TOTAL
TOTAL E&P PNG LIMITED

PAPUA LNG PROJECT

UPSTREAM ENVIRONMENTAL IMPACT STATEMENT

VOLUME 1: MAIN REPORT

Chapter 18: Major Hazards

TOTAL E&P PNG LIMITED

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18. Major Hazards

18.1 Introduction

Predicted, credible environmental, socio-economic, cultural heritage and amenity impacts associated with the Project that are part of normal operating conditions are discussed in Chapters 11 to 17. Major hazards associated with very low likelihood accidental, upset or abnormal events have been identified and are discussed in this chapter. While rare, such events can be either natural or due to human activity, and may cause injury, loss of life, serious environmental harm, asset loss and reputational damage. These are essentially unplanned impacts, to be anticipated as possibilities, for which preventative action and reactive responses are embedded in Project design and operating processes.

18.2 Discipline-specific Impact Assessment Method

18.2.1 Framework

Risk management is integral to TOTAL's business and is addressed in company documents, e.g.:

- Safety Health Environment Quality Charter that 'Total implements, for all of its operations, appropriate management policies regarding safety, security, health, the environment, quality, societal commitment and a periodic risk assessment of relevant policies and measures. Any development of a project or launch of a product is undertaken upon full lifecycle risk assessment.'
- Group Directive One-Maestro HSE Principles (DIR-GR-HSE-001):
  - Principle 3 addresses risk management that requires 'For any activity the hazards to which people, the environment and assets are exposed are systematically identified, the associated risks assessed and the measures for reducing them defined and implemented.'
  - Principle 7 addresses emergency preparedness and 'The emergency situations potentially critical for people, the environment and assets are identified based on a risk assessment.'

This is also reinforced in TEP PNG's HSE Charter:

> In order to achieve our standards, we shall, in all our activities: Perform appropriate HSE assessment to identify, minimize and manage the risks to personnel, the environment and assets.

18.2.2 Methods

Major hazards have been identified and assessed during the pre-Project phase in a social and environmental aspects and impacts identification (SENVID) study and hazard identification (HAZID) studies.

The SENVID focuses on environmental and social risks whereas the HAZID focuses on safety risks.

The purpose of the SENVID was to identify, at an early stage, the aspects that can potentially impact the environment or society including major hazards. The SENVID examined all Project phases to identify the components and activities that may cause environmental and social harm due to major accidental, upset or abnormal events.

The HAZID followed a similar approach to the SENVID but focused on upstream operations. The purpose of the HAZID was:

- To identify the hazards and associated risks that can impact infrastructure design.
- To identify the major hazards and put in place robust measures/preventative barriers and corrective actions.
- Where necessary propose recommendations to:
  - Better analyze the hazard and associated risks (e.g., collect more input data or carry out specific studies).
  - Consider the implementation of additional barriers or alternatives.

During the pre-Project phase, a hazard analysis (HAZAN) was also carried out to evaluate safety distance requirements.

Major hazards discussed in this chapter are extracted from the various assessments mentioned in this section. Related controls and mitigation to reduce risks from these hazards to as low as reasonably practicable are discussed in the following sections.

18.3 Major Hazards

The principal major hazards relate to the following:

- Loss of containment of product, gas, fuel and other hazardous materials through failure or damage to equipment from natural causes (e.g., earthquake, landslide, wildfire, tsunami, storm surge and flood events), equipment or system failures or third-party interference, (including intentional or unintentional vessel collisions).
- Fire and explosion, caused by ignition (e.g., from wildfire, lightning strike or electrical equipment) of a product release or leakage (e.g., of fuel, gases or chemicals).

These major hazards have the potential to cause a range of adverse impacts to people, facilities and the environment, including:

- Contamination of soil, surface water, groundwater or air posing a risk to human and ecological health.
- Loss of terrestrial and aquatic habitat, flora and fauna.
- Damage to property or cultural heritage sites.
- Reduced livelihoods (e.g., through loss or damage to land or water resources).
- Compromised health or safety, potentially including fatalities of Project personnel or third parties.
- Financial hardship or increased vulnerability for persons or dependents in the event of a major life-changing injury or fatality.

18.3.1 Wells and Wellpads

The following major hazards have been considered at wells and wellpads, which are in the northern part of PRL-15:

- Fire during well drilling or operations.
- Loss of well control during well drilling or operations.
- Release of high levels of H_2S due to equipment failure.

18.3.2 Central Processing Facility

The following major hazards have been considered at the CPF:

- Major fuel spill from plant, machinery and equipment or system failures during construction and production.
- Fire at the CPF during construction.
- Release of high levels of H_2S due to equipment failure.
- Fire or explosion of gaseous or liquid hydrocarbons during processing.
- Seismic events damaging processing facilities causing a large-scale hazardous material release.

18.3.3 Flowlines, Trunklines and Export Pipelines

The following major hazards have been considered for flowlines, trunklines and export pipelines:

- Major release of liquid contaminating surrounding areas.
- Explosion or fire during production.

18.3.4 Transport Routes

The following major hazard has been considered in relation to transport routes:

- Fuel spills due to rupture of a vessel bunker or bulk fuel and chemical containers, e.g., from a vessel grounding, collision or fire, in the Gulf of Papua and river transport routes.

18.4 Mitigation and Control

18.4.1 Facilities Location

As described in Chapter 5 (Project Options and Analysis), social sensitivity has been a key criterion used in defining the location of facilities and exclusion zones. This results in avoiding populated areas to the best extent, hence minimizing communities' potential exposure to major hazards.

18.4.2 Safety Concept

Based on the outcome of the studies referred to in Section 18.2.2, a Project Safety Concept has been developed. It defines the basis for the specific safety engineering requirements to be adopted for the Project design, so that facilities are designed to a recognized safety standard, and the systems required to protect personnel, the environment and Project assets from the identified hazards are provided.

The Project Safety Concept establishes the measures to:

- Avoid or limit exposure to potential hazards.
- Minimize the potential (frequency) for hazardous occurrences.
- Contain and minimize the consequences of an incident.
- Provide the means of escape and evacuation for personnel from an incident.

The Safety Concept; therefore, defines design mitigation and controls, in relation to site layout, safety shutdown systems, specific requirements associated with flare and vent systems, drainage and spill management, fire and gas detection, fire protection and the fire-fighting philosophy,

emergency power, alarm and telecommunications systems, escape and evacuation, personnel safety and contingency planning.

An overview of those embedded design controls is provided in Chapter 4 (Project Description) and some are discussed further in 18.4.3. Contingency planning is discussed in 18.4.4.

18.4.3 Mitigation and Control Measures

18.4.3.1 Layout Requirements

The following main principles have been considered in the layout of the wellpads and CPF:

- Process, utilities, storage and flares are segregated into different fire zones.
- Separation distance between fire zones is computed according to TOTAL General Specification, Impacted Area, Restricted Area and Fire Zones (GS EP SAF 253), to minimize the potential for escalation of credible hazardous events.
- Ignition sources are located upwind or perpendicular to the flammable sources, as far as reasonably practicable.
- Ignited vents and flares (ignition sources) are located perpendicular to the prevailing winds.
- Escape evacuation and rescue routes and systems are located upwind of hazardous areas, as far as reasonably practicable.
- Attention is paid to the potential for transport impacts, dropped objects or swinging objects with protection measures put in place at specific locations to prevent impacts.

The land acquisition process takes into consideration safety distance requirements. In addition, access to site will be restricted and security managed as described in Chapter 4 (Project Description).

18.4.3.2 Pipeline Requirements

The pipeline network will be buried. The pipeline design considers a corrosion allowance amongst other parameters, and corrosion inhibitor will be injected into the production manifold at the production wellpads, as defined in Chapter 4 (Project Description).

The pipeline will be designed with a pipeline fiber optic monitoring system that will detect ground movement and any intrusion for the onshore sections. The equipment will be designed considering corrosion risk and chemical corrosion.

18.4.3.3 Drainage and Spill Management

The drainage system comprises open and closed drain systems. As described in Chapter 4 (Project Description), the general philosophy is for the system to segregate and manage runoff via three separate networks, with a design based on extreme rainfall events:

- OD1 - permanent hydrocarbon-contaminated drains.
- OD2 - accidental hydrocarbon-contaminated drains.
- OD3 - hydrocarbon-free drains.

In addition, hydrocarbon storage tanks and some other very large liquid hydrocarbon inventories require containment systems (e.g., bunded areas, impounding basins) designed to contain large, accidental leaks.

This minimizes spillage and the risk of hydrocarbon ignition and subsequent fire escalation.

Operational controls in relation to hazardous materials transport, bunkering and transfer will be defined in the Hazardous Materials Management Plan.

18.4.3.4 Fire and Gas Detection

A fire detection system will be installed and equipped with flame, heat and smoke detectors at the CPF and wellpads. Flammable gas detection, and manual alarm call points will be provided.

A toxic gas (H_2S) detection system will be installed at the CPF. A toxic gas detection system is not installed at the wellpad, as it is not a permanently manned facility. An individual portable gas detector shall be provided for personnel visiting the wellpad and CPF.

The objective of the fire and gas detection system is to alert personnel in case of a major failure, such as a flammable gas cloud, toxic gas cloud or fire, and to reduce escalation by initiating automatic or manual actions, e.g., shutdown processes.

18.4.3.5 Safety Shutdown System

A safety shutdown system, which comprises field sensors, logic solvers and final elements (e.g., valves or circuit breakers), will be in place. Its prime function will be to shutdown facilities to a safe state in an emergency situation, thus protecting personnel, the environment and the Project asset. In general, emergency shutdown (ESD) and emergency depressurization (EDP) systems contribute to the following objectives:

- Contain hydrocarbon: Limit the loss of containment by isolating incoming and outgoing hydrocarbon flows (ESD).
- Prevent ignition: Isolate and de-energize potential sources of ignition (ESD).
- Mitigate: Depressurize equipment under fire (EDP); reduce or minimize the hydrocarbon inventory by routing hydrocarbons to the flare/vent (EDP); reduce the quantity released through a leak (EDP); initiate active fire-fighting.

18.4.3.6 Fire Protection and Fire-fighting Philosophy

Fixed fire-fighting means will be provided only on the CPF (i.e., manned facilities). The main features of the fixed fire water system comprise firewater deluge systems, monitors and hydrants, a firewater distribution network, pumps and a firewater storage tank.

Mobile fire-fighting support (e.g., fire trucks and fire teams) will be provided to access the wellpad (from the CPF) and will include wheeled, portable dry chemical units and portable extinguishers.

18.4.3.7 Escape and Evacuation

Primary and secondary escape routes will be provided to facilitate personnel evacuation in critical situations. Escape routes will be as straight as possible and lead to muster points or other safe areas and will be further defined in the detailed design phase of the Project.

18.4.3.8 Blowout Contingency Planning

Accidental blowout scenarios have been assessed during the pre-Project phase and a general philosophy to manage an accidental blowout defined. Blowout management will be refined under the Blowout Contingency Plan that will be generated during the detailed design phase of the Project.

18.4.3.9 Seismicity and Landslide Risk

The presence of geohazards is a key criterion that has been used to define facilities' locations and pipeline routing, as identified in Chapter 4 (Project Description) and Chapter 5 (Project

Options and Analysis). Seismicity and landslide risk have been considered when defining design and safety requirements.

Potential increases in the incidence of landslides due to Project activities and infrastructure with related mitigation are discussed in Chapter 11 (Impacts: Terrestrial).

18.4.4 Emergency Preparedness and Response

Principle 7 of the TOTAL Group Directive One-Maestro HSE Principles (DIR-GR-HSE-001) states:

> An organization is set up to ensure that emergency plans, appropriately-trained personnel and suitable equipment necessary for dealing with such situations are constantly on hand.
>
> Emergency and associated external assistance plans are drawn up, tested during periodic exercises and updated on a regular basis.
>
> Where appropriate, these emergency plans consider local communities, mutual aid organizations and authorities. All employees, contractors, suppliers and visitors are informed about what to do in the event of an emergency.

TEP PNG has an Emergency Response Plan that provides a systematic approach to managing incidents and emergencies. It is based on a risk assessment process that identifies potential credible emergency scenarios.

The Emergency Response Plan is reviewed regularly and will be updated as needed to include the following:

- Description of the emergency response team organization (e.g., structure, roles, responsibilities and decision makers).
- Elements for managing emergency scenarios, with contact details for relevant personnel.
- Description of response procedures (e.g., details of response equipment and location, procedures, training requirements and duties) for the following:
  - Major spills.
  - Fire and explosions.
  - Vessel and vehicle collisions.
  - Loss of well control.
  - Evacuation.
  - Emergency medical evacuation (MEDEVAC) procedures for injured or ill personnel.
  - Attack by third parties.
- Descriptions and procedures for alarm and communications systems.
- Description of available first aid supplies and backup medical support.
- Description of other available emergency facilities and response times.
- Description of emergency response equipment.
- Policies defining measures for limiting or stopping events, and conditions for terminating actions.

TEP PNG has established on-call emergency response and crisis management teams that are capable of mobilizing and responding to the extent required for an emergency situation, and

without delay. The teams are staffed with competent individuals, organized into teams with allocated and clearly defined roles.

The teams are trained to respond to emergencies, rescue injured persons and perform emergency actions in coordination with other agencies and organizations that may be involved in emergency response.

Personnel are provided with suitable emergency response equipment, including medical emergency, spill response and firefighting equipment. These are managed and located for effective use, with sufficient equipment available as required.

Exercises in emergency preparedness are and will continue to be practiced regularly.

The Emergency Response Plan will be developed to manage preparation for and response to emergency events. It will contain (Chapter 19, Environmental Management, Monitoring and Reporting):

- Site contingency plans, that will consider fire management measures.
- Oil Spill Contingency Plan, that will consider spill risks for all Project activities and all Project phases.
- Blowout Contingency Plan, including contingency measures.

18.4.5 Next Steps

Major hazards assessment and management will be progressively updated and refined, as required, as the Project proceeds through detailed design. Hazard and operability studies will be undertaken and their outcomes addressed in the Project design.

A detailed Emergency Response Plan will be prepared and will include the modeling of accidental releases to assess the risk associated with major hazards, as part of the Oil Spill Contingency Plan and response definition. Other aspects of emergency response will be defined in the Hazardous Materials Management Plan, and a Traffic and Transport Management Plan will be in place to define safe driving and vessel movement requirements. Operational controls in relation to major hazards prevention and control will be further defined as part of the Project's health, safety and environment (HSE) management system deployment (Chapter 19, Environmental and Social Management, Monitoring and Reporting).