



RISK MANAGEMENT PLAN

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1 INTRODUCTION

1.1 Why Manage Risks?

There are straightforward moral, legal and business reasons for managing health, safety and environment (HSE) risks in the workplace. Not anyone who has ever experienced a serious accident at work, or the death of a work colleague in an accident, or a widespread environmental contamination, will need to be persuaded of the need. In addition, federal and local authorities set forth regulatory requirements to ensure the safety and clean operations of any business.

There are strong legislative drivers worldwide today that require companies to manage their work activities safely. This now includes the activities of company directors who are obliged to understand and manage the risks affecting their company. Under new safety legislation for major hazard industries (like oil and gas exploration and production) it is now common that a company is required to demonstrate that it has a management system that reduces workplace risks to an acceptably low level. In the event of an accident, a company will need to show that, at a minimum, it was following its own management system.

Finally, there are very good business reasons for managing risks because accidents cost money and can ultimately lead to the downfall of a company through damage to reputation and loss of customer and shareholder support. This document focuses in safety and risk management, refer to the Vista Project Occupational Health and Safety (OHS) Plan.

1.2 Why Risk Management?

It is not enough simply to assess risks. The whole point of risk assessment is to establish what the problem is and how serious it is so that decisions can then be made about allocating resources to the problem. As soon as we introduce the notions of decision-making and resource allocation, it becomes obvious that we need to have a process that will allow us to manage these things in a consistent and equitable way

2 RISK MANAGEMENT

The practice of risk management is now well established in a number of major hazard industries (nuclear power, petrochemicals, aerospace). At heart, it follows the standard management process of Plan-Do-Check-Improve.

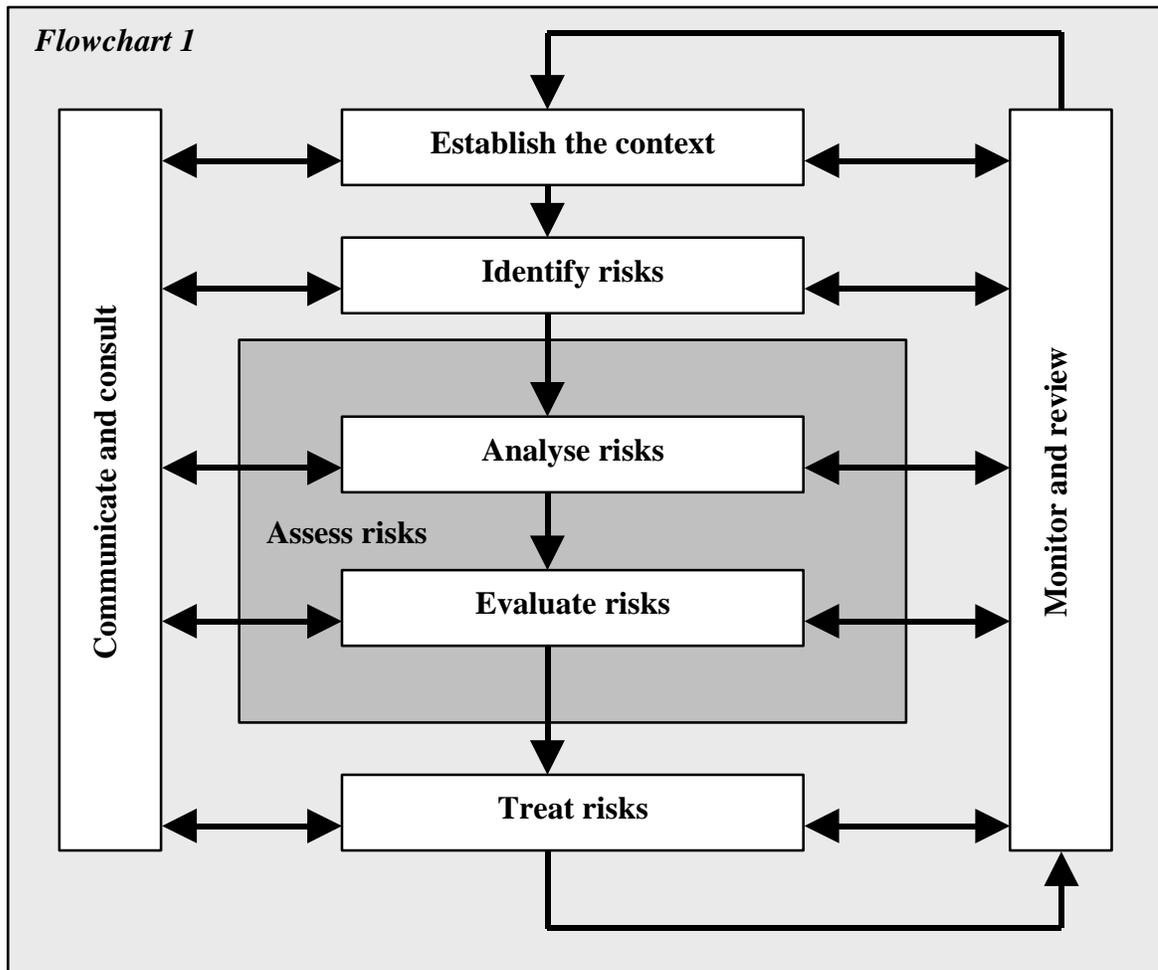
A good outline of the risk management process may be found in the following documents:

- AS 4360:1999 – Risk Management [1]; and
- HS(G)65: Managing for Health and Safety (HSE Books) [2]

The flowchart in

Figure 2.1 below is to be found in both of the referenced standards.

Figure 2.1: Risk Management Process



It can be seen that there are three essential processes shown in the flowchart. The central process addresses the assessment and management of risks. The other two processes provide the review/checking and continuous improvement/feedback loops. The consistent application of the risk management process allows, through the lifecycle of the facility:

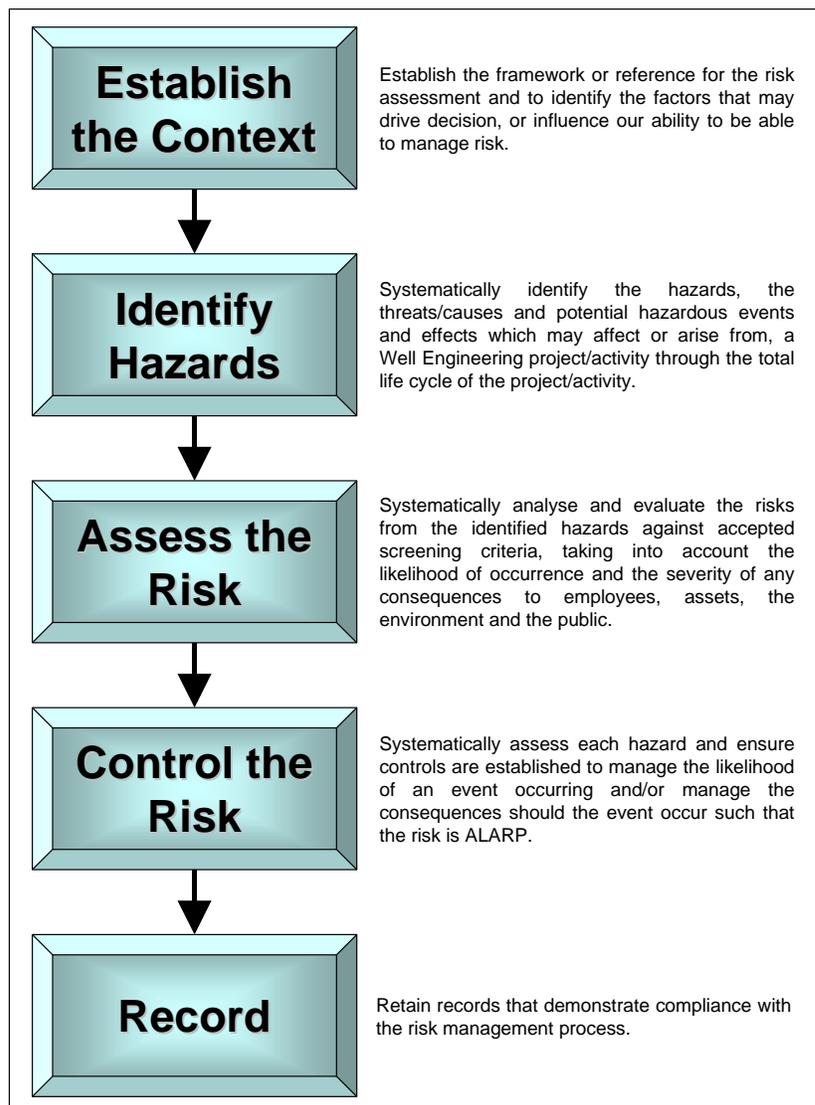
- Comprehensive identification of hazards and existing controls,
- Risk ranking of credible major accident hazard scenarios,
- Listing and assessment of adequacy of existing preventive and mitigation controls,
- Identification of further needs, for example specialized or quantitative safety and risk studies to assess and reduce risk,
- Following status and adequate closure of safety and risk study recommendations
- Decision making and tracking of risk reduction measured and their effectiveness , application of lessons learned
- Demonstration of hazards and risk good management, due diligence and operations per the “as low as reasonably practicable” concept (refer to Section 6)

3 THE BASICS

3.1 Risk Management Process

The basic risk management process is illustrated in the diagram presented in Figure 3.1. The process is well known and may be found in a similar form irrespective of where it is used. It is widely used throughout fields such as insurance, corporate finance, safety, environment, business process, sports, military and medicine although there are different flavors, or ways of delivering this process.

Figure 3.1: Risk Management Process



Properly executed, risk assessment and management processes are excellent means of understanding the risks faced by a project / operation and improving its performance.

In simplistic terms, risk management really consists of answering the questions:

- What can go wrong / right?
- How bad / good can it be?
- What can we do about it?

3.2 Setting the Context

Establishing the context is arguably the most important part of the risk management process as it 'sets the scene' for the remainder of the process. The goals, objectives, scope and boundaries of the activity, or project, to which the risk process is being applied need to be determined. Considerations may include:

- What project / activity are we looking at?
- Are we looking at health, safety, environment, all three or other things as well?
- Are we assessing these risks at Site, Project, Business Group or Company level?
- What phase of the business or project life cycle is being assessed?
- How are we going to break down the project / activity into sensible parts?
- What project / activity life are we looking at – activity / 1 year / whole life?

3.3 Records

Records should be as comprehensive as is practically possible, and should commence early in the risk management process. In many instances, they will be referred to sometime after the workshop has been completed. In these cases, it can be difficult to follow the 'logic' of the risk assessment in retrospect. Therefore, notes and comments are very useful, but require discipline to capture during the workshop proceedings.

Workshop results are commonly recorded and maintained in a Project Hazard Register. A sample Hazard Register template is shown in Attachment 1 - HAZID TOR.

It is often the case that an ad-hoc record is created using a word processing package or a spreadsheet; these are perfectly acceptable providing that they capture the right information.

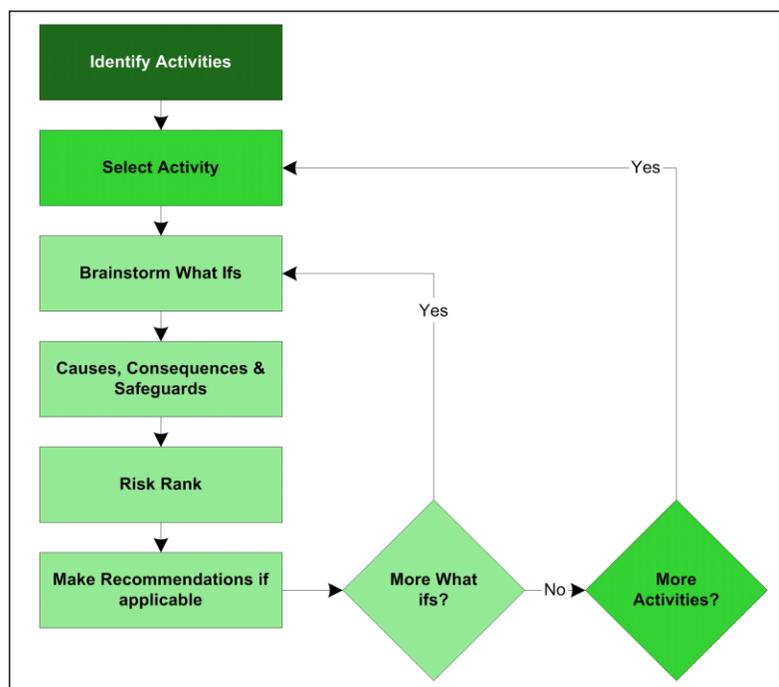
4 HAZARD IDENTIFICATION

4.1 HAZID Basics

Once Context has been set, including understanding the facility basis of design and process safety information, hazard identification is the first step in the risk management process and probably the most important. It involves identifying hazards, threats, causes, potential hazardous events and effects [3][4][5][6]. Hazards are typically identified by convening a workshop attended by experienced personnel from within the company and risk management specialists. The regulatory authority may well attend in an observer capacity.

The planned activities are systematically examined for potential hazards and accident events using a brainstorming method in conjunction with a standard "What if" analysis. The process is illustrated in the figure below, and a more detailed Terms of Reference (TOR) document for such a study is presented in Attachment 1 - HAZID TOR.

Figure 4.1 : Hazard Identification Process



If the activities are routine and well understood (such as in normal operations for example) then it is more appropriate and effective to use the hazard identification workshop as a verification exercise. In these circumstances, the hazard identification worksheet can be pre-populated with details of generic hazards and barriers. The workshop can then confirm the relevance of each generic hazard, verify that the appropriate barriers are in place and then focus team efforts on the specifics of that activity or project to reveal any further safeguards or barriers that might be appropriate.

Figure 4.2: Sample Hazards Check List

Hazardous, Combustible, Flammable and Toxic Hazards	Dropped Objects and Mechanical Handling	Fire and Explosion	Dynamic Hazards	Occupational
Hydrocarbon release	Dropped objects	Fire / Explosion	Line of fire	Noise, vibration
Hazardous materials release	Swinging loads	Hot surfaces	Collision	Procedures followed incorrectly
Chemical spill	Snagged equipment	Hot work	Compressed or tensioned object	Impaired escape during emergency
Fuel spill	Traversing hydrocarbon equipment	Confined area	Moving or rotating parts	Night operations, low visibility
H ₂ S exposure		Static energy	Flying debris	Communications failure
		Reactive hazards	Stored energy	Inadequate PPE

Hazardous, Combustible, Flammable and Toxic Hazards	Dropped Objects and Mechanical Handling	Fire and Explosion	Dynamic Hazards	Occupational
				Inadequate safety equipment
				Confined space entry
				Over-exertion
				Odd positioning
				Repetitive movement
				Alarm overload
				Inadequate human-machine interface

4.2 Hazard Register

A hazard register is the primary product of HAZID and an effective tool to continuously assess hazards and risk, follow up implementation of measures, and identify new hazards associated with project management of change. It is an evergreen document and evolves with the project as it advances and matures in development. The hazard registers are facility specific and can be set up by type of facility with similar inherent hazards (e.g., a HAZID Register for each of these: well fluids gathering, oil treatment, compression station, pumping station, pipeline system, and power plant). A sample Hazard and Risk Register template is presented in Attachment 1 - HAZID TOR.

4.3 Hazards and Operability (HAZOP) Studies

Hazard and Operability (HAZOP) Studies is a team workshop based analysis to identify potential process safety and environmental hazards and major operability problems. HAZOP is one of the techniques specifically mentioned in some regulations and is generally accepted as one of the preferred hazard identification methodologies in the chemical and petroleum industries.

HAZOP is a methodology used in design and operations to provide a rigorous design integrity assurance process. It is applicable to both major projects and existing operations. HAZOP is a key hazard identification technique because of its systematic approach.

The HAZOP technique was originally developed as a hazard identification tool for chemical processing and petroleum industries. Over recent years, the study areas examined have broadened and the HAZOP process is currently recognized as a suitable technique for application to the following systems and sequences:

- Fluid medium or other material flow (e.g. HAZOP study of process flowlines and vessels)
- Software applications including programmable electronic systems (e.g. HAZOP study for basic process control systems – sometimes referred to as a Control HAZOP)
- Examination of different operating sequences and procedures (e.g. HAZOP study for batch operation or for operating, maintenance, shutdown, sampling or testing procedures – sometimes referred to a Procedural HAZOP)
- Systems involving the movement of people by transport modes such as road and rail

The process is illustrated in more detailed in the Terms of Reference document for such a study presented in Attachment 2 - HAZOP TOR

5 ASSESSING RISK

5.1 Overview

Risk assessment generally involves analyzing hazard consequences and likelihood to generate risk estimates, allowing for the effects of the existing barriers or safeguards. These risks are then evaluated against accepted tolerability standards. Risk assessment can be either qualitative or quantitative and involves similar basic steps:

- Select a hazardous event;
- Identify causes for that event;
- Estimate event frequency;
- Determine the consequences of the event;
- Identify Prevention Barriers and estimate the contribution made to risk reduction;
- Identify Mitigation Barriers and estimate the contribution made to risk reduction; and
- Rank or estimate risk as the product of likelihood and consequence.

5.2 Risk Analysis

The objectives of the analysis are to separate the minor acceptable risks from the major risks, and to provide data to assist in the evaluation and treatment of risks. Risk analysis involves consideration of the sources of risk, their consequences and the likelihood that those consequences may occur. Factors which affect consequences and likelihood may be identified. Risk is analyzed by combining estimates of consequences and likelihood in the context of existing control measures.

5.2.1 Qualitative Risk analysis

Qualitative risk analysis is based primarily on experience and judgment which are exercised within some form of semi-quantitative framework. It is usually formalized in a set of guidelines describing different levels of consequence and likelihood that can be combined via a scoring system to produce a numerical risk estimate. The most basic form of qualitative risk assessment is the Boston Square, which is a simple two-by-two matrix used to categorize issues according to seriousness. A typical Risk Ranking Matrix, and how it is used is described in detail in Attachment 2 - HAZOP TOR.

Some identified hazards and its consequences need more data gathering a focused semi-quantitative assessment. For example and loss of hydrocarbon containment and fire prevention, detection, and mitigation. Detailed Terms of Reference for three of these kind of studies are presented in Attachment 3 - Blowout Risk Assessment, Attachment 4 - Fire Safety Analysis, and Attachment 5 – Spill Prevention and Countermeasures Control (SPCC).

5.2.2 Quantitative Risk Analysis (QRA)

Quantitative analysis uses numerical values (rather than the descriptive scales used in qualitative analysis) for both consequences and likelihood using data from a variety of sources. The quality of the analysis depends on the accuracy and completeness of the numerical values used.

Consequences may be estimated by modeling the outcomes of an event or set of events, or by extrapolation from experimental studies or past data. Consequences may be expressed in terms of monetary, technical or human criteria, or any of the other criteria. In some cases, more than one numerical value is required to specify consequences for different times, places, groups or situations.

A typical QRA study involves:

- Structured review techniques – primarily to identify the questions to be answered by the QRA model.
- Consequence analysis.
- Frequency Analysis – using Fault Tree, Event Tree and Decision Tree Analysis.

5.3 Risk Evaluation

Risk evaluation involves comparing the level of risk found during the analysis process with previously established risk criteria. QRA results are usually tested against corporate and regulatory risk acceptability criteria.

Risk analysis and the criteria against which risks are compared in risk evaluation should be considered on the same basis. This qualitative evaluation involves comparison of a qualitative level of risk against qualitative criteria, and quantitative evaluation involves comparison of numerical level of risk against criteria which may be expressed as a specific number, such as fatality, frequency or monetary value. The output of a risk evaluation is a prioritized list of risks for further action.

6 CONTROLLING RISK

6.1 Overview

The final stage in the risk management process is deciding what additional steps can be taken to reduce risks further. Risk treatment involves identifying the range of options for treating risk, assessing those options, preparing risk treatment plans and implementing them.

This stage is essentially about deciding what further resources need to be assigned to reduce risks. This stage can also be called the “As Low as Reasonably Practicable” (ALARP) process because it is the process by which the risks that have been revealed in the preceding steps are then tackled to find reasonable and effective ways of reducing risks further until the investment would be disproportionate to the risk reduction gain.

6.2 Risk Tolerability

The Risk Matrix can be used to define regions of risk in terms of what sort of ALARP process needs to be applied, as shown in Figure 6.1.

The essential point about this diagram is that, for risks in the region indicated, a formal ALARP process has to be delivered.

Figure 6.1: Formal ALARP required (Example)

Severity	Consequences				Increasing Likelihood				
					A	B	C	D	E
	People	Assets	Environment	Reputation	Never heard of in the industry	Heard of in the industry	Has happened in the organization or more than once per year in the industry	Has happened at the location or more than once per year in the organization	Has happened more than once per year at the location
0	No injury or health effect	No damage	No effect (no or temporary impact - days)	No impact (local media, no significant concern)	L	L	L	L	L
1	Slight injury or health effect (first aid or medical treatment)	Slight damage	Slight effect (local scale, short term damage – weeks)	Slight impact (short term local concern)	L	L	L	L	L
2	Minor injury or health effect (restricted work case or LTI)	Minor damage	Minor effect (local scale, short term damage – months)	Minor impact (short term national mention)	L	L	L	M	M
3	Major injury or health effect (partial disability)	Moderate damage	Moderate effect (local scale, medium terms damage – years)	Moderate impact (medium term national concern)	L	L	M	M	H
4	< 3 fatalities, or permanent total disabilities	Major damage	Major effect (local scale, long term damage – decades)	Major impact (regional or persistent national concern)	L	M	M	High Risk (Formal Demonstration of ALARP required)	
5	> 3 fatalities	Massive damage total loss	Massive effect (regional scale, permanent damage)	Massive impact (global concern and media coverage)	M	M	H	H	H

L	Low Risk
M	Medium Risk
H	High Risk

6.3 ALARP Process

The ALARP process consists of the following steps for each identified major accident hazard:

- Apply the hierarchy of risk management measures to brainstorm additional prevention and mitigation barriers;
- Evaluate and categorize options as;
 - No brainers, implement immediately,
 - Not practicable so reject, or
 - Requiring further evaluation
- Select and implement barriers that are reasonably practicable;
- Provide a record of the process and document management decision about options rejected or carried forward

6.4 Risk Reduction

In essence, the objective is to identify additional barriers, either Prevention or Mitigation, to increase the degree of control over that risk. The process requires key risk drivers and key control measures to be identified from the earlier risk assessment. This helps to identify the main risk influences and focus attention on those. The process then applies brainstorming techniques to identify additional barriers, structured around the following hierarchy of measures.

- Elimination.
- Substitution.
- Engineering Control.
- Administrative Control.
- PPE.
- Emergency Management Recovery.

It is usual to find that with most existing facilities there will only be a limited scope for identifying additional engineered protection systems. Most new measures will be concerned with additional procedural controls.

The ALARP test is used to determine when enough has been done to discharge obligations under the ALARP concept. This is a difficult subject on which to offer definitive guidance. However, an approach that has been used with some success is to be able to show three lists of measures at the end of the process:

- “No-brainers” or quick wins – measures which have obvious merits and can be selected immediately.
- Require further evaluation of costs & benefits – normally measures that offer clear risk reduction but at a cost.
- Rejected measures – those that are simply not practicable, or too expensive, or involve exposing people to other risks in order to implement them.

This approach has the advantage of demonstrating that a wide range of new measures was considered and a proper process was used to evaluate and categorize those measures. It should also show that there was a “bias for action” employed in the process. This is important because in past times the quantitative approach and particularly Cost Benefit Analysis was applied strictly and used as grounds for rejecting a measure that was otherwise eminently practicable.

6.5 Vista Project Physical Scope

The facilities listed in Table 6.1 are considered for expansion or grass-root development. The table presents a high level guidance for the risk management studies applicable for each.

The Vista project includes existing facilities that will be expanded or upgraded to handle more production, and also new facilities. For existing facilities, the baseline safety studies will be updated to consider the design changes in scope. In the case of projected new facilities in the 5-year field production expansion plan, safety and risk studies for each project development phase will be identified and included in the engineering, procurement and construction work streams; as applicable.

Table 6.1: Vista Project - Risk Management Studies

Drilling Operation / Facility	HAZID	HAZOP	Blow-out Risk Assess.	Fire Safety Analysis	SPCC	OSH	ERP
Drilling Operation - 110 new active wells (producing after frac)	✓	✓	✓	✓	✓	✓	✓
2 Early Production Facilities (EPF) for primary fluids separation - New	✓	✓		✓	✓	✓	✓
1 Oil Treatment Plant (PTC) – New	✓	✓		✓	✓	✓	✓
Plant revamps for existing facilities (for emergency evacuation plan):							
- <i>Borde Montuoso Battery (1 BMo)</i>	✓					✓	✓
- <i>Water Management Plant (PTA and PIA BMo)</i>	✓					✓	✓
- <i>Entre Lomas oil treatment plant (PTC ELO)</i>	✓					✓	✓

BMo: Borde Montuoso

ELO: Entre Lomas

EPF: Early production facilities

PIA: Planta de inyección de agua

PTA: Planta de tratamiento de agua

PTC: Planta de tratamiento de crudo

7 REFERENCES

- [1] ISO 31000/ANSI/ASSP Z690 Risk Management Standards, 2018
- [2] HS(G)65 Managing for Health and Safety, Health and Safety Executive, UK Guidelines, 2013
- [3] ISO 17776-2002 Petroleum and natural gas industries – Offshore production installations – Guidelines on tools and techniques for hazard identification and risk assessment, 2002
- [4] UK HSE [HSL/2005/58](#), Review of Hazard Identification Techniques, 2005
- [5] NOPSA [N-04300-GN0107](#) - Guidance Note - Hazard Identification, 2010
- [6] CCPS, Guidelines for Hazard Evaluation Procedures, Third Edition 2008

ATTACHMENT 1 - HAZID TOR

ATTACHMENT 2 - HAZOP TOR

ATTACHMENT 3 - BLOWOUT RISK ASSESSMENT

ATTACHMENT 4 - FIRE SAFETY ANALYSIS

**ATTACHMENT 5 – SPILL PREVENTION AND COUNTERMEASURES CONTROL
(SPCC)**

ATTACHMENT 6 – EMERGENCY RESPONSE

**ATTACHMENT 7 – OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT PLAN
(OHS)**

ATTACHMENT 8 - HEALTH AND SAFETY IFC / OPIC REQUIREMENTS