibility of Project Manager/ plant manager Zero cost	N/A
	A complaints register will be maintained as necessary.	As necessary	Contractor	Responsibility of Project Manager/ plant manager Zero cost	N/A

TABLE 7.7: OPERATIONAL IMPLEMENTATION SCHEDULE AND COST ESTIMATES

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
Air Quality					
Emissions to air from burning of DFO,HFO and natural gas	Use of SCR	Part of plant design and requirement of EPC Contract	Contractor	Inherent in design	N/A
	Operation on a low sulphur fuel	Sourcing of appropriate fuel	Proponent	Inherent in design	N/A
	A stack of sufficient height and flue gases of sufficient temperature and velocity to ensure good dispersion.	Part of plant design and requirement of EPC Contract	Contractor	Inherent in design	N/A
	Stack emissions will be monitored for NO_x, O_2 and CO	Part of plant design and requirement of EPC Contract. The proponent will ensure that the monitor is properly calibrated on an annual basis.	Proponent	$5000	$5000
Fugitive dust emissions	General good housekeeping to prevent fugitive dust emissions	The Environmental Manager will make staff aware of the requirement.	Proponent	$3,000	$3,000

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
Water Quality					
	All oil and chemical storage tanks and areas where drums are stored will be surrounded by an impermeable bund. Single tanks will be within bunds sized to contain 110 per cent of capacity and multiple tanks or drums will be within bunds sized to contain 110 per cent of the capacity of the largest tank. Permanently fixed taps, filler pipes, pumping equipment, vents and sight glasses will also be located within the bunded area. Taps and valves will be designed to discharge downwards and will be shut and locked in that position. Manually started electrically operated pumps will remove surface water collected within the bund and its composition will be verified prior to disposal. (for maintenance of the system)	Part of plant design and requirement of EPC Contract	Contractor/ proponent	$500 (one off payment)	N/A
	An oily waste water drainage system will drain all areas where oil spillages could occur. The design will incorporate oil interceptors and traps. These will discharge with the other surface water discharge to the storm water discharge system. The discharge from each oil interceptor will contain no visible oil or grease.	Part of plant design and requirement of EPC Contract	Contractor/ proponent	Inherent in design no additional cost	N/A
	Disposal of the sludge from the evaporation ponds will be undertaken by an appropriate contractor and disposed of off-site at an appropriate disposal site.	Disposal to appropriate disposal site as necessary.	Proponent	$2,000	$2,000

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	Sludge removed in the oily waste separation pond will be removed by road tanker and disposed of at an appropriate disposal site.	Disposal to appropriate disposal site as necessary.	Proponent	$500	$500
	Waste water containing detergent will be discharged to the oily waste separation pond and oil separators prior to discharge to an on-site chemical waste water storage pond.	Part of plant design and requirement of EPC Contract	Proponent	$1,000	$1,000
	Collection pond will be appropriately bunded to ensure that no water leaches in to the ground.	Part of plant design and requirement of EPC Contract	Contractor	Inherent in design	N/A
	Emergency response plans will be developed for the leaking of any hazardous substances stored/used on-site.	Emergency response plans will be developed	Proponent	$10,000	N/A
	The plant will be designed taking into consideration the danger of flash floods. This may include such measures as construction of a diversion channel or berm surrounding the plant facilities.	Part of plant design and requirement of EPC Contract	Contractor	$70,000	N/A
	All elements of the treatment systems will be regularly monitored to ensure optimum performance and maintenance.	All elements of the treatment systems will be regularly monitored by the plant staff as necessary	Proponent	Part of best working practice	N/A
	Designated waste areas will be used to store the minimal amounts of waste (principally office wastes generated by the plant.	Part of plant design and requirement of EPC Contract	Proponent	$400	N/A
	Visual inspection of bunded areas will be made to ensure the effectiveness of these systems.	Visual inspection of bunded areas will be made.	Proponent	Part of best working practice	N/A

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	The inspection of oil interceptors will be undertaken on a regular basis.	Inspection of oil interceptors will be undertaken	Proponent	Part of best working practice	N/A
Noise and Vibration					
	Since tonal or impulsive noises are considered more annoying than continuous noise sources, plant items will be silenced or otherwise controlled through regular maintenance to ensure such emissions are minimised at NSR locations	Part of plant design and requirement of EPC Contract	Contractor	$2,000	$2,000
	High performance acoustic enclosures will be considered for plant items where practicable, not overlooking smaller plant items such as compressors and pumps	Part of plant design and requirement of EPC Contract if required	Contractor	$2,000,000	N/A
	Internal surfaces within the turbine hall will be treated to control internal reverberant noise levels. An appropriate treatment would consist of dense mineral wool panel behind perforated sheet steel, or a spray on cellulose fibre treatment	Part of plant design and requirement of EPC Contract	Contractor	$30,000	N/A
	Provisions to be put in place for the monitoring of noise at sensitive receptors (on and off-site) in the event that there is a complaint or reason for concern.	Monitoring in the event of complaint as necessary	Proponent	$500 (equipment purchase)	minimal
	Site walkover surveys and occasional noise monitoring at sensitive receptors will be undertaken as deemed appropriate	Site walkover surveys and occasional noise monitoring.	Proponent	(equipment purchase above)	minimal

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
Ecology and Biodiversity					
	The proponent will avoid any unnecessary removal of existing natural vegetation.	Environmental Manager will ensure that staff are made aware of the requirement as necessary.	Proponent	Part of best working practice	N/A
	Use of machinery will be restricted to the proposed site as will parking of vehicles.	Managers will ensure that staff are made aware of the requirement as necessary.	Proponent	Part of best working practice	N/A
	Any maintenance of vehicles or machinery will be performed off-site unless strictly necessary.	Environmental Manager will ensure that staff are made aware of the requirement as necessary.	Proponent	$2,000	$2,000
	The proponent will not allow workers to hunt or kill animals.	Environmental Manager will ensure that staff are made aware of the requirement as necessary.	Proponent	Part of best working practice	N/A
	The destruction of bird nests will be prohibited.	Environmental Manager will ensure that staff are made aware of the requirement as necessary.	Proponent	Part of best working practice	N/A
	The planting of exotic or invasive plants for landscaping inside and around the plant will be prohibited with a preference given to the planting of native species where landscaping is deemed necessary	Environmental Manager will ensure that staff are made aware of the requirement as necessary.	Proponent	Part of best working practice	N/A
	Disposal of domestic or industrial wastes will be to appropriate disposal sites.	Disposal of domestic or industrial wastes to appropriate disposal sites as necessary	Proponent	$2,000	$2,000
	No materials will be disposed of on-site and in the surrounding area especially at the near shallow wadies.	Environmental Manager will ensure that staff are made aware of the requirement. Any materials found will be removed	Proponent	$500	$500

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	Parking on areas outside the designated parking area will not be allowed unless strictly necessary.	Managers will ensure that staff are made aware of the requirement as necessary.	Proponent	Part of best working practice	N/A
	Directional lighting and buffer planting to screen the plant.	Part of plant design and requirement of EPC Contract	Proponent	$40,000	N/A
	Any accidents resulting in the death of wild life will be reported to the Ministry of Environment and RSCN.	Environmental Manager will ensure that staff are made aware of the requirement.	Proponent	Part of best working practice	N/A
Landscape and Visual					
	The architectural design of the buildings will be carefully considered to provide a high standard of visual amenity, given practical and economic constraints.	Part of plant design and requirement of EPC Contract	Contractor	Inherent in design	N/A
	The development generally will be in materials to match nearby buildings and particularly at upper levels colours will be neutral and subdued to provide the least visual intrusion and to minimize contrasts with the existing environment.	Part of plant design and requirement of EPC Contract	Contractor	$25,000	N/A
	The external structures of the buildings will be designed such that there will be no deterioration in the power station's appearance over the 30 years lifetime of the plant with steel structures of the plant painted with surface protected suitable for local conditions in accordance with the standards and practices of the Steel Structures Painting Council.	Part of plant design and requirement of EPC Contract	Contractor	$80,000	N/A
	Directional lighting will be employed to minimize light pollution.	Part of plant design and requirement of EPC Contract	Contractor	Inherent in design	N/A

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	Light will be switch off lights when not required for safety, security.	Staff will be made aware of this requirement by the management	Proponent	Part of best working practice	N/A
	Trees and bushes may be planted to provide screening for local receptors.	Part of plant design and requirement of EPC Contract	Proponent	$5,000	N/A
	Visual inspection will be made to check for any degradation of the power stations appearance.	Visual inspection will be made to check for any degradation of the power stations appearance.	Proponent	Part of best working practice	N/A
	Visual inspections will be made to ensure that plant wastes are not escaping to the surrounding environment.	Visual inspections will be made to ensure that plant wastes are not escaping to the surrounding environment.	Proponent	Part of best working practice	N/A
Transport and Infrastructure					
	Regular servicing and maintenance of vehicles will be undertaken to minimize emissions to air, noise, leaks etc.	As necessary	Proponent	$15,000 (period of contract)	N/A
	Safety training may be provided to vehicle drivers if considered necessary	As necessary	Proponent	$500	$500
	Transport of HFO and DFO to the site would endeavour to avoid the peak traffic congestion rush hours at 6:30 am and 4.30 pm to minimize the impact to the local traffic network.	Plant Manager to ensure compliance	Proponent	N/A	N/A
	Drivers will be instructed to obey all relevant speed limits and other relevant laws.	Drivers will be made aware of the requirement and complaints investigated	Proponent	N/A	N/A
Socio-economics					
	Labor law (No. 8,1996) will be applied and complied with throughout the duration of the project as necessary.	Managers will be made aware of the requirements of the law	Proponent	Part of best working practice Minimal cost	N/A
On-site Health and Safety					

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	Equipment, tools and substances will be suitable for their use and selected to minimize dangers to safety or health when used correctly.	Part of EPC Contract. Guidance and training will be provided on equipment use etc as necessary.	Contractor/ proponent	Equipment supplied by EPC see above tables	N/A
	Work places will where possible receive natural light and be supplemented with sufficient artificial illumination, and signage will appropriately mark hazards, exits, materials etc.	Part of plant design	Contractor	N/A	N/A
	Ventilation design factors will consider physical activity, substances in use and process related emissions. Temperatures will be maintained at levels appropriate for the purpose of the facility.	Part of plant design, then regulation of plant conditions though monitoring of temperatures	Proponent	$200	$200
	Fire prevention and protection will be adequate for the dimensions and use of the premises, equipment installed, physical and chemical properties of substances present, and the maximum number of people present. Fire detection and protection systems will be provided throughout the plant and site area. These will include fixed foam protection systems, fire alarms, portable appliances, etc. The plant will also store firewater sufficient to meet the requirements of the Jordan Fire Department and the local fire code requirements.	Part of plant design and best working practice, will be automatically applied	Contractor/ proponent	$300,000 (one off payment)	N/A

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	Places of work, traffic routes and passageways shall be kept free from waste and spillage, regularly cleaned, and maintained. First aid facilities will be provided and will be easily accessible throughout the place of work. Welfare facilities will include locker rooms, an adequate number of toilets with washbasins, and a room dedicated for eating. An ample supply of drinking water will be provided at all places of work.	Visual inspections will be made as necessary to ensure that facilities remain adequate	Contractor/ proponent	$10,000 (one off payment then part of best working practice)	N/A
	Buildings and structures will be designed according to local and internationally recognized standards. They will be structurally safe, provide appropriate protection against the climate and have acceptable light and noise conditions.	Part of plant design and requirement of EPC Contract.	Contractor	Inherent in design	N/A
	Personal protection equipment will be identified and provided, that will offer adequate protection to the worker, co-workers and occasional visitors without incurring unnecessary inconvenience. The use of PPE will be actively enforced if alternative technologies, work plans or procedures cannot eliminate or sufficiently reduce a hazard or exposure. The employer shall ensure that PPE is cleaned when dirty, properly maintained and replaced when damaged or worn out. Proper use of PPE shall be part of the recurrent training programs for employees.	Personal protection equipment will be identified and provided. The use of PPE will be actively enforced by site managers/foremen etc.	Proponent	$15,000 (initially then replaced as necessary)	$1000

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	Exposure to vibration from equipment will be controlled through selection of equipment and limitation of time of exposure. The limits for vibration and action values will conform to those provided by the IFC guidelines for OHS.	Exposure to vibration from equipment will be controlled through selection of equipment and limitation	Contractor/ Proponent	$50,000 (one off payment)	$1000
	Indoor temperatures will be maintained such that they are reasonable and appropriate for the work at site. Risks of heat related stress will be adequately addressed and feasible control measures implemented for work.	Part of plant design.	Contractor/ Proponent	$150,000 (one off payment then minimal additional costs)	$1000
	First aid facility adequately and appropriately stocked	Visual inspections and reordering of supplies as necessary	Proponent	$15,000 (one off payment then minimal additional operational costs)	$500
	A health and safety plan would be prepared with the aim of preventing accidents and injuries for both and construction and operation stages of the project.	A health and safety plan would be prepared	Contractor/ Proponent	$20,000 (one off payment)	N/A
	A training register for Employees would be maintained and kept up to date with evaluation of training sessions made.	A training register for Employees will be maintained	Proponent	Responsibility of Project Manager/ plant manager Zero cost	N/A
	Daily visual inspection of use of PPE equipment would be made.	Daily visual inspection by site managers/foremen etc	Proponent	Responsibility of safety Manager Zero cost	N/A
	A register of accidents on-site would be maintained with prevention training sessions held.	As necessary accidents will be registered.	Proponent	Responsibility of safety Manager (Zero cost)	N/A

Concern	Mitigation / Monitoring Measure	Implementation Procedure	Responsibility	Capital Cost	Re-Current Costs per Year
	Review site specific health and safety plan would be made on an appropriately regular basis.	Annual review by safety manager/officer	Proponent	$2000	$2000
Off-site Health and Safety					
	The plant will be located within a security fence ensuring to prevent trespass or accidental entry of the site by local peoples. The plant will also be fitted with security cameras	Part of EPC contract/plat design	Contractor/ Proponent	$500 for camera operation (fence part of EPC Contract)	$500
	The transport of raw materials and the transport and disposal of waste will be undertaken in an appropriate manner.	Best working practices will be applied and any complaints investigated.	Proponent	$2000	$2000
	Project vehicles and equipment will be well maintained with project-related traffic will be requested to travel no faster than the speed limit.	Staff will be made aware of the requirement. Preparation of traffic management plan will be made and consideration of any complaints as necessary	Proponent	Part of best working practice Minimal cost	N/A
	Accidents and incidents involving the public will be documented and reported to management.	As necessary	Proponent	Responsibility of Project Manager/ plant manager Zero cost	N/A
	A complaints register will be maintained as necessary.	As necessary	Proponent	Responsibility of Project Manager/ plant manager Zero cost	N/A

TABLE 7.8: ENVIRONMENTAL REPORTING TIMETABLE – OPERATION

Theme	***Report***	***Frequency***
Air	All emissions (NO_x, SO_2, CO, dust)	Annual
Water	Analysis of discharges from the site, inspections of bunded areas and treatment systems	Annual
Noise	Noise levels at nearest sensitive receptors	3 years
Waste	Amounts, transport options and disposal route (incl. recycling rates)	Annual

SECTION 8

INTERAGENCY, NGO AND PUBLIC CONSULTATION

8 INTERAGENCY, NGO AND PUBLIC CONSULTATION

8.1 Introduction

8.1.1 This Section summarizes the measures taken in order to facilitate the involvement of Government Ministries / Agencies, Non-Governmental Organizations (NGOs) and members of the general public in the ESIA process for the Power Project.

8.2 Scoping Exercise

8.2.1 The principle objectives of the Scoping Exercise were to:

- Identify the key environmental issues to be included in the ESIA;
- Identify the Legal Requirements and Framework for the Power Project over the course of its lifetime;
- Identify the relevant component studies to establish the relevant baseline for the Power Project;
- To finalize the proposed Terms of Reference (ToR); and
- Understand the concerns of the local community.

Scoping Methodology

8.2.2 The following methodology was followed to fulfil the objectives mentioned above:

- A decision was made by the Ministry of Environment (MoE) to conduct a formal Scoping Session for the purposes of the ESIA, in accordance win MoE ESIA Regulations.
- A list of relevant and potentially relevant stakeholders was prepared by the ESIA Team and the MoE.
- An Invitation Letter was issued by MoE, which included a date and place for the Scoping Session.
- The results of the Scoping Session were used to produce a Scoping Meeting Report and ToR for the Power Project.

Scoping Session

8.2.3 At the request of the MoE, a formal Scoping Session was held on the 31 July 2011 in the Holiday Inn Hotel, Amman in accordance with MoE ESIA Regulations.

8.2.4 The MoE invited relevant and potentially relevant stakeholders to the Scoping Session, including organizations from the public and private sectors in addition to NGO's and neighbouring residents. A Registration Form was used to collect the names of the stakeholders that attended the Scoping Session. The Registration Form is provided in Appendix A.

8.2.5 During the scoping session, members of the ESIA Team gave a presentation detailing the project activities, facilities, and processes. Graphics and diagrams were included in the presentation which highlighted the importance of the Power Project, and the potential environmental impacts and proposed methodology for the ESIA.

8.2.6 The participants were provided with a comments form to write down their concerns regarding the Power Project over the construction, operational and decommissioning phases. Sufficient time was allowed for comments to be made by all those who attended the Scoping Session. Copies of the comments were then provided to the ESIA Team such that they were able to prepare the Scoping Study, and subsequently carry out the ESIA.

8.2.7 The issues identified during the Scoping Session by the various attendees are summarized in the Tables below as functions of valued environmental components and proposed Power Projects phases identified (i.e. construction, operation and decommissioning).

PUBLIC HEALTH

Issue	*Construction*	*Operation*	*Decommissioning*
Stack emissions	√	√	√
Noise impacts	√	√	√
Solid waste	√	√	√
Wastewater treatment / impact	√	√	√
Hazardous materials handling & waste Impacts	√	√	√
Proximity to dwellings	√		
Dust impacts	√	√	
Disposal, Leakage of hazardous wastes	√	√	√
Gas pipeline installation / gas storage	√		
Storage tanks overflows / spills	√	√	
Thermal emissions		√	
Future impact on the area		√	
Impact of the plant on local population	√	√	
Vibration impacts	√		
Traffic impacts	√	√	
Geological risks	√		
Odour impacts		√	
Protection against sabotage of facilities		√	

WATER RESOURCES

Issue	*Construction*	*Operation*	*Decommissioning*
Wastewater disposal and its effect on groundwater	√	√	√
Quality and quantity of water resources for the plant needs	√	√	
Impact of wastes on groundwater	√	√	√
Water resources on the site	√	√	√
The need for treated wastewater reuse in irrigation		√	
Impact of the water consumption on the availability of water resources		√	
Water demand	√	√	
Impact of wastewater on the agricultural activities		√	
Impacts of works on sewage networks	√		

BIODIVERSITY

Issue	*Construction*	*Operation*	*Decommissioning*
Impacts on flora	√	√	√
Impact on birds from emissions and overall fauna	√	√	√
Impact on habitat	√	√	√
Agricultural activities	√	√	√
Access Roads impact	√	√	√
Rehabilitation of natural environment			√
Impacts on soil	√	√	√

SOCIO-ECONOMICS CONDITIONS

Issue	*Construction*	*Operation*	*Decommissioning*
Employment	√	√	
Constant consultation with the local community ensuring their approval	√	√	
Training/emergency training	√	√	
Analyze potential expansion of project	√	√	
Agriculture activity	√	√	
Transportation	√	√	√
Remediation of natural environment			√
Security of supply		√	
Economic future of the area and negative impact on the plant		√	
Impact on land use	√	√	√
Consenting with local government/municipalities	√		
Respecting property of the local population	√	√	

OCCUPATIONAL HEALTH AND SAFETY

Issue	*Construction*	*Operation*	*Decommissioning*
Medical care	√	√	√
Dust	√		√
Noise	√	√	√
Hazardous fumes	√	√	√
Accidents	√	√	√
Waste water	√	√	√
Solid waste	√	√	√
Industrial solid waste		√	
Emergency plan	√	√	√
Fire hazardous	√	√	√
Vibration		√	

8.3 Public Consultation

Consultation Methodology

8.3.1 The public consultation process was conducted by two methods.

1. House to house meetings with local people to explain the nature of the Power Project and its expected impacts and benefits.
2. Public meeting in Al-Manakher Village as part of the scoping process.

8.3.2 Al-Manakher Village was selected as the most appropriate location for the public consultation as it represents the nearest community to the Power Project site and, as a result, its residents will be the most affected.

8.3.3 Al-Manakher is a small village with a population of approximately 436 people who depend mainly on governmental jobs and agricultural activities for their livelihoods.

House to House Meetings

8.3.4 A Questionnaire was developed for house to house meetings, in order to examine the potential socio-economic impacts of the Power Project on the societies and economic performance. Also, a brief description of the Power Project was written as an introduction.

8.3.5 People who were unable to complete the Questionnaire (illiterate) were interviewed and their responses were recorded.

8.3.6 The Questionnaire used for the house to house meetings is provided in Appendix F.

8.3.7 The aim of the house to house meetings was to investigate and get the opinion of Al-Manakher residents toward the Power Project and explore how differences in livelihood, cultural and socio-economic conditions influence the attitude and perceptions of people in the community.

Analysis and Results

8.3.8 A sample of 15 houses out of approximately 35 houses (approximate numbers of Al-Manakher village houses) was obtained. 20 per cent of the interviewed residents were women.

8.3.9 The Questionnaire results showed that the residents close to the Power Project were unsatisfied due to the high level of noise generated from the existing IPP1. They expected that the same level of noise would be generated from the Power Project.

8.3.10 A breakdown of the questionnaire results are shown in Tables 8.1 to 8.7.

8.3.11 33.3 per cent of the interviewed residents think that the Power Project will increase employment opportunities in the area.

TABLE 8.1: PROBABILITY OF INCREASING JOB OPPORTUNITY

Cumulative Percent	*Percent*	*Frequency*	*Answer*
66.7	66.7	10	No
100	33.3	5	Yes
100	100	15	Total

8.3.12 85.7 per cent of the interviewed residents think that the Power Project will contribute in increasing the area prosperity and will encourage establishing of shops and new economic activities.

TABLE 8.2: PROBABILITY OF AREA PROSPERITY

Cumulative Percent	*Percent*	*Frequency*	*Answer*
14.3	14.3	2	No
100	85.7	12	Yes
100	100	14	Total

8.3.13 73.3 per cent of the interviewed residents think that the introduction of the Power Project to the area will reduce their land price.

TABLE 8.3: PROBABILITY OF INCREASING LAND PRICE

Cumulative Percent	*Percent*	*Frequency*	*Answer*
73.3	73.3	11	No
100	26.7	4	Yes
100	100	15	Total

8.3.14 35.7 per cent of the interviewed residents think that the introduction of the Power Project to the area will improve the water, electricity and telephone networks in the area.

TABLE 8.4: PROBABILITY OF IMPROVING THE WATER, ELECTRICITY AND TELEPHONE NETWORKS

Cumulative Percent	*Percent*	*Frequency*	*Answer*
64.3	64.3	9	No
100	35.7	5	Yes
100	100	14	Total

8.3.15 28.6 per cent of the interviewed residents think that the Power Project will raise their living standards.

TABLE 8.5: PROBABILITY OF INCREASING LIVING STANDARDS

Cumulative Percent	*Percent*	*Frequency*	*Answer*
71.4	71.4	10	No
100	28.6	4	Yes
100	100	14	Total

8.3.16 All of the interviewed residents think that if the company plants the empty areas around the Power Project, it would improve the landscape of the area.

8.3.17 50 per cent of the interviewed residents think that the Power Project will attract other industries and businesses to the area.

TABLE 8.6: PROBABILITY OF BRINGING OTHER INDUSTRIES AND BUSINESSES TO THE AREA

Cumulative Percent	*Percent*	*Frequency*	*Answer*
50	50	7	No
100	50	7	Yes
100	100	14	Total

8.3.18 Finally, 46.7 per cent of the interviewed residents support the construction of the Power Project.

TABLE 8.7: PERCENTAGE OF INTERVIEWED RESIDENTS WHO SUPPORT THE POWER PROJECT

Cumulative Percent	*Percent*	*Frequency*	*Answer*
53.3	53.3	8	No
100	46.7	7	Yes
100	100	15	Total

8.3.19 Based on the above, the issues and concerns are summarised as follows:

- Negative Concerns:
  - Dust emissions and noise during construction and operation of the Power Project which may negatively affect residents and their health.
  - Home cracks from construction and operation activities.
  - AES not giving priority of employment to the local community during the construction and operational phases.
  - Reducing the price of the land.
- Positive Issues:
  - The Power Project will attract other industries and businesses to the area.
  - The Power Project will help in raising the living standards for the residents of Al-Manakher Village and the surrounding areas.

Public Meeting

8.3.20 A public meeting was held at Al-Manakher village on August 4 2011 by the RSS Team and the AES Jordan Team. The meeting formed part of the scoping process and aimed to identify the concerns of the residents regarding the Power Project and the associated activities in relation to the major environmental and social aspects.

8.3.21 Approximately 75 people attended the public meeting including the Deputy Parliament of the area, Chairman of Al-Manakher Village and police station staff of Al-Manakher.

FIGURE 8.1: PARTICIPANTS WITH DEPUTY PARLIAMENT

8.3.22 An opening speech was given by the RSS Team describing the Power Project and its associated activities / facilities. After that, the participants were asked to identify their environmental / social issues and concerns related to all phases of the Power Project.

FIGURE 8.2: OPENING SPEECH BY THE RSS TEAM

8.3.23 According to the participants, the main issues and concerns from the existing IPP1 and the Power Project are:

- Decreasing the price of their land.
- Non-expansion of the village as no one wants to buy a land next to a power plant.
- Air pollution, especially when the Power Project uses diesel as a fuel.
- High levels of noise.
- Cracks in their buildings from construction and operation activities.
- Concern from some participants that discharge of treated wastewater outside the Power Project site boundary may cause problems to their livestock.
- There would be no recruitment / employment (for either skilled or unskilled labour) from the local community.
- Dissatisfaction of the contribution provided by the existing IPP1 Project Company to the local community (e.g. the provision of electricity subsidies).

FIGURE 8.3: PARTICIPANTS EXPLAINED THEIR ISSUES AND CONCERNS

8.3.24 Based on the outcomes of the Public Meeting, and in response to the issues and concerns raised by the participants, the following are the residents' requirements:

- Suitability of site location.
- Addressing and solving the noise problem.
- Stopping discharging the treated wastewater outside the Power Project site boundary.
- Providing the village with water directly from the company water pipeline.
- Supporting the Al-Manakher Village School by building three class rooms for the village girls.
- Purchasing air conditioners and water coolers for the Al-Manakher Village Mosque.
- Providing recruitment / employment opportunities for the local community.

8.3.25 Subsequent to the scoping sessions, a Scoping Meeting Report and ToR for the Power Project was undertaken by PB in August 2011.

8.3.26 The Scoping Meeting Report and ToR described the key environmental issues that, in PB's opinion, would require detailed evaluation as part of the ESIA process.

Conclusions of Public Consultation

8.3.27 It is considered that most of the Al-Manakher village residents now have a much better understanding of the Power Project, and the environmental and social impacts associated with the construction, operation and decommissioning phases.

8.3.28 In order to continue the good relationship established with the local community, the Consortium have nominated one of their local employees to act as a direct point of contact with the local community. It is hoped that this will afford the local community easy access to Consortium management to raise any concerns.

8.4 Compliance with Jordanian and World Bank / IFC Performance Standards and Guidance

8.4.1 As has been demonstrated in this ESIA, the Power Project fully complies with all relevant Jordanian Laws, Regulations and Standards, and World Bank / IFC Performance Standards and Guidance.

8.4.2 For clarity these are summarized in Table 8.8 and Table 8.9.

TABLE 8.8: COMPLIANCE WITH RELEVANT JORDANIAN LAW, REGULATIONS AND STANDARDS

Jordanian Law / Regulation / Standard	*Compliance / Rational*
Environmental Protection Law (No. 52, 2006)	Power Project Complies: The Power Project will not pose an unacceptable impact to the environment and complies with all relevant Jordanian legislation.
Environmental Impact Assessment Regulations (No. 37, 2005)	Power Project Complies: An Environmental and Social Impact Assessment has been undertaken for the Power Project.
Ambient Air Quality Standards (JS: 1140, 2006)	Power Project Complies: The Power Project will comply with all relevant Jordanian ambient air quality requirements
Water Authority Law (No. 18, 1988) and Underground Water Monitoring By-law (No. 85, 2002)	Power Project Complies: All water will be provided by WAJ with no water taken from other sources. No water will be released to sensitive surface or ground waters.
Instruction for Management and Handing of Consumed Oil for 2003	Power Project Complies: The Power Project will handle all waste oils in accordance with the instruction.
Jordanian Guidelines for the Prevention of Noise (2003)	Power Project Complies: The Power Project will comply with the criteria of the Guidelines.
Management of Solid Waste Regulations (No. 27, 2005)	Power Project Complies: The Power Project will ensure proper and appropriate handling of waste materials during the construction, operational and decommissioning phases.
Dimensions, Total Weights and Vehicles' Engine Horse Power By-law issued in accordance with Paragraph (a) from Article (19) and Article (64) from the Traffic Law (No. 49, 2008)	Power Project Complies: The Power Project will comply with the requirements of the law.
Agriculture Law (No. 44, 2002)	Power Project Complies: The Power Project will not include the removal of large areas of agricultural land from its current use or impact on these during construction or operation.
Labor Law (No. 8, 1996)	Power Project Complies: The Power Project will operate under the requirements of this law
Archaeology Law (No. 21, 1988)	Power Project Complies: No significant archaeological interests were identified at site.
Instructions for Hazardous Waste Management and Handling for 2003	Power Project Complies: The Power Project will ensure the proper storage and use of any hazardous substances to be used.
Management, Transport and Handling of Harmful and Hazardous Substances Regulations (No. 24, 2005)	Power Project Complies: The Power Project will ensure the proper storage and use of any hazardous substances. All hazardous waste will be transported from site by a licensed Waste Contractor.
Civil Defence Law (No. 35, 1999)	Power Project Complies: The Power Project will not pose a safety hazard to the general public.
Public Heath Law (No. 47, 2008)	Power Project Complies: The Power Project will not pose a health hazard to the general public.

Jordanian Law / Regulation / Standard	*Compliance / Rational*
General Electricity Law (No. 64, 2002)	Power Project Complies: The Power Project complies through the role of an IPP.
Regulation of the Organisation and Administration of the Ministry of Energy and Mineral Resources (No. 26, 1985)	Power Project Complies: The Power Project complies by supporting the NTS.

TABLE 8.9: COMPLIANCE WITH IFC PERFORMANCE STANDARDS

IFC Performance Standard	*Compliance / Rational*
Social and Environmental Assessment and Management Systems	Power Project Complies: An environmental assessment, and Environmental Mitigation and Monitoring Programme (EMMP) has been prepared for the Power Project. .
Labor and Working Conditions	Power Project Complies: No person will be harmfully or unwilling employed by the Sponsor.
Pollution Prevention and Abatement	Power Project Complies: The Power Project has considered technologies and practices (techniques) to reduce adverse impacts on human health and the environment while remaining technically and financially feasible and cost-effective.
Community Health, Safety and Security	Power Project Complies: Preventative measures have been employed in the Power Project design to ensure community, health, safety and security.
Biodiversity Conservation and Sustainable Natural Resource Management	Power Project Complies: The Power Project will not impact significantly on local habitats.
Cultural Heritage	Power Project Complies: No historic or culturally significant features were identified on the Power Project site.

8.5 Conclusions

8.5.1 The Consortium has allowed for full and proper public disclosure to Government Ministries / Agencies, NGOs and members of the general public in the ESIA process for the Power Project.

8.5.2 In addition, the Power Project fully complies with all relevant Jordanian Laws, Regulations and Standards, and World Bank / IFC Performance Standards and Guidance.

SECTION 9

CONCLUSION

9 CONCLUSION

9.1.1 Following the undertaking of the ESIA for the Power Project it is considered that the Power Project will not give rise to an unacceptable impact on the environment, in isolation, when considered against the existing background or in combination with the existing IPP1 plant.

9.1.2 To ensure that any adverse environmental impacts are minimised mitigation measures have been identified and where appropriate monitoring of environmental performance in both the construction and operational periods.

9.1.3 The Power Project has allowed for full and proper public disclosure to Government ministries/agencies, Non-Governmental Organisations and members of the general public in the ESIA process for the Power Project.

9.1.4 It has been found that the Power Project has been found to fully comply with the relevant Jordanian Laws, Regulations and Standards and the World Bank / IFC requirements.

9.1.5 In conclusion the construction and operation of the Power Project and associated infrastructure is considered to be environmentally acceptable.

APPENDIX A

SCOPING MEETING REGISTRATION FORM

برنامج الحلقة التشاورية

دراسة الأثر البيئي والاجتماعي
مشروع محطة توليد المناخر - شرق عمان
مزود الطاقة المستقل رقم (٤)

(الأحد: ٣١ / ٧ / ٢٠١١)

الرجاء كتابة الاسم والجهة باللغتين العربية والانجليزية

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.١٤				

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٢٣.				

APPENDIX B

PARTICIPANTS AT AL-MANKAHER VILLAGE SCOPING SESSION

List of Participants in Scoping Session held in Al-Manakher Village on August 4th, 2011

No.	Name
1.	Hani Metlag Salam Al-Bunian
2.	Anwar Salamah Al-Da'ajah
3.	Salamah Abdulkareem Salamah
4.	Assaf Abdulakareem Salamah
5.	Mohammad Suleiman Al-Bunian
6.	Nassar Mohammad Suleiman
7.	Ibrahim Hamdallah Suleiman
8.	Metlag Salamah Mnahi
9.	Nahar Menwer Al-Bunian
10.	Nayef Hamdallah Suleiman
11.	Nedal Daifallah Suleiman
12.	Abdullah Salamah Mnahi
13.	Meshweh Salamah Mnahi
14.	Hamed Ahmad Suleiman
15.	Maher Ahmad Suleiman
16.	Naser Ahmad Suleiman
17.	Mahmoud Nayef Hamdallah
18.	Mohammad Nayef Hamdallah
19.	Abdullah Nayef Hamdallah
20.	Saleh Hamdallah Suleiman
21.	Atallah Suleiman Al-Bunian
22.	Suleiman Atallah Suleiman
23.	Rami Metlag Salamah
24.	Mohammad Assaf Abdulkareem
25.	Mohammad Daifallah Mohammad

No.	Name
26.	Ziad Hani Metlag
27.	Ahmad Suleiman Mnahi
28.	Reyad Ahmad Suleiman
29.	Shadi Mohammad Salamah
30.	Fadi Mohammad Salamah
31.	Mohammad Noweran Al-Da'ajah
32.	Awwad Salamah Mnahi
33.	Ala'a Metlag Salamah
34.	Yousof Hamdallah Suleiman
35.	Abdulkareem Al-Bunian
36.	Abdulhameed Hamdallah Suleiman
37.	Sami Hamallah Suleiman
38.	Mahmoud Hamdallah Suleiman
39.	Hamzah Abdulhameed Hamdallah
40.	Ali Noweran Al-Da'ajah
41.	Marzouq Ali Noweran
42.	Awwad Ali Noweran
43.	Mohammad Hamdan Suleiman
44.	Anwar Abdulkareem Al-Bakheet
45.	Ahmad Abdulkareem Al-Bakheet
46.	Abdulkareem Hamdallah Suleiman
47.	Hatem Abdulkareem Hamdallah
48.	Awdallah Mohammad Suleiman
49.	Daifallah Mohammad Suleiman
50.	Hasan Al-Horani
51.	Zyhair Aref

No.	Name
52.	Mohammad Awdallah Mohammad
53.	Ahmad Abulkareem Hamdallah
54.	Metlag Salamah Al-Nweran
55.	Fares Metlag Salamah
56.	Thamer Assad Abdulkareem
57.	Mohammad Metlag Salamah
58.	Husain Hamdallah Suleiman
59.	Mansour Mohammad Suleiman
60.	Malek Awdallah Mohammad
61.	Muhannad Abdulakreem Salamah
62.	Hayel Mohammad Nweran
63.	Mekhled Mohammad Nweran
64.	Husam Mohammad Nweran
65.	Isam Mohammad Salamah
66.	Awdah Salem Al-Mnahi
67.	Awwad Salem Al-Mnahi
68.	Sami Metlag Salamah
69.	Ayman Awwad Salamah
70.	Ahmad Awwad Salamah
71.	Affash Abdulkareem Salamah
72.	Hani Husain Salem
73.	Mohammad Mosa
74.	Rafat Assi
75.	Mohammad Abdulhaleem
76.	Khaled Salamah
77.	Khaled Othman

No.	Name
78.	Feras Hammad

APPENDIX C

NOISE MEASUREMENT LOCATION

N
W E
S

Legend

- Site Boundary
- Noise Monitoring Locations
- 11 School
- 12 13 Noise Sensitive Receptors

• PROJECT	IPP4 Power Project		
• TITLE	Noise Measurements Location		
• DATE	01.07.2011	• DRAWN BY	LS
• SCALE	NTS	• PRODUCED BY	LS
• CAD REF	-------	• CHECKED	MW
		• APPROVED	MW

PB PARSONS BRINCKERHOFF 125 YEARS

Parsons Brinckerhoff
Amber Court, William Armstrong Drive, Newcastle upon Tyne, NE4 7YQ
Tel: +44-(0)-191-226-1234 Fax: +44-(0)-191-226-2345

• DRAWING NUMBER APPENDIX C

APPENDIX D

NOISE MONITORING FORMS

Day time measurements 26,27,28-06-2011

Points	Coordinates (UTM)	Description	Day Time	Type of noise heard	Dominanat noise source	Variability of noise source	Noise Level (dB(A)) L aeq	L max	L min
1	*E223887, N3532808*	southern corner of AES	**11:24 - 11:29** **11:29 - 11:34** **11:34 - 11:39**	passarine birds, fin fan, paving machines, corona from NEBCO	fin fan and paving machines	continous fin fan	**58.6** **58.6** **60.4**	**67.0** **68.5** **73.2**	**56.2** **54.9** **54.7**
2	*E223817, N3532597*	close to NEBCO wall	**15:17 - 15:22** **15:22 - 15:27** **15:27 - 15:32**	passarine birds, fin fan, paving machines, corona from NEBCO, fuel tanks	fin fan and paving machines	continous fin fan and paving machines	**52.2** **52.2** **49.1**	**72.4** **61.1** **56.8**	**46.7** **45.9** **44.8**
3	*E223797, N3532597*	close to NEBCO wall	**15:42 - 15:47** **15:47 - 15: 52** **15:52 - 15:57**	fin fan, gas turbine, cock sound	gas turbine and fin fan	continous fin fan and gas turbine	**53.1** **57.6** **57.6**	**61.2** **69.3** **68.0**	**49.3** **50.3** **50.6**
4	*E223590, N3532683*	close to house 10 m	**14: 56 - 15:01** **15:01 - 15: 06** **15:06 - 15:11**	fin fan, gas turbine,fuel tanks inside AES, cars, passarine birds	gas turbine and fin fan	continous fin fan and gas turbine	**52.5** **49.4** **57.4**	**67.9** **84.7** **80.2**	**43.5** **42.4** **46.4**
5	*E223606, N3532722*	fence of existing power station	**14:38 - 14:43** **14:43 - 14:48** **14:48 - 14:53**	gas turbine, cars, passarine birds	gas turbine and fin fan	continous fin fan and gas turbine	**56.3** **58.5** **65.5**	**74.2** **74.9** **83.1**	**45.2** **45.8** **48.9**
6	*E223507, N3532756*	close to gas line 100 m close to AES fence 50 m	**16:48 - 16:53** **16:53 - 16:58** **16:58 - 17:03**	gas turbine, cars, paving machines	gas turbine	continous gas turbine	**57.0** **54.1** **55.3**	**72.8** **62.2** **63.9**	**45.4** **46.2** **49.9**
7	*E223511, N3532772*	close to the southern fence of AES 33 m close to residential area 70 m close to the fuel tanks of AES 120 m close to the gas line 60 m	**16:58 - 17:03** **17:03 - 17:08** **17:08 - 17:13**	gas turbine	gas turbine	continous gas turbine	**58.9** **56.9** **61.9**	**70.4** **64.8** **69.6**	**52.6** **50.5** **56.2**
8	*E223459, N3532788*	close to gas line 100 m close to AES fence 50 m	**19:50 - 19:55** **19:55 - 20:00** **20:00 - 20:05**	gas turbine,sheep sound, air traffic	gas turbine	constant	**50.8** **50.8** **49.2**	**59.5** **61.0** **59.5**	**43.5** **43.9** **43.6**
9	*E223447, N3532804*	the land corner was not appear clearly, since back fill covers the land corner, AES representitive determine the approximate locations of each corner rods	**19:34 - 19:39** **19:39 - 19:44** **19:44 - 19:49**	cars	cars	constant	**49.0** **54.5** **55.9**	**64.4** **77.7** **69.8**	**41.1** **44.2** **49.5**
10	*E223513, N3532927*	close the fuel tanks of AES	**19:09 - 19:14** **19:14 - 19:19** **19:19 - 19:24**	gas turbine, passarine birds,cars	gas turbine, cars	constant	**53.9** **54.1** **54.0**	**63.4** **67.1** **64.6**	**46.5** **44.7** **48.4**

Night Measurements 26,27,28/06/2011

Points	Coordinates (UTM)	Description	Night Time	Type of noise heard	Dominanat noise source	Variability of noise s	Noise Level (dB (A)) L aeq	L max	L min
1	*E223887, N3532808*	southern corner of AES	22:15 - 22:20 22:20 - 22:25 22:25 - 22:30	passerine birds, fin fan corona, paving machines	fin fan paving machines	continous fin fan	58.6 58.6 60.4	67.0 68.5 73.2	56.2 54.9 54.7
2	*E223817, N3532597*	close to NEBCO wall	21:34 - 21:39 21:39 - 21:44 21:44 - 21:49	fin fan, NEBCO, gas turbine, passarine birds, fuel tanks, paving	fin fan corona from NEBCO	continous NEBCO, fin fan, gas turbine	55.3 52.4 49.6	63.4 58.1 56.4	51.1 50.5 47.8
3	*E223797, N3532597*	close to NEBCO wall	20:34 - 20:39 20:39 - 20:44 20:46 - 20:51	dog barking, fin fan, gas turbine, NEBCO,air traffic	fin fan gas turbine corona from NEPCO	continous fin fan, NEBCO and gas turbine	52.1 53.0 53.8	57.9 69.1 61.9	50.5 49.8 49.4
4	*E223590, N3532683*	close to house 10 m	21:11 - 21:16 21:16 - 21:21 21:21 - 21:26	dog barking, fin fan, gas turbine, cars	fin fan gas turbine	continous fin fan and gas turbine	59.3 51.1 52.7	70.0 58.3 54.6	49.3 47.9 50.6
5	*E223606, N3532722*	fence of existing power station	21:20 - 21:25 21:25 - 21:30 21:30 - 21:35	dog barking, fin fan, gas turbine	fin fan gas turbine	continous fin fan and gas turbine	61.6 63.4 52.5	74.7 75.6 61.2	45.2 45.8 48.9
6	*E223507, N3532756*	close to gas line 100 m close to AES fence 50 m	20:50 - 20:55 20:55 - 21:00 21:00 - 21:05	Gas turbine,Dogs Barking	Gas Turbine	constant	49.8 52.1 47.5	61.8 61.0 54.4	44.5 46.3 42.6
7	*E223511, N3532772*	close to the southern fence of AES 33 m close to residential area 70 m close to the fuel tanks of AES 120 m close to the gas line 60 m	20:31 - 20: 36 20:36 - 20: 41 20:41 - 20:46	Gas turbine,Dogs Barking,sheep sound	Gas Turbine	continous gas turbine	51.1 50.3 48.5	65.3 68.7 59.8	43.5 41.5 42.4
8	*E223459, N3532788*	plowed land close to the gas line 10 m close the to the residential area 100 m	20:15 - 20:20 20:20 - 20:25 20:25 - 20:30	Gas turbine, Dogs Barking, cars	Gas Turbine	continous gas turbine	46.1 48.5 50.1	52.8 64.0 60.6	42.0 40.1 41.2
9	*E223447, N3532804*	the land corner was not appear clearly, since back fill covers the land corner, AES representitive determine the approximate locations of each corner rods	21:09 - 21:14 21:14 - 21:19 21:19 - 21:24	Gas turbine, Dogs Barking, cars	Gas Turbine	constant	48.4 48.2 47.7	61.2 60.9 57.5	40.0 44.2 43.4
10	*E223513, N3532927*	close the fuel tanks of AES	21:28 - 21:34 21:34 - 21:39 21:39 - 21:44	Gas turbine,Dogs barking, cars, alghbawy landfill vehicles (from transfer station to the landfill	Gas Turbine Alghbawy landfill vehicles (from transfer station to the landfill)	continous gas turbine	46.3 46.9 46.5	52.4 53.2 50.1	43.6 44.9 44.5

Table (1): Long term continuous noise measurements at Amman East Power Plant Extinsion Project conducted on 30 / 5 / 2011

Date	Time	Measured Noise Levels (dB (A))
30/05/2011	00:00 - 01:00	66.5
	01:00 - 02:00	66.2
	02:00 - 03:00	65.9
	03:00 - 04:00	65.7
	04:00 - 05:00	65.4
	05:00 - 06:00	65.2
	06:00 - 07:00	64.9
	07:00 - 08:00	64.7
	08:00 - 09:00	64.6
	09:00 - 10:00	64.4
	10:00 - 11:00	64.2
	11:00 - 12:00	64.1
	12:00 - 13:00	63.9
	13:00 - 14:00	63.7
	14:00 - 15:00	63.8
	15:00 - 16:00	63.7
	16:00 - 17:00	63.5
	17:00 - 18:00	63.4
	18:00 - 19:00	63.3
	19:00 - 20:00	63.2
	20:00 - 21:00	63.1
	21:00 - 22:00	63.0
	22:00 - 23:00	62.8
	23:00 - 24:00	62.7

Cont. Table (1): Long term continuous noise measurements at Amman East Power Plant Extinsion Project conducted on 31/5/2011

Date	Time	Measured Noise Levels (dB (A))
31/05/2011	00:00 - 01:00	62.6
	01:00 - 02:00	62.5
	02:00 - 03:00	62.4
	03:00 - 04:00	62.3
	04:00 - 05:00	62.2
	05:00 - 06:00	62.1
	06:00 - 07:00	62.0
	07:00 - 08:00	62.0
	08:00 - 09:00	62.0
	09:00 - 10:00	61.9
	10:00 - 11:00	61.9
	11:00 - 12:00	61.8
	12:00 - 13:00	61.7
	13:00 - 14:00	61.7
	14:00 - 15:00	61.8
	15:00 - 16:00	61.8
	16:00 - 17:00	61.8
	17:00 - 18:00	61.9
	18:00 -19:00	61.8
	19:00 -20:00	61.8
	20:00 - 21:00	61.7
	21:00 - 22:00	61.6
	22:00 - 23:00	61.6
	23:00 - 24:00	61.5

Table (1): Long term continuous noise measurements at Amman East Power Plant Extinsion Project conducted on 01/06/2011

Date	Time	Measured Noise Levels (dB (A))
01/06 /2011	00:00 - 01:00	61.4
	01:00 - 02:00	61.4
	02:00 - 03:00	61.3
	03:00 - 04:00	61.2
	04:00 - 05:00	61.2
	05:00 - 06:00	61.1
	06:00 - 07:00	61.1
	07:00 - 08:00	61.0
	08:00 - 09:00	61.0
	09:00 - 10:00	61.0
	10:00 - 11:00	60.9
	11:00 - 12:00	61.4
	12:00 - 13:00	62.3
	13:00 - 14:00	63.4
	14:00 - 15:00	64.2
	15:00 - 16:00	64.7
	16:00 - 17:00	65.4
	17:00 - 18:00	65.7
	18:00 - 19:00	65.7
	19:00 - 20:00	65.6
	20:00 - 21:00	65.6
	21:00 - 22:00	65.5
	22:00 - 23:00	65.5
	23:00 - 24:00	65.4

Point	coordinates	Point Description	Time	Type of noises heard	Dominant noise source	Variability of noise source	Noise level [dB(A)]		
							L_{Aav}	L_{max}	L_{min}
12	**N 3532646** **E 223526**	• Nearest farm (northern corner) contains fruit trees • Nearest house at 40 m • Nearest camel and sheep shed • Resident area	Day	• cars • Passerine birds	nothing	constant	59.3	76.3	47.2
							57.1	74.1	46.6
							56.4	79.1	43.8
			Night	• cars	nothing	constant	60.2	77.3	47.2
							54.5	68.3	45.2
							54.4	68.7	44.8
13	**N 3532686** **E 223540**	• Nearest farm (southern corner) contains fruit trees • Nearest house at 40 m • Nearest camel and sheep shed • Resident area	Day	• camel and sheep shed • Passerine birds • Gas turbine in AES • dog barking	Gas turbine	Continuous gas turbine	63.1	72.8	55.7
							66.6	85.1	53.0
							66.7	82.0	53.4
			Night	• Gas turbine • dog barking	Gas turbine	Continuous gas turbine	57.7	76.4	48.7
							54.4	86.7	44.8
							57.2	79.2	43.2

APPENDIX E

STACK HEIGHT CALCULATION

HMIP Technical Guidance Note (Dispersion) D1
Guidelines on Discharge Stack Heights for Polluting Emissions

Fuel: Heavy Fuel Oil

Pollution Index

NO_x flow rate	D	89.85	g/s	SO_2 flow rate	D	75.96	g/s
NO_x emissions concentration	G_d	0.2	mg/m^3	SO_2 emissions concentration	G_d	0.35	mg/m^3
Assumed background NO_x concentration	B_c	0.15	mg/m^3	Assumed background SO_2 concentration	B_c	0.2625	mg/m^3

Pollution Index (P_i) = 1000 x D / (G_d - B_c)

Pollution Index (NO_x)	P_{i_NOx}	1797000	m^3/s	Pollution Index (SO_2)	P_{i_SO2}	868114.3	m^3/s

Total Pollution Index	P_{i_total}	2665114	m^3/s

Heat Release

Volumetric flow rate	V	240.99	m^3/s
Flue gas temperature	T_d	670.65	K

Heat Release (Q) = (V x (1 - (293 / T_d))) / 2.9*

Heat Release	Q	46.8	MW_{th}

Uncorrected Stack Height for Buoyancy

Uncorrected Stack Height for Buoyancy (U_b) = (10 ^ a) x (P_{i_total} ^ b)

For Q values > 1 MW_{th}	a	-1.427
	b	0.498

Uncorrected Stack Height for Buoyancy	U_b	60	m

Uncorrected Stack Height for Momentum

Stack Efflux Velocity	w	25	m/s

Momentum (M) = (293 / T_d) x V x w*

Momentum	M	2632	m^4/s^2

$\log_{10}$(Uncorrected Stack Height for Momentum (U_m)) = X + (y.$\log_{10}$(P_i) + Z)$^{0.5}$

	X	-0.675
	Y	3.766
	Z	-14.541

Uncorrected Stack Height for Momentum	Um	271	m

Final Corrected Stack Height

Lesser of Um and Ub	U	**60**	**m**
A = Um / Ub	A	4.52	
Building Height	H	20	m
Building Width	B	151	m
Lesser of Building Height and Width	K	20	m

Height of Disturbed Flow over Building (T) = H + (1.5 x K)

	T	50	m

Final Corrected Stack Height (C) = H + (0.6 x (U + (((2.5 x H) - U)(1 - (A ^ (-U / H))))))*

Corrected Stack Height	**C**	***Only used where U < 2.5 x H_{max}***

* Ambient temperature assumed as 20°C / 293 K

HMIP Technical Guidance Note (Dispersion) D1
Guidelines on Discharge Stack Heights for Polluting Emissions

Fuel: Distillate Fuel Oil

Pollution Index

NO_x flow rate	D	85.20	g/s	SO_2 flow rate	D	72.03	g/s
NO_x emissions concentration	G_d	0.2	mg/m^3	SO_2 emissions concentration	G_d	0.35	mg/m^3
Assumed background NO_x concentration	B_c	0.15	mg/m^3	Assumed background SO_2 concentration	B_c	0.2625	mg/m^3

Pollution Index (P_i) = 1000 x D / (G_d - B_c)

Pollution Index (NO_x)	P_{i_NOx}	1704000	m^3/s	Pollution Index (SO_2)	P_{i_SO2}	823200	m^3/s

Total Pollution Index	P_{i_total}	2527200	m^3/s

Heat Release

Volumetric flow rate	V	230.14	m^3/s
Flue gas temperature	T_d	670.65	K

Heat Release (Q) = (V x (1 - (293 / T_d))) / 2.9*

Heat Release	Q	44.7	MW_{th}

Uncorrected Stack Height for Buoyancy

Uncorrected Stack Height for Buoyancy (U_b) = (10 ^ a) x (P_{i_total} ^ b)

For Q values > 1 MW_{th}	a	-1.424	
	b	0.498	
Uncorrected Stack Height for Buoyancy	U_b	59	m

Uncorrected Stack Height for Momentum

Stack Efflux Velocity	w	25	m/s

Momentum (M) = (293 / T_d) x V x w*

Momentum	M	2514	m^4/s^2

$\log_{10}$(Uncorrected Stack Height for Momentum (U_m)) = X + (y.$\log_{10}$(P_i) + Z)$^{0.5}$

X	-0.691	
Y	3.778	
Z	-14.499	
Uncorrected Stack Height for Momentum	Um	265	m

Final Corrected Stack Height

Lesser of Um and Ub	U	**59**	**m**
A = Um / Ub	A	4.49	
Building Height	H	20	m
Building Width	B	151	m
Lesser of Building Height and Width	K	20	m

Height of Disturbed Flow over Building (T) = H + (1.5 x K)

	T	50	m

Final Corrected Stack Height (C) = H + (0.6 x (U + (((2.5 x H) - U)(1 - (A ^ (-U / H))))))*

Corrected Stack Height	**C**	***Only used where U < 2.5 x H_{max}***

* Ambient temperature assumed as 20°C / 293 K

APPENDIX F

AL-MANAKHER VILLAGE CONSULTATION QUESTIONNAIRE

الجمعية العلمية الملكية
Royal Scientific Society

الجمعية العلمية الملكية
الاستشارات والمشاريع البيئية
قسم دراسات الإدارة البيئية

دراسة الأثر البيئي والاجتماعي
"مشروع محطة توليد المناخر - شرق عمان
مزود الطاقة المستقل رقم (4) / مشروع الطاقة "

01	محافظة	
02	لواء	
03	قضاء	
04	التجمع السكاني	

وصف المشروع

المشروع المقترح عبارة عن بناء محطة لتوليد الكهرباء بطاقة 200 - 250 ميغاواط، يقع المشروع بمحاذاة موقع محطة الطاقة الموجودة مزود الطاقة المستقل رقم (1).

تنبع أهمية هذا المشروع إلى الحاجة المتزايدة للكهرباء داخل الأردن نظراً لازدياد السكان والحركة العمرانية والصناعية.

سوف يعمل المصنع في الأوضاع الاعتيادية عن طريق حرق الوقود الثقيل والديزل، مع وجود خيار لاستعمال الغاز الطبيعي عن طريق مزود الطاقة المستقل رقم (1) عندما يصبح الغاز متوفراً.

سيتم تزويد المياه إلى موقع المشروع من قبل سلطة المياه الأردنية عن طريق اتفاقية خاصة بذلك.
آثار المشروع سوف تنعكس بصورة إيجابية على سكان المناطق المجاورة وبالأخص سكان قرية المناخر، من خلال ما يلي:

- سوف يتوفر خلال مرحلة إنشاء المشروع 600 - 700 فرصة عمل و 40 -50 فرصة عمل دائمة خلال مرحلة التشغيل.
- سوف يزداد الطلب على المواد الإنشائية، والتموينية، وقطع الغيار للشاحنات والسيارات، والتي سوف تؤمن من المناطق المجاورة.
- نظراً لوجود المحطة في قرية المناخر فان هذا سيؤدي إلى تطور البنية التحتية للقرية.,

وأخيراً نتقدم بالشكر الجزيل على تعاونكم، وسوف يتم اخذ جميع أرائكم وملاحظاتكم المدونة في الاستبانة بعين الاعتبار.

الاسم (اختياري) :.....
الوظيفة :.....

الجنس : ☐ **ذكر** ☐ **أنثى**

الوضع الاجتماعي: ☐ **أعزب** ☐ **متزوج**

المستوى العلمي: ☐ **ابتدائي** ☐ **ثانوي** ☐ **جامعي** ☐ **غير ذلك**

---

1. كم هو عدد أفراد أسرتك؟.....

2. باعتقادك هل سيساهم هذا المشروع بزيادة فرص العمل في المنطقة ؟
   - ❒ نعم
   - ❒ لا

3. باعتقادك هل سيساهم المشروع بازدهار المنطقة (سيساعد على وجود محلات ونشاطات اقتصادية جديدة) ؟
   - ❒ لن يساهم
   - ❒ يساهم إلى حد ما
   - ❒ يساهم جداً
   - ❒ لا اعرف

4. هل تتوقع بأن وجود المحطة بالقرب من قرية المناخر سيزيد من سعر الأراضي في المنطقة؟
   - ❒ نعم
   - ❒ لا

5. هل تتوقع بأن وجود المحطة بالقرب من قرية المناخر سيحسن شبكة المياه والكهرباء والهاتف في المنطقة؟
   - ❒ نعم
   - ❒ لا

6. باعتقادك هل سيساعد المشروع في رفع مستوى المعيشة لدى سكان المنطقة والمناطق المجاورة؟
   - ❒ نعم
   - ❒ لا

7. إذا تم زراعة المساحات الخالية في المحطة هل تتوقع ان تحسن المنظر الجمالي للمنطقة؟
   - ❒ نعم
   - ❒ لا

8. هل تتوقع أن أقامة المشروع سوف يعمل على تطوير المنطقة وجذب رؤوس الأموال والمشاريع للمنطقة مما سيكون له اثر ايجابي في زيادة فرص العمل لسكان المنطقة والمناطق المجاورة؟

- ❒ نعم
- ❒ لا

9. هل تؤيد وجود مثل هذا المشروع ؟

- ❒ نعم
- ❒ لا

10. اذكر أهم القضايا البيئية والاجتماعية والاقتصادية والصحية الايجابية والسلبية التي قد يسببها المشروع ؟

الايجابية

.....
.....
.....
.....

السلبية

.....
.....
.....
.....

شاكرين لكم حسن تعاونكم