13.0 Risk and Safety

13.1 Introduction

This section of the EIS identifies health and safety issues associated with the construction and operation of the refinery, residue storage facility (RSF) and pipelines. This section also describes measures to mitigate any potential impact. Hazards have been analysed to identify residual risks to human health, safety and the environment, with detail of risk control measures provided.

Gladstone Pacific Nickel Limited's (GPNL's) health, safety and environment (HSE) philosophy provides direction for the development and implementation of sound principles for the protection of the environment and the health and safety of project stakeholders and the community.

13.2 Health and Safety Management

13.2.1 Policies and Objectives

GPNL's goal is to eliminate all potential adverse impacts on the health and safety of project stakeholders and on the environment, wherever practicably achievable.

GPNL will develop HSE policies which will form the basis for all HSE management system activities. The HSE policies will describe GPNL's HSE philosophy and will establish HSE objectives.

A HSE management system will be developed and implemented for the project based on HSE policies and identified HSE risks. HSE management requirements during the design and construction stages of the project will be described in the project's Health, Safety and Environment Management Plan (HSEMP). This system will be based on the HSE objectives and targets and will be continually reviewed and improved based on monitoring of HSE performance through HSE key performance indicators (KPIs).

For the operations stage of the project, GPNL will implement an integrated risk management system (IRMS). Operations management plans will be developed for HSE aspects specific to operations. Relevant components of the design and construction HSEMP will be incorporated into the operations management plans. A comprehensive set of standards and procedures to support HSE management plans will be developed during the project's implementation.

The system will be designed to take into account the general and specific circumstances relevant to project components (e.g. processing plant, pipelines and infrastructure, and residue storage) and the stage of the project (e.g. design, construction and operations).

13.2.2 Legislative Compliance

The health and safety requirements of the construction and operation of the project are governed by a number of legislative requirements, relating to a range of issues. These are detailed in Table 13.2.1, along with the measures to be undertaken to ensure compliance.

Table 13.2.1 Legislative Requirements

Legislation	Requirement	Compliance
Workplace Health and Safety Act 1995 and *Regulation 1997*	To prevent a person's death, injury or illness being caused by a workplace, by a relevant workplace area, by work activities, or by plant or substances for use at a workplace. Preventing or minimising a person's exposure to the risk of death, injury or illness. Establishing a framework for minimisation and prevention.	Safety in design and Safety Management System (refer Section 13.2.4) for construction and operational phases
Dangerous Goods Safety Management Act 2001 and *Regulation 2001* National Standard for the Control of Major Hazard Facilities (MHF) (NOHSC:1014(2002)) (if relevant)	The objective of the *Dangerous Goods Safety Management Act 2001* is to protect people, property and the environment from harm caused by hazardous materials, and dangerous goods. To achieve this, the Act creates broad safety obligations for all people involved with the storage, handling and manufacture of hazardous materials,	Management of dangerous goods in accordance with the requirements of the relevant Australian Standards for the storage and handling of dangerous goods (refer Section 13.2.3) Safety Management System (refer Section 13.2.4)
Explosives Act 1999 and *Regulation 2003*	To ensure the safe utilisation, storage, handling and disposal of explosives during all stages of the project so as not to endanger persons, property or the environment	Contractor HSEMP during construction (refer Section 13.8)
Radiation Safety Act 1999 and *Regulation 1999*	To ensure the safe utilisation, storage, handling and disposal of radioactive material so as not to endanger persons, property or the environment	Safety Management System (refer Section 13.2.4) for construction and operational phases
Building Act 1975 and *Building Fire and Safety Regulation 1991*	The safe design and operation of all buildings so as not to endanger persons, property or the environment	Design and maintenance compliance with Building Code of Australia Safety Management System (refer Section 13.2.4)
Fire and Rescue Service Act 1990 and *Fire* and *Rescue Service Regulation 2001*	Establish effective relationships and implementation of the Queensland Fire and Rescue Service (QFRS) and to provide for the prevention of and response to fires and certain other incidents endangering persons, property or the environment and for related purposes	Involvement of QFRS in emergency planning (refer Section 13.7.1)
Electricity Safety Act 2002 and *Electrical Safety Regulation 2002*	Eliminating the human cost to individuals, families and the community of death, injury and destruction that can be caused by electricity.	Safety in design and Safety Management System (refer Section 13.2.4) for construction and operational phases

Table 13.2.1 Legislative Requirements

Legislation	Requirement	Compliance
	Preventing persons from being killed or injured by electricity; and preventing property from being destroyed or damaged by electricity.	
Transport Operations (Road Use Management) Act 1995 and associated regulations for dangerous goods and other relevant aspects	Provide for the effective and efficient management of vehicle and road use associated with all components and stages of the project	Safety Management System (refer Section 13.2.4) for construction and operational phases
Health Act 1937, *Health Regulation 1996* and *Health (Drugs and Poisons) Regulation 1996*	Ensure a safe and healthy environment so as not to endanger persons, property or the environment	Contractor HSEMP during construction (refer Section 13.8) Integrated Risk Management System (refer Section 13.2.4)
Workers Compensation and Rehabilitation (WCR) *Act 2003* and *WCR Regulation 2003*	Ensuring and promoting improved health and safety performance	Integrated Risk Management System (refer Section 13.2.4)

13.2.3 Dangerous Goods

The Department of Emergency Services (DES) is the regulatory authority for the *Dangerous Goods Safety Management* (DGSM) Act 2001 and the DGSM Regulation 2001 through DES' Chemical Hazards and Emergency Management Services (CHEM Services). CHEM Services is the agency responsible for the coordination, ongoing training and industry support. Following substantial completion of detailed design, GPNL will notify CHEM Services in regard to the refinery being a large dangerous goods location and a potential major hazard facility (MHF). MHF classification is dependent on the types and quantities of dangerous goods to be stored and/or used at the refinery and other factors such as the proximity to other industrial activities in the area.

The following hazardous materials listed in Table 1 of Schedule 1 of the National Standard for the Control of Major Hazard Facilities (MHF) (NOHSC:1014(2002)) will be stored and/or used for processing at the refinery:

- Ammonia, anhydrous.
- Hydrogen.
- Hydrogen sulphide.
- Oxygen.

Other dangerous goods listed in Table 2 of Schedule 1 of the MHF national standard will also be stored and/or used for processing at the refinery. The expected quantities of each of these dangerous goods stored and/or used at the refinery will be determined during the detailed design phase of the project. GPNL is minimising the quantities of these dangerous goods on-site in the design of the refinery. Examples of plant design controls to minimise inventories include:

- No on-site storage of hydrogen sulphide; hydrogen sulphide is produced on-site at a rate required by the hydrometallurgical processing plant.
- Minimal on-site storage of anhydrous ammonia and significantly reduced requirement for truck unloading of anhydrous ammonia, through the provision of a supply pipeline from the Orica Yarwun facility on Reid Road.

It is expected that the quantities of these dangerous goods stored and/or used on site will be below the aggregate threshold for classification as a MHF. GPNL will consult with DES when quantities of materials have been determined during the detailed design phase of the project. Estimates of the proposed quantities of dangerous goods to be used and / or stored are detailed in Section 2.6 and Section 2.7.

All hazardous materials used on site will be managed in accordance with the relevant Australian Standards (e.g. for the storage and handling of dangerous goods) including:

- AS/NZS 4452:1997 (a): The Storage and Handling of Toxic Substances.
- AS 1940:2004 The Storage and Handling of Flammable and Combustible Liquids.
- AS 3780:1994 The Storage and Handling of Corrosive Substances.

Material safety data sheets (MSDS) for all chemicals to be used will be available at appropriate locations such as the chemicals storage facilities and the laboratory. Spill prevention measures will be implemented and spill response strategies will be developed.

Further details are given in the chemicals and dangerous goods management plan in Section 14.

13.2.4 Safety Management System

The objective of the safety management component of the IRMS, hereafter named the safety management system, is to ensure that the occupational health and safety performance of the project meets the GPNL health and safety policies, legislative requirements, and industry best practice and standards. The safety management system is a requirement of the DGSM Act 2001 for a large dangerous goods location and the National Standard for the Control of Major Hazard Facilities (MHF) (NOHSC:1014(2002)) for a MHF. The key to achieving this objective will be for the safety management system to:

- Clearly identify potential health and safety hazards.
- Assess risks resulting from the hazards identified.
- Develop control measures that prevent, or minimise, the level of the risk.
- Implement corrective measures to control or remove hazards and associated risks.
- Monitor and review the effectiveness of any corrective action.

These requirements of the safety management system will be met through GPNL's HSE management system and policies.

13.2.5 HSE Management Standards

The IRMS will be developed to be consistent with the following standards for HSE management systems:

- AS/NZS ISO 14001:2004(b): Environmental management systems – Requirements with guidance for use.
- AS/NZS ISO 14004:2004(c): Environmental management systems – General guidelines on principles, systems and supporting techniques.
- AS/NZS 4801:2001 Occupational health and safety management systems – Specification with guidance for use.
- AS/NZS 4804:2001(a): Occupational health and safety management systems – General guidelines on principles, systems and supporting techniques.

13.2.6 Audits and Inspections

HSE planning will include the monitoring of HSE performance through suitable KPIs. Monitoring of KPIs will enable GPNL to assess progress towards HSE objectives and targets, and will also assist in recognising achievement. KPIs will include compliance with applicable HSE legislation and GPNL HSE policies and plans.

A comprehensive program of audits and inspections will be developed and implemented through the entire duration of the project. Audit and inspection procedures will nominate frequencies appropriate for the stage of the project and the activities being performed.

Corrective actions arising from inspections, audits, incident investigation, hazard reports, and meetings will be documented, monitored and closed out.

13.2.7 HSE Risk Management

The management of HSE risks is a critical component of the project's HSE management system. Health and safety hazards and environmental aspects will be identified during each stage of the project. Associated risks will be assessed and risk controls implemented. Risk management activities will be undertaken in accordance with AS/NZS 4360:2004 Risk Management. A hazard/risk register will be developed and be updated throughout the life of the project.

13.3 Risk Management Approach

The National Code of Practice for the Control of Major Hazard Facilities (NOHSC:2016:1996) promotes a three tiered approach to a multilevel risk review. That is, if the preliminary studies do not find significant offsite risks, then further detailed studies such as quantitative risk assessments (QRA) may not be necessary. The code suggests that the following types and combinations of risk assessments be considered:

- **A broad qualitative hazard analysis**. A preliminary hazard analysis considers the nature and quantities of chemicals used, the storage facilities and transportation methods utilised for raw materials and finished product. The objective is to determine credible worst-case scenarios that may have offsite impacts (the likelihood of such events is not considered at this stage). The consequences of these scenarios will then be modelled. If no realistic chance of offsite impacts is determined then further analysis would not be required. However, if there appears to be significant offsite impacts then a semi-quantitative risk assessment would be undertaken
- **A semi-quantitative hazard consequence evaluation to determine hazard effects**. A semi-quantitative risk assessment determines the likelihood of the scenarios identified in the preliminary hazard analysis. A preliminary assessment using risk characterisation systems (such as that documented in AS/NZS 4360:2004) will be completed in association with interested parties and stakeholders. Depending on the outcomes of the assessment, the need for a QRA will be determined.
- **A quantitative risk assessment**. Finally, a QRA will be undertaken if the semi-quantitative risk assessment deemed it necessary and will follow a formal technique to determine individual and societal risk values. These would be assessed against the New South Wales Department of Urban Affairs and Planning's Hazardous Industry Planning Advisory Paper No. 4 *Risk Criteria for Land Use Safety Planning* (HIPAP 4).

A hazard and risk analysis of the project (excluding the slurry and seawater pipelines) has been undertaken by sub-consultants ModuSpec Australia. A copy of the report is provided in Appendix T.

The main objective of the risk assessment was to assess the major hazards associated with the refinery in accordance with AS/NZS 4360:2004, and to identify hazards that have the potential to extend offsite. This was done through a broad qualitative hazard analysis and a semi-quantitative hazard consequence evaluation as described above. These two risk reviews determined if a QRA was required.

A major hazard was defined as a large scale situation that has the potential to have a significant impact on people, environment or property i.e. events that have the potential to lead to:

- Fatalities.
- Wide spread environmental damage.
- Property loss in excess of $1 million.

Excluded from the assessment were localised events such as:

- Occupational health and safety events e.g. falls.
- Events associated with construction and maintenance e.g. isolation and confined space hazards.

The risk assessment covered the following project components that were deemed to have major hazard potential:

- Refinery (leach plant area).
- Refinery (metal plant area).
- Pipelines to/from the RSF at Aldoga.
- RSF at Aldoga.

The risk assessment for the pipeline components of the project is detailed in Section 7.8.

13.4 Risk Analysis

13.4.1 Risk Matrix

The risk analysis was undertaken by using a risk matrix developed from AS/NZS 4360:2004 and HB 436:2004. The latter is a companion document to AS/NZS 4360:2004 and provides guidelines on determining risk matrices. A risk matrix is a tool that allows the risk associated with a hazard to be qualified. This is done through the following steps:

- Estimating how often the hazardous event is expected to occur (i.e. the likelihood).
- Estimating the impact on people, the environment, and property when the major hazard occurs (i.e. the consequence).
- Determining the associated risk from the matrix where the likelihood row and consequence column intersect.

The matrix has been developed to ensure that major hazardous events that occur often and have the greatest impact are considered to be high risk. Those that occur infrequently and have little impact are considered to be low risk. A sliding scale is applied between these two extremes. Tables 13.4.1, 13.4.2 and 13.4.3 detail the risk matrix, the frequency guidelines, and the consequence guidelines utilised. The following was considered when developing the matrix:

- Major hazardous events occur very infrequently so the likelihood axis needs to extend well beyond “once in the life of the facility”.
- The consequences of major hazardous events can be significantly reduced if there are sufficient controls in place. Therefore the consequence axis includes a full range of consequences e.g. from fatalities to no injury.
- The community is more concerned about offsite fatalities and releases to the environment than onsite fatalities and releases.
- Each major hazard is area based (e.g. release of H_2S from sulphide precipitation area). Risk levels need to reflect this. Further, risk levels should change gradually across the matrix. Defining points include:
  - Single onsite fatality risk is considered very high (VH) if it occurs more than once every 10 years and high (H) if it occurs once in the life of the facility.
  - Lowest consequence risk is considered to be low (L) in all but the most frequent of events.

Table 13.4.1 Risk Matrix

Likelihood	Consequence				
	1	2	3	4	5
A	M	H	VH	VH	VH
B	L	M	H	VH	VH
C	L	L	M	H	VH
D	L	L	L	M	H
E	L	L	L	L	M

VH - very high; H – high; M – medium; L - low

Table 13.4.2 Frequency Guidelines

Level	Frequency p.a.	Description 1	Description 2	Description 3	Description 4
A	>1	More than once per year		Highly likely	Repeated incidents
B	0.1 - 1	Once every 10 years to once per year		Likely	Isolated incidents
C	0.01 - 0.1	Once every 100 years to once every 10 years	Approx once in the life of the facility	Possible	
D	0.001 - 0.01	Once every 1000 years to once every 100 years	Approx once in the life of 10 facilities	Unlikely	
E	<0.001	Less than once every 1000 years		Rare	

Table 13.4.3 Consequence Guidelines

Level	Health & Safety		Environment	Property ($)
	Onsite	Offsite		
1	No treatment required	No impact	Insignificant release	<10K
2	First aid required	No treatment required but activity interrupted e.g. traffic congestion	Onsite release contained	10K - 100K
3	Medical treatment required, one person disabled	First aid required	Onsite release with large clean up	100K - 1M
4	Single fatality, small number of people disabled	Medical treatment required, one person disabled	Offsite release with short term impact	1M - 10M
5	Multiple fatalities, large number of people disabled	Single fatality, small number of people disabled	Offsite release with long term impact	10M+

During the risk assessment process, the role of existing controls is considered in determining the likelihood and associated consequences.

13.4.2 Analysis Methodology

The methodology used for the hazard risk analysis has three main steps:

- Preliminary work and preliminary hazard identification (HAZID).
- Workshop review with GPNL project personnel.
- Consequence modelling and finalisation of the risk assessment.

This methodology is consistent with the guidelines set out in AS/NZS 4360:2004(a) Risk Management. The steps are outlined below.

13.4.3 Hazard Identification

Project information that was reviewed as part of the preliminary HAZID process included the following:

- Process description.
- Process flow diagrams.
- Plant layout and location drawings.
- Reagents and emissions data.

Credible major hazards, causes, consequences and controls were identified using a structured review process as follows:

- Divide the refinery into smaller area.
- Identify significant equipment and hazardous materials handled in each area.
- Discuss the processes employed in each area.
- Brainstorm credible hazards.
- Identify causes, consequences and existing controls for each hazard.

The HAZID for the refinery was supplemented by a review of risk assessments of similar facilities.

13.4.4 Workshop Review

The preliminary HAZID work was reviewed during a one-day workshop involving ModuSpec Australia and GPNL and URS project personnel. The above steps were repeated for each relevant project area to:

- Ensure all major hazards identified were relevant and correct for the refinery.
- Identify additional major hazards, causes, consequences and controls.

13.4.5 Consequence Modelling

The preliminary HAZID determined that major hazards with the potential to result in off-site consequences, related to the release of vapours or gases.

For flammable releases, consequence modelling determined the extent of the lower flammable limits (LFL) cloud at 1 m above ground level. Fatalities are considered likely within this contour, should the cloud be ignited.

For toxic releases, consequence modelling determined the extent of the Specified Level of Toxicity Dangerous Toxic Load (SLOT DTL) cloud at 1 m above ground level. The DTL describes the exposure conditions, i.e. the airborne concentration and the exposure duration of the given chemical, that will produce a particular level of chemical toxicity within the general public (HSE, 2003). The SLOT equates to the approximate toxic dose that will result in 1 % mortality for the exposed population (i.e. LC_1). Fatalities are considered possible within the SLOT DTL contour. The SLOT DTL values and units used for each chemical are presented in Table 13.4.4. Units for SLOT DTL are chemical dependent.

Table 13.4.4 Toxicity Data

Material	SLOT DTL Value	Unit
Ammonia	3.78×10^{08}	ppm^2.min
Hydrogen sulphide	2.00×10^{12}	ppm^2.min
Sulphur trioxide	1.30×10^{04}	ppm^2.min

13.5 Risk Analysis Results

The refinery was divided into 31 areas. There were 27 major hazards identified and consequence modelling was completed for 15 representative scenarios. Risk assessment results for the 31 areas and 27 major hazards are summarised in Table 13.5.1. Major hazard consequences that have the potential to extend offsite are summarised in Table 13.5.2. Appendix T provides the consequence modelling data and assumptions for the 15 representative scenarios and also provides the consequence modelling data for the ammonia cases (the highest rated risks).

The risks associated with the Gladstone Nickel Project (GNP) are generally low. All areas were assessed as having a "low" risk with the exception of the solvent extraction, nickel reduction/cobalt reduction, and ammonia areas. These were assessed as having a "medium" risk. The results show that most major hazardous events do not extend offsite. The following major hazardous events have the potential to extend offsite:

- Release of residue slurry from pipelines to/from the RSF at Aldoga.
- Release of sulphur from sulphuric acid plant stack (upset condition during plant start-up).
- Release of ammonia from the ammonia storage area.

Of the above three hazards with offsite potential, only the release of ammonia is considered to be of medium risk (the others have been assessed as being of low risk). The results indicate the following:

- Scenario 15 Ammonia Vessel Failure - SLOT DTL footprint has the potential to extend up to 460 m downwind.
- Scenario 7 Ammonia Pump/Unloading Arm Failure - SLOT DTL footprint has the potential to extend up to 145 m downwind.

Because the surrounding land use is heavy industry, the risks to the surrounding land uses are considered low. The refinery is located within the state government designated Gladstone State Development Area (GSDA) and is zoned as being within the major industry and GSDA zones by the Draft Calliope Shire Planning Scheme. Figure 10.12.2 illustrates the zoning of the refinery and the location of sensitive receptors as inferred from the shire zoning scheme. Modelling has shown that the SLOT DTL footprint for ammonia extends slightly offsite and is unlikely to impact on the nearby Orica Chemical Complex. The cumulative risk for the proposed refinery when the off-site risk from the Orica Chemical Complex is considered (as based on the QRA undertaken for the Ammonium Nitrate Uprate EIS), is also considered to be acceptable. The 1×10^{-6} risk contour for this QRA crosses the GNP's refinery site boundary; however, this contour is acceptable for residential areas under HIPAP 4. The nearest residential zones to the refinery are the Yarwun community including rural residential properties to the west of the refinery area on Calliope River Road, the Gladstone suburb of Clinton, and rural residential properties to the east of the Calliope River. There are no residential properties in close vicinity of the refinery site. Figure 13.5.1 shows the sensitive receptors within a 5 km radius of the refinery.

The acceptability of the risk to surrounding land uses has been assessed. The surrounding land uses are heavy industry within the GSDA and the risk on the surrounding land uses is perceived to be low. Based on these results, it is considered that further analysis of the risks from the site in the form of a QRA is not warranted.

● Rural - Residential

Site Boundary

URS

Client: Gladstone Pacific Nickel Ltd

Project: GLADSTONE NICKEL PROJECT ENVIRONMENTAL IMPACT STATEMENT

Drawn: VH | Approved: CMP | Date: 30-01-2007

Job No: 4262 5791 | File No: 42625791-g-098b.wor

Title: **LOCATION OF SENSITIVE RECEPTORS**

Figure: 13.5.1 | Rev: B | A4

Table 13.5.1 Risk Assessment Results

Area No	Area	Hazard No	Major Hazard	Consequence	Likelihood	Risk
1	Ore Receival and Slurry Storage	-	None	-	-	-
2	High Pressure Acid Leach	-	None	-	-	-
3	Saprolite Neutralisation	-	None	-	-	-
4	Counter Current Decantation	-	None	-	-	-
5	Solution Neutralisation	1	Release of hydrogen sulphide	3	E	L
6	Sulphide Precipitation	2	Release of hydrogen sulphide	3	D	L
7	Final Neutralisation	-	None	-	-	-
8	Pipelines to/from RSF at Aldoga	3	Release of residue to environment	4	E	L
9	RSF at Aldoga	4	Release of residue to environment	2	E	L
10	Sulphide Leach	-	None	-	-	-
11	Impurity Removal	5	Release of ammonia	2	C	L
12	Solvent extraction	6	Release of organic phase	4	D	M
		7	Mixer/settler fire	4	D	M
13	Nickel Reduction	8	Release of ammonia	3	C	M
		9	Release of hydrogen	4	E	L
14	Nickel Metal Handling	10	Furnace explosion	2	D	L
		11	Release of natural gas	1	C	L
		12	Release of hydrogen	2	C	L
15	Cobalt Reduction	13	Release of ammonia	3	C	M
		14	Release of hydrogen	4	E	L
16	Cobalt Metal Handling	15	Furnace explosion	2	D	L

Table 13.5.1 Risk Assessment Results

Area No	Area	Hazard No	Major Hazard	Consequence	Likelihood	Risk
		16	Release of natural gas	1	C	L
		17	Release of hydrogen	2	C	L
17	End Solution Stripping	18	Release of hydrogen sulphide	2	E	L
18	Ammonium Sulphate Plant	-	None	-	-	
19	Sulphuric Acid Plant	19	Release of sulphuric acid	2	C	L
		20	Release of sulphur, sulphur dioxide/trioxide	4	E	L
20	Hydrogen Plant	21	Release of hydrogen	4	E	L
		22	Release of natural gas	4	E	L
21	Hydrogen Sulphide Plant	23	Release of hydrogen sulphide	3	D	L
		24	Release of hydrogen	3	E	L
22	Air Separation Plant	-	None	-	-	-
23	Limestone Plant	-	None	-	-	-
24	Lime Plant	-	None	-	-	-
25	Flocculants Storage	-	None	-	-	-
26	Filter aid Storage	-	None	-	-	-
27	Ammonia Storage	25	Release of ammonia	5	E	M
28	Polyacrylic Acid Storage	-	None	-	-	-
29	Caustic Soda Storage	--	None	-	-	-
30	Power station	26	Release of natural gas	4	E	L
		27	Gas-fired boiler explosion	4	E	L
31	Waste water treatment plant	-	None	-	-	-

Table 13.5.2 Major Hazard Consequences with Potential to Extend Off-site

Area No.	Area	Hazard No.	Major hazard	Cause	Likelihood	Scenario	Consequence Description	Consequence	Risk
8	Pipelines to/from RSF at Aldoga	3	Release of residue to environment	Pipe/flange failure of underground pipelines	E	-	Release of slurry/saline water into pipeline corridor/offsite, short term impact	4	L
19	Sulphuric Acid Plant	20	Release of sulphur, sulphur dioxide/ trioxide	Loss of temperature in converter during start up, sublime plant leading to sulphur deposition and sulphur, sulphur dioxide/trioxide release via stack	E	-	Potential sulphur deposition offsite, short term impact on plants. Note: Sulphur dioxide/trioxide cloud does not extend offsite	4	L
27	Ammonia	25	Release of ammonia	Vessel failure (100 mm)	E	15	SLOT DTL extends 460m	5	M
				Pump or unloading arm failure (80 mm)	E	7	SLOT DTL extends 145 m.	4	L

The risk assessment was conducted on Stage 1 because of the level of plant design detail for Stage 1 being available at the time. Despite the potential increase for failure likelihoods for Stage 2, it is not considered that the risks associated with Stage 2 would be significantly different to Stage 1 for the following reasons:

- The quantity of stored ammonia for Stage 2 is likely to be the same as for Stage 1 alone.
- The ammonia storage area for Stage 2 is likely to be located the same approximate distance from the offices, laboratory and administration areas as for Stage 1.
- The ammonia and hydrogen sulphide pipeline diameters are unlikely to increase as line sizing because Stage 1 was based on conservative preliminary designs.
- The process design for Stage 2 is unchanged for the parts of the process associated with hazardous materials.
- The number of operating personnel for Stage 2 is only expected to be about 15% higher than for Stage 1 (not double).
- Stage 2 will be constructed in the same area and extending to the south of Stage 1 i.e. away from neighbouring industrial facilities.

13.6 Risk Mitigation

Based on the hazards identified, a number of risk prevention and mitigation strategies have been included in the project’s design. These prevention and mitigation strategies have been accounted for in the risk assessment analysis. The locations of the hazardous areas within the refinery (Stage 1) are shown on Figure 13.6.1.

13.6.1 Solvent Extraction

The risk associated with the solvent extraction area is due to the potential for significant equipment damage by organic phase fire. The following controls are proposed to reduce risk in this area:

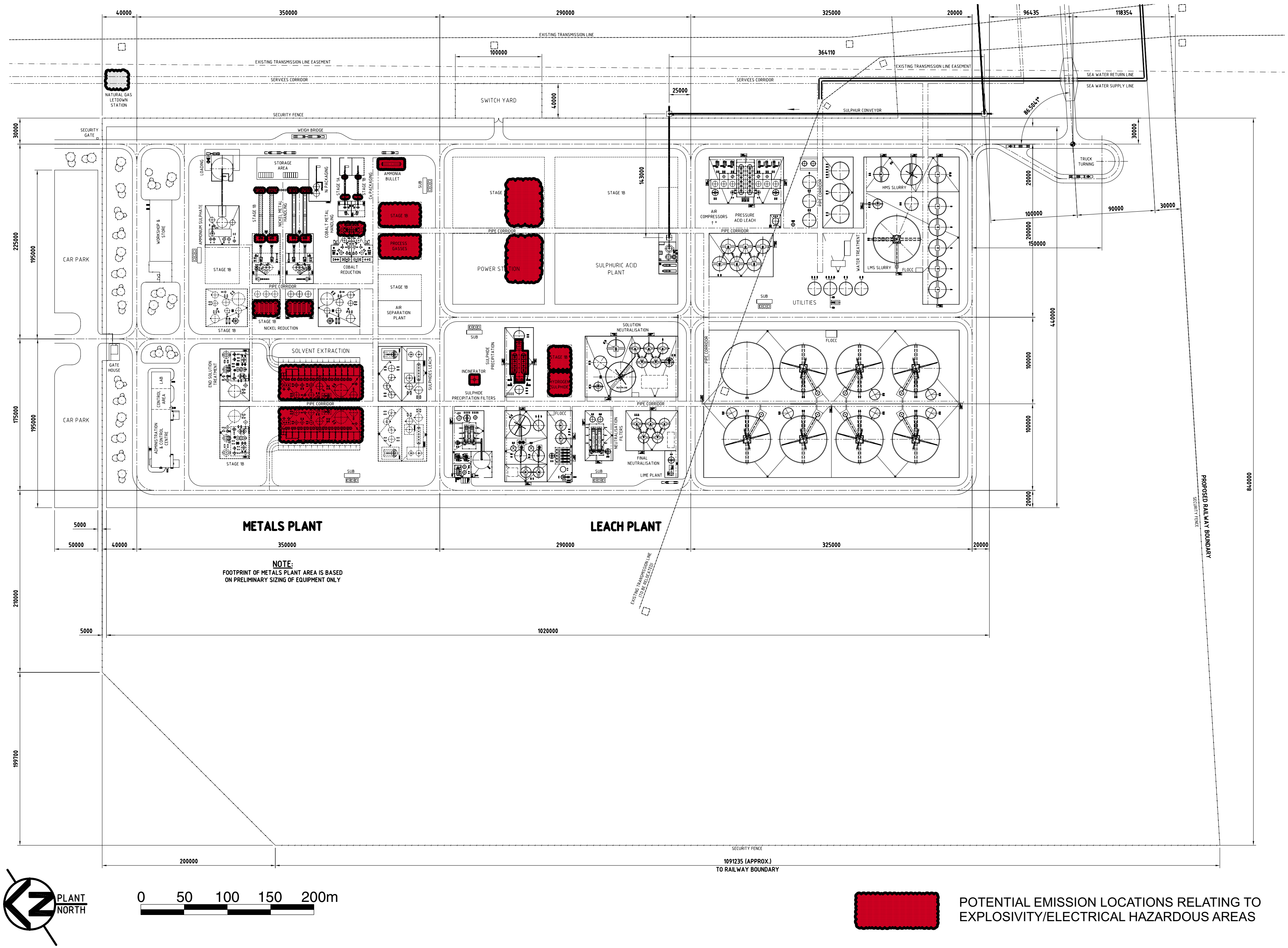
- Condition monitoring.
- Ignition control (anti-static clothing, diesel vehicles, hot work permits).
- Fire water/foam systems.

13.6.2 Ammonia Areas

The risk associated with the ammonia areas are driven by the inventory of ammonia supplied to site by pipeline and a small inventory stored on site. This risk would have been greater if the ammonia was transported to site by truck, requiring a larger inventory to be stored on site. The following controls are proposed to reduce risk in this area:

- Condition monitoring.
- Excess flow valves on storage vessels, road tankers and supply pipeline.
- Locating the ammonia storage area at a safe distance away from the main facility to minimise the consequences of incidents.
- Burying the supply pipeline.

While the offsite risk associated with the ammonia area was assessed to be medium, it should be noted that releases of ammonia from this area have the potential to cause multiple onsite fatalities. The impact of these releases could extend to nearby plant areas and, in the case of vessel failure, could also extend to the store, car park, workshop and other areas likely to be occupied by refinery personnel.



URS

Client: Gladstone Pacific Nickel Ltd

Project: GLADSTONE NICKEL PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Title: HAZARDOUS AREAS

Drawn: TN | Approved: CMP | Date: 07/11/2006

Job No.: 42625791 | File No. 42625791-g-061.cdr

Figure: 13.6.1 | Rev. B | A4

13.6.3 Nickel and Cobalt Reduction

The risks associated with the nickel and cobalt reduction areas are greater than the other areas using ammonia due to the larger pipe diameters from which there would be higher release rates in the case of a pipe failure. Once again, condition monitoring is important in minimising risk in these areas.

13.6.4 Hydrogen Sulphide Areas

For areas using hydrogen sulphide, the following controls are proposed to minimise the risk:

- Hydrogen sulphide detectors/alarms/shutdown.
- Windsocks located strategically throughout the refinery.
- Administrative controls for personnel in the hydrogen sulphide area, including the use of personal respirators and associated policies.

Other controls to be implemented include:

- Man down radios.
- Hydrogen sulphide personal protection equipment (PPE) (personal monitor, escape respirator).
- Additional hydrogen sulphide respirators throughout the refinery.

13.7 Emergency Planning and Management

Emergency plans for the project site will be produced in consultation with the DES. The responsible manager will liaise periodically with the DES to ensure maintenance of service standards.

13.7.1 Emergency Services

The Queensland Ambulance Service (QAS) has stations at Mount Larcom, Calliope and Gladstone. Each station has the following staff and vehicle numbers:

- Mount Larcom: 2 paramedics, 2 vehicles – common response to medical callouts.
- Calliope: 1 permanent paramedic, 1 travelling relief, 2 vehicles – provide intensive care facilities.
- Gladstone**:** 16 paramedics, 5 vehicles.

The Queensland Police Service (QPS) district headquarters are located at Gladstone. The Gladstone District includes the City of Gladstone and the neighbouring divisions of Tannum Sands, Calliope and Mount Larcom. The Gladstone communications centre handles all calls for the whole district. The Gladstone Division is staffed by 60 officers in a number of specialised sections on a 24-hour roster. Currently Gladstone is the only 24-hour station in the district. There are a total of 17 police vehicles within the district.

The Gladstone branch of the Queensland Fire and Rescue Service (QFRS) has one full time crew on duty 24 hours a day. Each crew consists of one officer and three fire fighters. The on-shift crew will respond immediately to a callout, with a response time out of the door of less than two minutes. The following additional crews can be called, with the following approximate response times:

- Gladstone, two off-duty crews (full time), 10-15 minutes response.
- Boyne Island, two crews (part time), 10-15 minutes response.
- Calliope, one crew (part time), 10-15 minutes response.
- Rockhampton, two on-duty crews (Hazmat & Fire truck), 2 minute response time.

If required, the State Emergency Service (SES) can also be called on to provide assistance.

Gladstone QFRS also has a specific chemical response team. All of Gladstone's full time fire fighters are hazardous-material trained, as are the majority of part-time fire fighters. Breathing apparatus is available for all fire fighters attending an incident.

An incident in the GSDA would result in immediate response from the on-duty QFRS crew with a hazmat truck, followed by two engines as backup crews became available. It would take approximately 15 minutes for a crew responding to a call to reach the refinery site, during which time the on-site emergency response plan (ERP) will already have been put into action by refinery personnel. It is a requirement that there will be refinery staff on-site who have received emergency response training from an accredited provider (including QFRS).

The refinery will have special fire services (fixed fire suppression) to control on-site fires in particular locations. In the event of a fire, the focus of emergency services will be on supporting this fixed system. In the case of a flammable or toxic vapour cloud, the focus would be on evacuation and isolation of the area.

QFRS expects all weather and all vehicle entry to the site to be available from at least two locations. The site will have one access point (via Hanson and Reid Roads). Another emergency access point will be provided (location to be determined) to ensure that adequate access to the site is available in the event that the main entrance is blocked by an emergency situation.

Two fire units and one hazmat unit will attend a miscellaneous dangerous goods incident, such as a road transport accident. The plant's workplace health and safety (WHS) representatives and possibly the Environmental Protection Agency (EPA) will also be in attendance to provide advice. Spills will be contained and collected in appropriate sized containers. Gladstone SES has access to a commercial truck mounted waste collection unit.

In addition to its existing resources, (including hazmat truck, telescopic aerial pumper, standard medium urban pumper, and light pumper tanker), Gladstone QFRS can obtain use of the following:

- Composite pumpers from Calliope and Boyne Island.
- Rockhampton Capricorn rescue helicopter service (with Bambi bucket).
- Two light fire engines from QAL and Gladstone Power Station.
- A 20 tonne carbon dioxide (CO_2) tender with hose reel from Boyne Smelter.

Gladstone QFRS stores 3,000 L of emergency foam concentrate, which is the largest single store in Queensland outside of Brisbane.

The industries within and around the GSDA have formed the Gladstone Area Industry Network (GAIN). GAIN is an industry network comprising a number of committees made up of representatives of the member companies. These committees provide a mechanism for the discussion of common interest issues and for progressive collaborative activities. This regional industrial synergy provides many benefits namely; environmental, health and safety and community benefits. There are several major industries within GAIN: Queensland Alumina Ltd; NRG Gladstone Power Station; Cement Australia; Boyne Smelters Ltd; Orica Chemicals; Comalco Alumina Refinery; Central Queensland Ports Authority; Gladstone Area Water Board; and Queensland Energy Resources Ltd. GPNL will become active in this group, particularly with regard to development of an ERP within the GSDA.

13.7.2 First Response Teams

On-site "first response" capability will be maintained at the refinery. These teams will also be available to service other project sites in the area. "First response" teams will comprise rescue volunteers from all areas of operations, to ensure an adequate skill base for the teams.

The "first response" team will undertake regular training supported by simulations and competency maintenance in a number of areas such as first aid, rope work, breathing apparatus, fire fighting and suppression, rescue, spill containment and clean-up. The "first response" teams will have all the necessary fire fighting, spill containment, and rescue equipment available on site.

The GPNL "first response" teams will coordinate with similar teams from other local industries through their involvement with the local associations, in particular GAIN. GPNL representatives will participate in the regular fire and emergency management meetings held by GAIN or other relevant associations.

13.7.3 First Aid

First aid kits will be accessible throughout the refinery site and the content of these will reflect the nature of the work being conducted. All vehicles will be equipped with a first aid kit suitable for remote locations and the nature of the work being conducted.

Sufficient personnel will receive accredited first aid training to ensure that injuries can be treated and minimised when necessary.

A nurse or a paramedic and suitable first-aid facilities will be available at the refinery site. The nurse or paramedic will be qualified and authorised to conduct testing, including drug and alcohol testing, as required by GPNL's policies.

13.7.4 Emergency Response Plans

An ERP will be prepared for each work site, including the pipelines, and all personnel will be trained in the plan. For each work site, the supervisor will ensure an evacuation plan, serviceable equipment, and first-aid trained personnel are available. Roles and responsibilities during emergencies will be clearly described. Emergency plans and associated procedures will be displayed in workplaces and all personnel provided with training.

Each ERP will address actions required for specific environmental and safety emergencies both on and off the site. The ERP will be developed in consultation with the DES and be approved by the DES before commencement of operation. The ERP will be developed to complement the following guidelines developed by the CHEM Unit and Queensland Fire and Rescue Authority, and State Planning Policies (SPP):

- Emergency Planning: Guidelines for Hazardous Industry (DES, 2002).
- SPP 1/03 Bushfire Mitigation.

The refinery will be classified as a Large Dangerous Goods Facility. If the refinery is classified as a MHF, the requirements of 'Emergency Plans: Guidelines for Major Hazard Facilities (1996)' will also be met.

Regular reviews of the ERPs and liaison with both DES and GAIN will ensure that emergency response requirements are current. Emergency response drills will be undertaken regularly to ensure workforce familiarisation and to assist with the review and improvement of emergency plans.

Detailed design of the refinery, RSF and associated infrastructure is still to be completed. This design work, combined with development of the ERP with DES, will determine the specific requirements of the aspects of the project described below.

13.7.4.1 Mustering and Incident Control Points

Mustering points will be established for both the construction and operational phases of the refinery development. There is likely to be a minimum of two mustering points located away from the processing plant and located near one of the all weather and all vehicle site access points. Evacuation procedures will be developed with the specific locations in mind.

A number of incident control points will be established, to assist with management of the first response teams during all emergency situations. It is likely that the primary control point will be located in the administration building with other nominated control points established around the refinery during emergency situations.

13.7.4.2 Leak Detection and Control Points

Leak detection systems and control points will be implemented where required to reduce risk on the refinery site. Systems will comprise the following elements; area monitors, personnel monitors and pipeline monitors where warranted. The design of the systems will occur during the detailed design phase of the project.

Process conditions in the seawater and slurry pipelines will be monitored at each end of each pipeline to enable detection of large pipeline leaks.

13.7.4.3 Contingency Procedures

There will be two forms of contingency procedures. The ERP will contain contingency procedures in the form of roles, procedures and tasks for mitigating impacts and recovery after an emergency. There will also be contingency procedures for safe shutdowns of the refinery and pipelines and notification of the adjacent landholders and government authorities. Processes within the refinery will have automatic and manual emergency shutdown systems and procedures in place. These will be designed at the detailed design stage of the project.

13.7.4.4 Security and Site Access

Strategies for site security and access for the construction and operational phases of the Project will be developed during the detailed design phase. For the construction phase, the principal contractor/s will be required to establish security and access procedures and policies, which shall apply to all personnel visiting the site up to the date of practical completion. It is likely that these procedures will be developed further for the operational phase of the project. Policies regarding security and site access will be communicated to all contractors and staff.

As a minimum security measure, the refinery site will have fencing and a 24-hour manned gate house as a singular site access point during the operational phase. A pass system or similar will be utilised to gain access to certain areas of the refinery. All contractors, operational staff and visitors will be inducted to the site. The level of induction will be dependent on the level of refinery access that is required. It is likely that there will be 24 hour security patrols during the construction phase.

13.7.4.5 Hazardous Areas

The hazardous material areas of the refinery and areas of potential flammable emissions influencing electrical hazardous areas for Stage 1 are shown in Figure 13.6.1, which is a preliminary drawing indicating where hazardous materials are likely to be stored or handled. These areas include:

- Natural gas let down/metering station.
- Power station natural gas fired auxiliary boilers.
- Hydrogen plant.
- Hydrogen sulphide plant.
- Solvent extraction plant.
- Nickel reduction area.
- Cobalt reduction area.
- Nickel sintering furnaces.
- Cobalt sintering furnaces.
- Ammonia storage area.

Diesel will primarily be stored at the emergency power generators, fire water pumps and workshop areas.

Each hazardous material storage and use area will have designated spill kits for the containment, treatment and disposal of hazardous materials and wastes. Chemical and fuel specific procedures will be developed with the operating personnel prior to commissioning. The procedures will address requirements for fuel and chemical use, quality control, storage, handling, clean-up and disposal. All procedures will be in accordance with the relevant Australian Standards.

Appropriate safety distances and separation of hazardous materials will be considered when undertaking detailed design of the refinery.

13.7.4.6 Fire Safety and Management

A dedicated fire water system with backup diesel pump will be provided at the refinery. The pressurised fire protection system will comply with: *AS 2941 Fixed fire protection installations; AS 2419 Fire hydrant installations; and AS 2118.1:1999 Automatic Fire Protection Systems – General Requirements*. The areas to be covered by the Stage 1 refinery fire water system are shown on Figure 13.7.1, which is a concept drawing only. Detailed fire water piping layout and hydrant locations will not be determined until the detailed design phase of the project.

The proposed location of the fire water system tank and pumps is in the utilities area in the north-east corner of the refinery site. Fire fighting water will be provided via the filtered water reticulated system.

Flammable liquid storage tanks, reactors and columns will be fitted with fixed fire protection where appropriate for the volume stored or processed. Vessels will be appropriately bunded and will comply with AS 1940:2004 The storage and handling of flammable and combustible liquids.

Yard fire hydrants will be installed to provide external protection to plant and buildings. Where practical, whether the area is covered by sprinklers or not, full coverage of all areas with fire hydrants/hose reels will be provided as a minimum, supplemented with portable hand held fire extinguishers.

The main fire indicator panel for the refinery will be located in the Administration & Control Centre Building Main Control Room, with audible and visual alarms throughout the plant. A mimic panel will be provided at the gate house to provide the attending emergency services a full appraisal of any alarms. Detection systems, manual break glass alarms and audible/visual alarms will be provided throughout the site and networked over a site wide fibre optic communication system.

There will be a dedicated fire water system for any proposed construction workers' villages.

13.8 Workplace Health and Safety

This section describes the impacts of the project on the health and safety of the workforce, and how these impacts will be prevented through engineering design and managed though effective procedures and practices.

GPNL is committed to ensuring that all aspects of the *Workplace Health and Safety Act 1995* (WHS Act 1995) are observed during both the construction and operation of the refinery. As prescribed in Section 28 of the WHS Act 1995, GPNL is committed to ensuring that the refinery provides a safe and healthy workplace for all employees. This will be achieved through the development and implementation of the GPNL HSE management system.

An occupational health and safety risk assessment will be undertaken to assess the major hazards and impacts associated with the construction and operation of the project. The risk assessment will form the basis of a comprehensive occupational health plan, which will be developed and customised to address specific issues for each stage and component of the project.

In recognition of the fact that some products and substances resulting from GPNL's operations, such as some nickel and cobalt, may have negative effects on workers' health, a health surveillance program will be developed in consultation with health professionals and be administered by qualified occupational health specialists. The program will be developed in accordance with current legislation, standards and "best practice" in the industry and will address measures required to mitigate identified health risks.

Contractors working on the site will be required to adhere to GPNL's Safety Management System and HSE policies and plans. This will be reflected in the HSEMPs developed and implemented by contractors to address specific workplace hazards that could be encountered during the contractors' work. To prepare the HSEMP, the construction

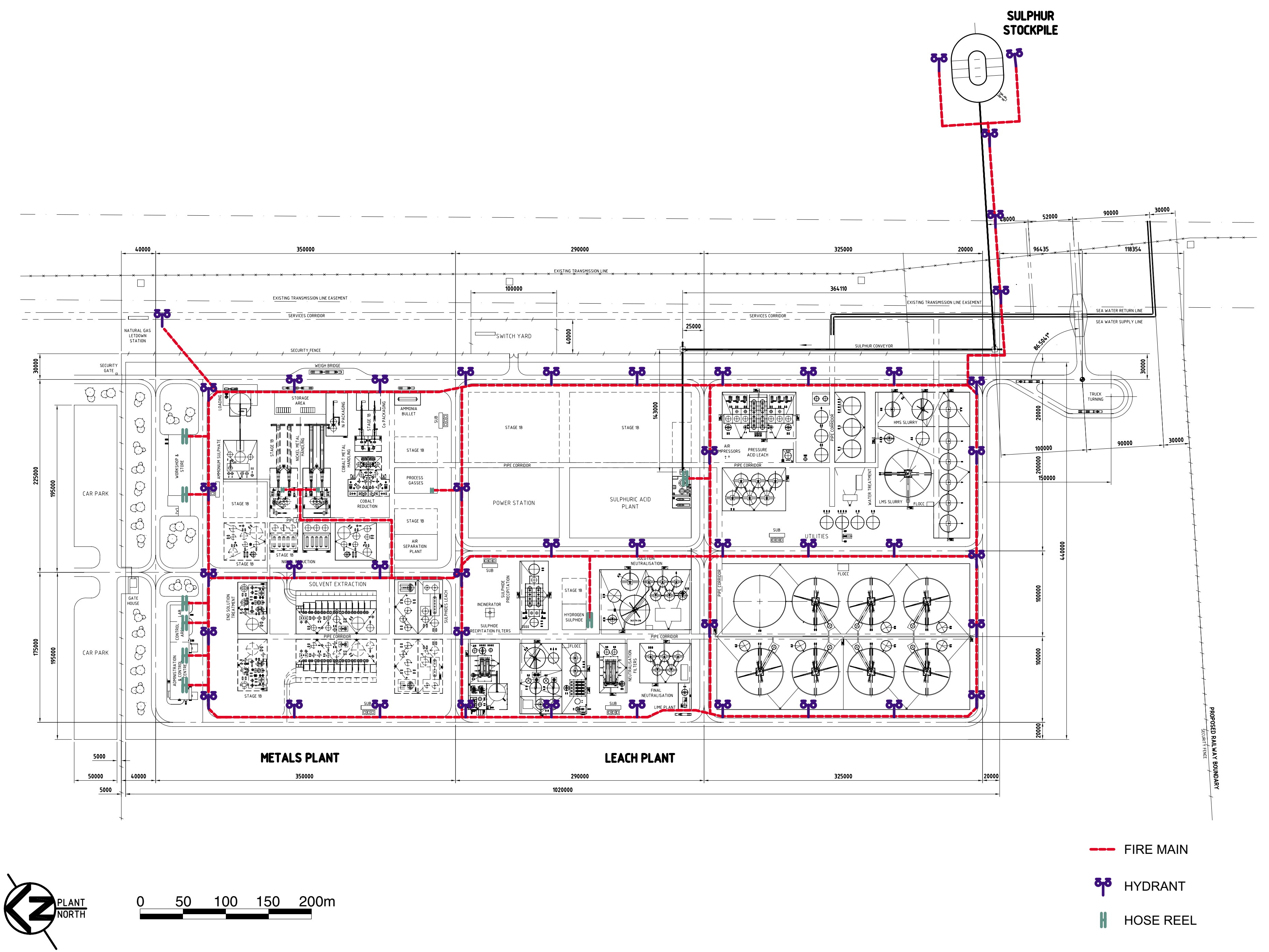
URS

Client: Gladstone Pacific Nickel Ltd

Project: GLADSTONE NICKEL PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Title: PRELIMINARY FIRE SAFETY SYSTEM

Drawn: TN
Approved: CMP
Date: 30/11/2006
Job No.: 42625791
File No. 42625791-g-062b.cdr
Figure: 13.7.1
Rev. B
A4



contractor will undertake a risk assessment to address the potential impacts that may occur during normal day-to-day construction activities. The HSEMPs will be approved by GPNL to ensure consistencies with GPNL's HSE policies and plans.

As part of the contractors' HSEMPs and GPNL HSE policies and plans, a return to work program will be developed and implemented. This will provide details of injury management and rehabilitation programs, including arrangements for medical assessment of injured staff. Contractors will be required to nominate an Injury Management/Rehabilitation coordinator who will liaise with the nominated medical practitioners and administer all aspects of the contractors' programs. This return to work program will ensure injured employees are capable of performing their tasks when returning to work.

GPNL recognises the importance of putting in place effective workplace consultative and communication arrangements to provide a mechanism through which employers, contractors and employees can work together to identify and resolve issues that may affect the health and safety of persons in the workplace. Paramount to the success of the consultative process is the role of the WHS representatives. WHS representatives will be elected by the workforce. GPNL will ensure that the role of the WHS representatives is given the necessary profile and support to ensure the success of the consultative process.

13.9 Workplace Hazards

The key workplace hazards at the refinery will include:

- Hazardous substances.
- Confined spaces.
- Working at heights.
- Fires.
- Vehicle safety.
- Heat.
- Noise.
- Equipment failure.
- Manual handling.
- Natural hazards.
- Pests including mosquitoes and red imported fire ants (RIFA).

Further details on these are given below.

13.9.1 Hazardous Substances

The main workplace hazard at the refinery and RSF is chemical exposure. Details and estimates of the proposed quantities of dangerous goods to be utilised and/or stored are detailed in Section 2.6 and Section 2.7.

A register of all chemicals will be kept on each project site. MSDSs will be included in the register. Prior to delivery to site, all chemicals will be identified and the appropriate means for use, handling and storage will be available on site. All hazardous substances and non-conforming materials (including reworked and recycled materials) will be handled and stored according to industry best practices and legislation. In addition, each storage and use area will have designated spill kits for the containment, treatment and disposal of hazardous materials and wastes. Chemical specific procedures will be developed with the operating personnel prior to commissioning. The procedures will address requirements for chemicals use, quality control, storage, handling and clean-up.

The health surveillance program will include surveillance related to substances which are designated by current rules and regulations. The hazards will be monitored as appropriate through a number of strategically placed detectors and alarms.

13.9.2 Noise

The design of the refinery will ensure that noise levels in the general workplace are as low as possible through good engineering design. Particular consideration will be given to adherence with Part 10 of the Workplace Health and Safety Regulation 1997 (WHS Regulation 1997).

In some instances, due to the nature of the equipment required in some operations, the noise levels adjacent to such equipment have the potential to exceed the prescribed 85 dBA limit set in the Occupational Noise National Standard (NOHSC:1007 (2000)). Where such circumstances have the potential to exist, measures will be taken to minimise exposure of plant personnel to the source of the noise. Such measures could include erecting acoustic barriers so that noise propagation is reduced and noise levels in surrounding operating areas are decreased.

In some circumstances it may not be practical to contain the potential noise. In such circumstances, the extremities of operating areas containing equipment items producing excessive noise will be signposted (in accordance with *Australian Standard AS 1319:1994 Safety Signs for the Occupational Environment*) to notify personnel entering the area that appropriate hearing protection is required. All personnel will be provided with hearing protection that conforms to *Australian Standard AS/NZS 1270:2002 Acoustics – Hearing Protectors* and management systems will be put in place to ensure that plant personnel comply with hearing protection requirements.

Further information on noise and vibrations impacts from the refinery can be found in Section 8.8.

13.9.3 Heat

The refinery process involves the use of materials at elevated temperatures. Through careful engineering design supported by detailed hazard and operability studies, potential hazards to employees through contact with hot substances and surfaces will be identified.

Having identified such hazards, the workforce will be shielded from exposure through the use of appropriate personnel protection (insulation, barriers, etc.) and other engineering practices such that heat impacts on employees will be minimised.

13.9.4 Confined Spaces

If work arises that requires entry into confined spaces, the personnel carrying out the work will be qualified and competent, the correct equipment will be made available and used, a risk assessment will be undertaken and work permits will be obtained. Procedures will be developed for accessing confined spaces, including for inspection and maintenance.

13.9.5 Working at Heights

A risk assessment will be conducted for all work at heights. Any such work will be conducted in accordance with the WHS Act 1995 and WHS Regulation 1997. For work carried out at heights on a regular basis for operations or maintenance, safe work procedures will be developed and implemented.

13.9.6 Fires

In the unlikely event of a fire at the refinery / RSF, emphasis will be placed on the protection of personnel, adjacent buildings and other infrastructure on the site. Refer to Section 13.7.4.6 for details of the proposed fire safety system

13.9.7 Vehicle Safety

Driving policies will be developed to cover all aspects of driving on GPNL property and designated project areas. The following requirements will be included:

- Hazard awareness
- Speed limits and driver behaviour
- Seat belts
- Driving conditions
- 4WD hazard awareness
- Defensive driving
- Offences
- Vehicle selection
- Vehicle equipment
- Vehicle inspection
- Nominated routes
- Drug, alcohol and smoking policy
- Vehicle cleanliness and condition reporting
- Mobile phone use policy
- First aid kits
- Fire extinguishers

13.9.8 Equipment Failure

The risk of equipment failure will be managed through the audit and inspection program. A comprehensive program will be developed and implemented for all equipment on site and associated with the operation of the pipelines. Audit and inspection procedures will nominate frequencies appropriate for the equipment and the activities being performed. Corrective actions that have arisen will be documented, monitored and closed out.

GPNL will implement a program to ensure that workplace personnel are monitored to detect any exposure to potential hazards or non compliance with company standards and procedures. Such monitoring will include routine surveys in all operating areas and at appropriate positions within and around the refinery and RSF.

13.9.9 Manual Handling

All new employees and contractors will receive training in manual handling during the induction process. An external specialist provider will provide comprehensive training in back care and manual handling as appropriate.

Wherever possible, lifting aids will be used to reduce the risk to personnel. Job tasks will be completed for positions throughout the operation and these will be used during the pre-employment process and return-to-work programs to ensure new and injured employees are physically capable of performing their tasks and thereby minimising the possibility of manual handling injuries.

13.9.10 Natural Hazards

13.9.10.1 Cyclones

On a long-term average, approximately 1.4 cyclones pass within 500 km of Gladstone each year. In the past 91 years of detailed record, the centres of 10 of these cyclones have passed within 100 km of the city. Tropical cyclones are generally accompanied by extremes in weather conditions including:

- Severe wind.
- Heavy rainfall.
- Large waves.
- Storm tides.

The main area of concern in Gladstone is the coastal strip in which shielding from the wind and storm tide is likely to be minimal. The local areas in which the overall wind risk is greatest are Barney Point, Boyne Island, New Auckland, Tannum Sands and West Gladstone (AGSO Geoscience Australia, 2001). All project facilities will be built to conform to the appropriate building code requirements for cyclone protection.

13.9.10.2 Storm Surge

A storm surge is an increase in local water level to a height markedly above the predicted tide level, and is usually caused by a combination of low barometric pressure and cyclonic wind fields coinciding with a high spring tide. Under these conditions storm surges can cause widespread flooding of adjacent low-lying coastal areas.

Between 1949 and 1992, there have been at least eight separate surge events at Gladstone. Of these, about a quarter resulted in storm tide levels reaching above the highest astronomical tide level. The Barney Point port area and the Boyne Island area have the greatest level of risk in terms of storm tide inundation (AGSO Geoscience Australia, 2001).

13.9.10.3 Regional Seismic Activity

The Gladstone region is the most seismically active area of Queensland and is the sixth most seismically active area in Australia. Since records have been compiled, the Gladstone region has experienced three earthquakes with a magnitude in excess of 6 on the Richter scale. A magnitude 6 earthquake on 6 June 1918 was one of the largest events felt in Queensland. The epicentre was located offshore approximately 140 km east-north-east of Gladstone.

The pattern of earthquake epicentres shown in Anon (1990) and McCue et al. (1993) indicates that recorded earthquake activity in the region is concentrated principally in two areas. These areas are:

- The offshore Capricorn Group of islands.
- A zone extending from north to Biloela to near Monto.

The recorded earthquakes clustered around the Capricorn Group are mostly of magnitudes 2 to 5 on the Richter scale while those in the Biloela to Monto area are smaller at Richter magnitudes of 1 to 2. In addition, several isolated earthquake epicentres have been recorded throughout the region.

However, the assessment of seismic risk cannot be made by simple extrapolation from seismic source zones defined by clusters of previous earthquake epicentres. The seismic risk maps developed by McCue et al (1993) which are reproduced in AS 1170.4, and by Gaull et al. (1990), incorporate other factors such as ground intensity attenuation, seismic records, geological data and tectonic information are relevant.

From Gaull et al. (1990), it is apparent that the intensities of earthquakes likely to occur between Yarwun and Gladstone may range from V to VI on the Modified Mercalli Intensity Scale. The directly observable effects of earthquakes of intensities V and VI as described in the Modified Mercalli Intensity Scale (Table 13.8.1) are set out in the following from Doyle (1995).

Table 13.8.1 Modified Mercalli Intensity Scale Data

Intensity	Damage
V	Felt outdoors; direction estimated. Sleepers awakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.
VI	Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knick-knacks, books etc off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry cracked. Small bells ring (church, school). Trees, bushes shaken visibly or heard to rustle.

In accordance with statutory requirements, the refinery and all associated structures will be constructed in accordance with AS 1170.4 (SA, 1993). The stated purposes of designing structures for earthquake loads under this standard are to:

- Minimise the risk of loss of life from structural collapse or damage in the event of an earthquake.
- Improve the expected performance of structures.
- Improve the capability of structures that are essential to post-earthquake recovery to function during and after an earthquake and to minimise the risk of damage to hazardous facilities.

The damageability limit state will ensure safety, limit the non-structural damage, and ensure the continued performance of facilities and services. The most severe credible earthquake that may be expected to occur at the site will be used to test safety.

13.9.11 Pests

13.9.11.1 Giant African Snail

A management plan and procedures will be developed and implemented to minimise the risk of importing Giant African Snails (*Achatina Fulica*) and other pests with imported feed materials. The Giant African Snail is one of the world's largest and most damaging land snail pests which can be spread through cargo. It does not occur in Australia, but has spread to much of the Indo-Pacific region. To reduce incursion risks, the Australian Quarantine and Inspection Service (AQIS) has introduced protection measures.

GPNL will comply with relevant AQIS requirements, including those associated with:

- Imported ore supplier and source procedures covering for example, storage prior to shipment and vessel cleanliness prior to loading.
- Procedures for the storage, transportation and handling of imported ore.
- Inspection of discharging cargo.
- Weed control along conveyor route.
- Cleared area buffers around perimeters of ore stockpiles.

13.9.11.2 Red Imported Fire Ants

A red imported fire ants (RIFA) management policy will be developed and implemented during all stages and components of the project. This will ensure compliance with the Department of Primary Industries and Fisheries (DPIF) RIFA policies. The objectives of the GPNL management policy will be:

- To prevent further spread of the RIFA and assist in its eradiation.
- To minimise impacts to wildlife.
- To minimise disturbance to landowners and third parties.

The objectives will be achieved through the following actions:

- Planning and undertaking earthworks to ensure that requirements for fire ant restricted boundaries are not violated.
- Co-operating with DPIF with respect to surveillance programs.
- Conducting awareness training for the workforce on the need for appropriate management of fire ants.
- Training employees and contractors to identify potential RIFA nests.
- Ensuring that vehicles and machinery carrying or that have carried high-risk items will be visually inspected prior to leaving the site to ensure these are not carrying RIFA.

A RIFA management plan is discussed in Section 14.

13.9.11.3 Mosquitoes

Mosquito management policies will be developed for the construction and operational phases of the project. The aim will be to minimise conditions which favour mosquito breeding sites and to implement measures to eliminate such breeding sites during all stages and components of the project. This will ensure compliance with the Queensland Health's *Guidelines to Minimise Mosquito and Biting Midge Problems in New Development Areas* (QLD Health, 2002*)*. The measures to prevent and manage mosquitoes stipulated in Division 2 of Part 8 of the Queensland *Health Regulation 1996* will be adopted. This will be achieved through the following actions:

- Include mosquito control as part of GPNL's induction program for employees and contractors.
- Train employees and contractors to identify mosquito breeding sites.
- Report locations of all breeding sites.
- Dispose of redundant/unwanted objects holding water as soon as possible.
- Where breeding sites are identified, ensure these are eliminated in accordance with EPA regulations.

A mosquito management plan is discussed in Section 14.

13.9.12 Monitoring of Workplace Hazards

GPNL will implement a program that ensures that workplace personnel are monitored to detect any exposure to potential hazards or non compliance with company health and safety standards and procedures. Such monitoring will include routine surveys in all plant operating areas and at appropriate positions around the refinery and RSF. The result of these surveys will be used to identify worker exposures in comparison to exposure standards.

GPNL will ensure that all employees are involved in the health and safety monitoring program and have routine personal health assessments so that there is a continual assessment of their general health. All personnel will be required to undergo regular medical examinations. Such assessments will provide assurance that personnel are not being exposed to hazards in the workplace which result in an impact on their health and do not adopt practices that place their health at risk.

13.9.13 Personal Protective Equipment

All employees will receive and be required to use, personal protective equipment (PPE) appropriate to their roles, including hard hats, safety glasses, gloves, hearing protection, flame-retardant/anti-static clothing, steel capped safety boots and specialist PPE such as personal respirators. These provisions will not only help to protect workers from chemical exposure, fire and explosion but also from other risks such as falls, thermal burns, hand injuries, noise exposure etc. New employees and contractors will be trained in the use of PPE during the induction process. All PPE provided will comply with the appropriate Australian Standards.

13.9.14 Workplace Health and Safety Training

A key activity in the HSE program is to establish, monitor and control the training and competency levels required to underpin a world class HSE outcome. All staff working on site, including contractors and management, will be required to be competent in the safe performance of their work. A training matrix will be developed as part of the management system and this will show the relevant qualifications required for each category of employee. The critical safety competencies for all project roles are identified in Table 13.8.2. In addition, specific workplace health and safety training for the project will be developed. These will be updated as a result of the processes and experience of the project. Progress status of all personnel site safety competencies will be monitored and reported as per the requirements of HSE record management procedures.

Table 13.8.2 Critical Safety Competencies for all Project Roles

Course	Objective	Topics Covered
Project Induction	Promote safety awareness and understanding of project HSE philosophy and HSEMP	HSE objectives for project; ZERO accident philosophy; personal risk management
Contractor Induction	Introduction to Engineering, Procurement and Construction Management (EPCM) contractor's HSE Policy, HSE mindset and office HSE requirements	HSE mindset value; emergency procedures, incident reporting, etc
GPNL Site Induction	Promote safety awareness and understanding of site HSE requirements	GPNL site-specific emergency procedures, work permit system, incident reporting etc.
Incident Recording System Training	Provide sufficient skills to use GPNL incident management system to record incidents	Entering incident reports, incident investigation, managing actions
Root Cause Analysis	Provide understanding of root cause analysis techniques	Root cause analysis technique
Job Hazard Analysis (JHA)	Apply JHA technique	Workplace hazard identification, risk assessment and control
Special Training	Promote safety awareness and provide specialist training for major hazard control	Topic and work team specific