PLANAGER
Risk Management Consulting

RISK ASSESSMENT FOR KNAUF INSULATION GLASS WOOL MANUFACTURING FACILITY STEEL RIVER INDUSTRIAL ESTATE, NEWCASTLE, NSW

Prepared for: URS Australia Pty Ltd

Document Number: URS\15-B211

Revision B

Prepared by: Karin Nilsson

24 June 2009

PO Box 248
Berowra Heights NSW 2082
Telephone: [02] 9985 1056
Facsimile: [02] 9427 7851

PLANAGER
Risk Management Consulting

Risk Assessment for Knauf Insulation Glass Wool Manufacturing Facility Steel River Industrial Estate, Newcastle, NSW

Acknowledgment

The author would like to thank the teams from Knauf Insulation, Crown and URS Australia for his assistance in forwarding the relevant information and preparing this report.

Disclaimer

This report was prepared by Planager Pty Ltd (Planager) as an account of work for URS Australia Pty Ltd. The material in it reflects Planager's best judgement in the light of the information available to it at the time of preparation. However, as Planager cannot control the conditions under which this report may be used, Planager and its related corporations will not be responsible for damages of any nature resulting from use of or reliance upon this report. Planager's responsibility for advice given is subject to the terms of engagement with URS Australia Pty Ltd.

Rev	Date	Description	Prepared By	Authorised By
A	05/06/2009	Draft for Comment	Karin Nilsson	Nick Ballard
B	24/06/2009	Final	Karin Nilsson	Nick Ballard

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

EXECUTIVE SUMMARY

E1. Introduction

Knauf Insulation are seeking permission for the development of a glass wool manufacturing plant at Steel River Industrial Estate in Newcastle, NSW.

The plant will produce a variety of insulation products including glass wool, white wool and recycling line.

The Preliminary Risk Screening in accordance with the *State Environmental Planning Policy No 33* concluded that the proposed development is not defined as *potentially hazardous*. Hence a *Preliminary Hazard Analysis* (PHA) is not required as per the standard requirements for so called *Potentially Hazardous Development*.

Even though a PHA is not required, a risk assessment has been conducted as part of Knauf Insulation's internal risk management requirements.

This risk assessment has been prepared in accordance with the NSW Department of Planning *Guidelines for Hazard* Analysis, with their *Multilevel Risk Assessment,* and with the Australian Standards for *Risk Management*.

The risks associated with the proposed development were assessed using the risk matrix approach described in the Australian Standards *Risk Analysis of Technological Systems* to determine whether the activities proposed for the site are managed in accordance with *As Low As Reasonably Practicable (ALARP)* principles and whether they constitute an escalation of existing hazards and risk in the area.

The risk assessment format was further used to provide an overview of the fire safety requirements for the proposed site. Detailed fire safety requirements can then be determined once detailed design and layout is complete.

E2. Main Risks

The main risks associated with the proposed site are listed in the table below.

Table E1 – Main Risks Associate with the Development

HAZARD POTENTIAL	INSTALLATIONS OR AREAS CONCERNED
Fire	Combustibles building (wood, paper, cardboard, plastics storage) Finish product overhead storage area Polymerisation oven General fire issues in office building and workshop
Emissions of toxic fumes following a fire in a storage area	Combustibles building (wood, paper, cardboard, plastics storage) Finish product at storage area
Fire / explosion following the formation of an explosive mixture	Fusion furnace Polymerisation oven Acetylene bottles LPG storage
Leak of oxygen	Oxygen plant Oxygen transport
Legionella emission	Air cooling towers
BLEVE	LPG bottle storage
Environmental pollution	Aqueous ammonia and storages of relatively benign raw materials. Spillages and contamination of raw materials

The risk profile of human injury and environmental pollution associated with the proposed site is in general classified as ***Low***. This is due to the combination of low severity scores with low likelihood scores for most of the potential incident scenarios identified for the new site.

There are some incident scenarios that have been classified as of ***Intermediate*** risk, which in each case relates to the potential for a high severity score even though the likelihood score (i.e. the probability of occurrence of the incident) is low.

E3. Conclusions

The preventative and protective systems proposed and recommended for the site match the hazard and hence the risk associated with the site is *low* to *intermediate* in accordance with the risk ranking methodology in AS4931 Risk Assessment for Technological Systems.

The activities proposed for the site do not constitute a major escalation of existing hazards and risk in the area.

Given the low and intermediate risks associated with the raw materials and products, designing for the recognised hazards by using appropriate Company and regulatory Codes and Standards will provide adequate prevention and protection against hazardous events.

The scoring of this development as not *Potentially Hazardous* in accordance with the Department of Planning Guidelines SEPP 33 appears consistent with these conclusions and further Departmental approval should not be required for this development.

E4. Assumptions in this PHA

To ensure the risk from the site is kept at a minimum a series of safeguards and risk management strategies will be implemented (listed in order of appearance in the report), as follows:

- Storage and unloading areas will be designed in accordance with AS3780 for corrosive substances (incl. bunding requirements).
- Hot work permit system will be established for all hot work such as welding, grinding etc.
- HAZOP or other structured hazard identification technique will be used to determine adequacy of process controls, trips and alarms, in particular for the oxygen plant and oxygen transportation and for the use of natural gas at the furnace.
- Hazardous Area Classification (zoning) required in accordance with Australian Standards. Electrical equipment design will be determined in accordance with Hazardous Zones.
- Location of natural gas isolation valve will be determined to allow for rapid isolation from a safe location in case of an incident.
- Location of oxygen gas isolation valve will be determined to allow for rapid isolation from a safe location in case of an incident.
- *The storage and handling of LP Gas* to be referred to in the design of the LPG storage.

- Knauf Insulation will prepare a fire safety strategy or other fire safety study to determine the required fire systems for the site.
- Hydrants and hoses will comply with standards and code requirements (as required in the fire safety strategy). The location of hose reels and hose reels will be determined in accordance with applicable Australian Standards (including AS1940, AS2419.1, AS1221 and AS2441) and with Building Code of Australia requirements.
- Portable fire extinguishers will be strategically located at the plants and within the building as per Australian Standard and BCA requirements. (Portable fire extinguishers will comply with AS2444. The testing of the fire extinguishers will comply with AS1850).
- Fire water application rates and hence fire water demand will be determined.
- Fire water containment strategy will be established for the site.
- At least two emergency access points for the fire brigade will be provided to access the site.
- All fire protection equipment will be maintained to AS1851.
- Site fire protection drawings will be prepared to show the exact location of all forms of fire protection once the detail design has finished, and the emergency procedures will include this drawing.

GLOSSARY

ALARP	As Low As Reasonably Practical
AS	Australian Standard
BCA	Building Code of Australia
C1	Combustible Liquid of flash point <165^{o}C
C2	Combustible Liquid of flash point >165^{o}C
DG	Dangerous Goods
DUAP	Department of Urban Affairs and Planning
E	Environmental issue
H&S	Health and Safety issue
HAZOP	Hazard and Operability Study
LFL	Lower Flammable Limit
MSDS	Material Safety Data Sheet
NG	Natural Gas
PHA	Preliminary Hazard Analysis
PPE	Personal Protective Equipment
SH&E	Safety, Health and Environment

REPORT

1 INTRODUCTION

1.1 BACKGROUND

Knauf Insulation are seeking permission for the development of a glass wool manufacturing plant at Steel River Industrial Estate in Newcastle, NSW.

The proposal involves the design and construction of a 24 hour operational facility covering an area of approximately 30,000 square metres. Roads, infrastructure, landscaping and utilities provision are also proposed.

The plant will produce a variety of insulation products including glass wool (roof insulation), white wool[1] (blowing wool where accessibility into roofs and walls is restricted) and recycling lines (i.e. yellow wool used to insulate walls).

1.2 SCOPE AND AIM OF THIS PRELIMINARY HAZARD ANALYSIS

1.2.1 Preliminary Risk Screening to SEPP 33

As part of the development application process, the NSW Department of Planning has requested that a preliminary risk screening be conducted in accordance with the Guideline Applying SEPP 33 (Ref 1). This screening is presented in Section 2 below.

As can be seen from the screening, the proposed development is not defined as *potentially hazardous* (as defined in the *State Environmental Planning Policy No 33*). Hence a *Preliminary Hazard Analysis* (PHA) is not required as per the standard requirements for so called *Potentially Hazardous Development*.

1.2.2 Risk Assessment Knauf Insulation Internal Risk Management Strategy

As part of Knauf Insulation's internal risk management practices an assessment of risks associated with the proposed development has been conducted and is summarised in the present report.

Even though a PHA is not required for the proposed development (as per the definitions in SEPP 33, see above), the risk assessment has been conducted in accordance with the NSW Department of Planning *Guidelines for Hazard*

[1] As determined by market conditions

Analysis (Ref 2), with their *Multilevel Risk Assessment* (Ref 3) and with the Australian Standards for *Risk Management* (Ref 4).

The risks associated with the proposed development were assessed using the risk matrix approach described in the Australian Standards *Risk Analysis of Technological Systems* (Ref 5).

The aim of the risk assessment is to determine whether the activities proposed for the site are managed in accordance with *As Low As Reasonably Practicable (ALARP)* principles and whether they constitute an escalation of existing hazards and risk in the area.

1.2.3 Providing an Overview of Fire Safety Requirements

The risk assessment format also is used to provide an overview of the fire safety requirements for the proposed site. Detailed fire safety requirements can then be determined once detailed design and layout is complete.

2 Results of the Preliminary Risk Screening in Accordance with Guidelines Applying SEPP 33

As part of the requirements by the Department of Planning a Preliminary Risk Screening to State Environmental Planning Policy No. 33 (SEPP 33) is required for the proposed development.

SEPP 33 represents the approach used in NSW for planning and assessing proposals for industrial development. Through the policy, the permissibility of an industrial proposal is linked to its safety and pollution control performance.

SEPP 33 ensures that only those industrial proposals which are suitably located, and able to demonstrate that they can be built and operated with an adequate level of safety, can proceed.

SEPP 33 applies to any proposals which fall under the policy's definition of 'potentially hazardous industry' or 'potentially offensive industry'. For development proposals classified as 'potentially hazardous industry' the policy establishes a comprehensive test by way of a preliminary hazard analysis (PHA) to determine the risk to people, property and the environment at the proposed location and in the presence of controls.

SEPP 33 is based on the quantity of dangerous goods involved in the proposal and, in some cases, the distance of these materials from the site boundary.

The table below lists the Dangerous Goods that will be stored and handled on the site.

Table 1 – Dangerous Goods to be Stored and Handled

PRODUCT NAME	MAXIMUM QUANTITY ON SITE	COMPOSITION	DANGEROUS GOODS CLASS	SEPP 33 SCREENING THRESHOLD
Ammonia solution	Atmospheric storage tank 30m^3	Aqueous ammonia solution with 25% ammonia.	DG Class 8 PGIII	50 tonnes
Natural Gas	No buffer storage. Used as fuel in the furnace. Supplied via a delivery station with pressure reduction to 2.5-3 bars and then delivered via underground piping (DN150 pipe diam.).	Methane (CH4): 86 to 98 %; Ethane (C2H5): 2 to 9 %; Carbon dioxide: < 3 %; Trace elements.	DG Class 2.1	Not applicable as no storage on site

PRODUCT NAME	MAXIMUM QUANTITY ON SITE	COMPOSITION	DANGEROUS GOODS CLASS	SEPP 33 SCREENING THRESHOLD
LPG	Storage method: In bottles, Total quantity on site is less than10 tonnes.	Propane (70%) and butane (30%) mixture	Class 2.1	10 tonne
Oxygen	Used in the furnace Supplied from oxygen plant to furnace via pressure piping. Stored in two pressure vessels (for use as backup supply)	Pure oxygen	DG Class 2.2 Subsidiary Risk Class 5.1	DG Class 2.2: Excluded from risk screening. Subsidiary risk DG Class 5.1: 5 tonnes. Not applicable as none of the other DG Classes exceed threshold quantities.

As can be seen in the table above SEPP 33 is not applicable for the proposed development provided that the LPG storage quantity is kept below 10 tonnes.

The subsidiary risk of 5.1 for oxygen is only counted should the LPG threshold quantity exceed the 10 tonnes.

Hence, the proposed development is not *Potentially Hazardous* (as per the definition in SEPP 33) and a PHA is not required as part of NSW Department of Planning requirements.

As the above dangerous goods are readily understood this PHA does not include the Material Safety Data Sheets (MSDSs).

3 METHODOLOGY FOR THE RISK ASSESSMENT TO KNAUF INSULATION REQUIREMENT

3.1 OVERVIEW

A detailed review of the proposed installation was performed to qualitatively assess the risk associated with the facility. Its main objective is the preparation of a robust Hazard Register, which includes the information on the cause, consequence and safeguards (prevention and mitigation) associated with facility. By using a risk ranking tool it allows ranking of the hazards according to their specific levels of risks.

The risk associated with the proposed site was evaluated qualitatively using the methodology proposed in the Australian Standards for *Risk Management (*Ref 4) and for *Risk Analysis of Technological Systems* (Ref 5).

The step by step methodology is as follows:

- Identification of the potential hazards associated with the facility;
- Assessment of the adequacy of the protection systems in keeping with identified hazards; including containment, maintenance, Australian Standards requirements and industry best practice;
- Ranking of hazards using a qualitative risk assessment methodology, based on a decision matrix system incorporating both the consequences and likelihood associated with identified hazards;
- Recommendations for improvements.

3.2 RISK MATRIX

The risk assessment matrix, which is shown in the accompanying figure, is a graphical portrayal of risk as the product of likelihood of occurrence and consequence severity. Risk scenarios are identified for the facility or system under consideration. A risk scenario is a hypothetical sequence of steps having an identifiable cause and consequence.

The risk matrix requires proper use of guidelines to assess both the likelihood and consequence. The consequences may vary from a safety or health consideration to an environment outcome. The resultant profile of the hazard scenario could be potentially quite different depending upon the issue it is being rated on. The Risk Matrix presented below is based on that proposed in AS3931 (*Risk Analysis of Technological Systems*).

Table 2 - Hazard Scenario Risk Assessment Matrix

Likelihood of occurrence	Risk class			
	Severity class			
	Catastrophic	Major	Severe	Minor
Frequent	HIGH	HIGH	HIGH	INTERMEDIATE
Probable	HIGH	HIGH	INTERMEDIATE	LOW
Occasional	HIGH	HIGH	LOW	LOW
Remote	HIGH	HIGH	LOW	LOW
Improbable	HIGH	INTERMEDIATE	LOW	TRIVIAL
Incredible	INTERMEDIATE	INTERMEDIATE	TRIVIAL	TRIVIAL

A likelihood of occurrence was assigned to each identified hazardous event. The contribution of the preventative and protective features to the occurrence of hazardous events was taken into account when assessing the likelihood of occurrence of each hazardous event. The frequencies of occurrence used for this risk assessment are listed in Table 3 below (from figure 4 in Ref 5).

The potential consequences and outcomes were assessed for each potential incident. These consequences assessed include both threats to the natural environment and to health and safety as defined in Table 4 and Table 5 below. Where a hazardous event may have several outcomes each potential outcome was assessed in turn. The severity classes for health & safety type outcomes are taken from figure 4 in the Australian Standard in Ref 5 while those for the threat to the natural environment are interpreted from the classification system proposed by Professor H M Tweeddale (Ref 6).

Table 3 – Likelihood of Occurrence for Hazardous Events

Likelihood of occurrence	Indicative Likelihood (per year)	Description
Frequent	0.1	Expected to occur typically once per year or more.
Probable	1 – 0.1	Expected to occur several times in the life of the site.
Occasional	0.1 – 0.01	Not likely to occur within the life of the site, but possible.
Remote	$0.01 – 10^{-4}$	Very unlikely to occur within the life of the site.
Improbable	10^{-4} - 10^{-6}	Examples of this type of events have historically occurred, but not anticipated for the site in this location.
Incredible	$<10^{-6}$	Theoretically possible, but practically incredible

Table 4 – Severity Classes for Health and Safety Issues

Severity Class	Description
Catastrophic	▪ Many fatalities.
Major	▪ One or Few fatalities.
Severe	▪ Hospitalising injuries.
Minor	▪ No injuries.

Table 5 – Severity Classes for Environmental Issues

Severity Class	Description
Catastrophic	▪ Extremely severe pollution.
Major	▪ Major local pollution.
Severe	▪ Significant local pollution.
Minor	▪ Spill contained on site, no pollution.

The risk scenarios are plotted on the Risk Matrix in order to estimate risk. The highest risk scenarios are judged to have the highest priority for consideration of additional risk reductions options. Low risk scenarios are subject to the normal, ongoing improvement process. Any scenarios falling within the "Catastrophic" or "Major" columns of the matrix should be retained in the Hazard Register, regardless of whether the risk is deemed to be low or trivial.

4 SITE DESCRIPTION

4.1 LOCATION

The site is located on the Pacific Highway, Mayfield West within the Steel River Industrial Estate (Newcastle LGA) and is approximately 9 km North West of Newcastle CBD. The location of the site is presented in Figure 1 below.

The site is bounded by Pacific Highway (south), Pambalong Drive (east), Hunter River (north) and the Kooragang Goods Rail Line (West). Access to the site is via Steel River Boulevard and Channel Road which are accessed from Industrial Drive.

The site covers and area of 23 hectares.

Other developments within the Steel River Estate include Intec Metal Refinery, Horan Steel, Ulrich Aluminium, CSIRO's Energy Research Division, Hunter Water Corporation facilities, and smaller strata titled industrial lots. Detached residential dwellings are situated south of the Pacific Highway.

The site layout and side elevation are presented in Figure 2 below.

4.2 SITE OCCUPANCY AND HOURS OF OPERATION

The site will operate on a 24 hours per day 7 days per week basis.

Approximately to 50+ people will be present on site during day shift, including shift operators and management personnel, administration personnel, and maintenance personnel.

Outside of day shift approximately 20 people will be present.

The site will employ approximately 130-140 full time equivalent staff over three shifts.

Figure 1 – Site Location

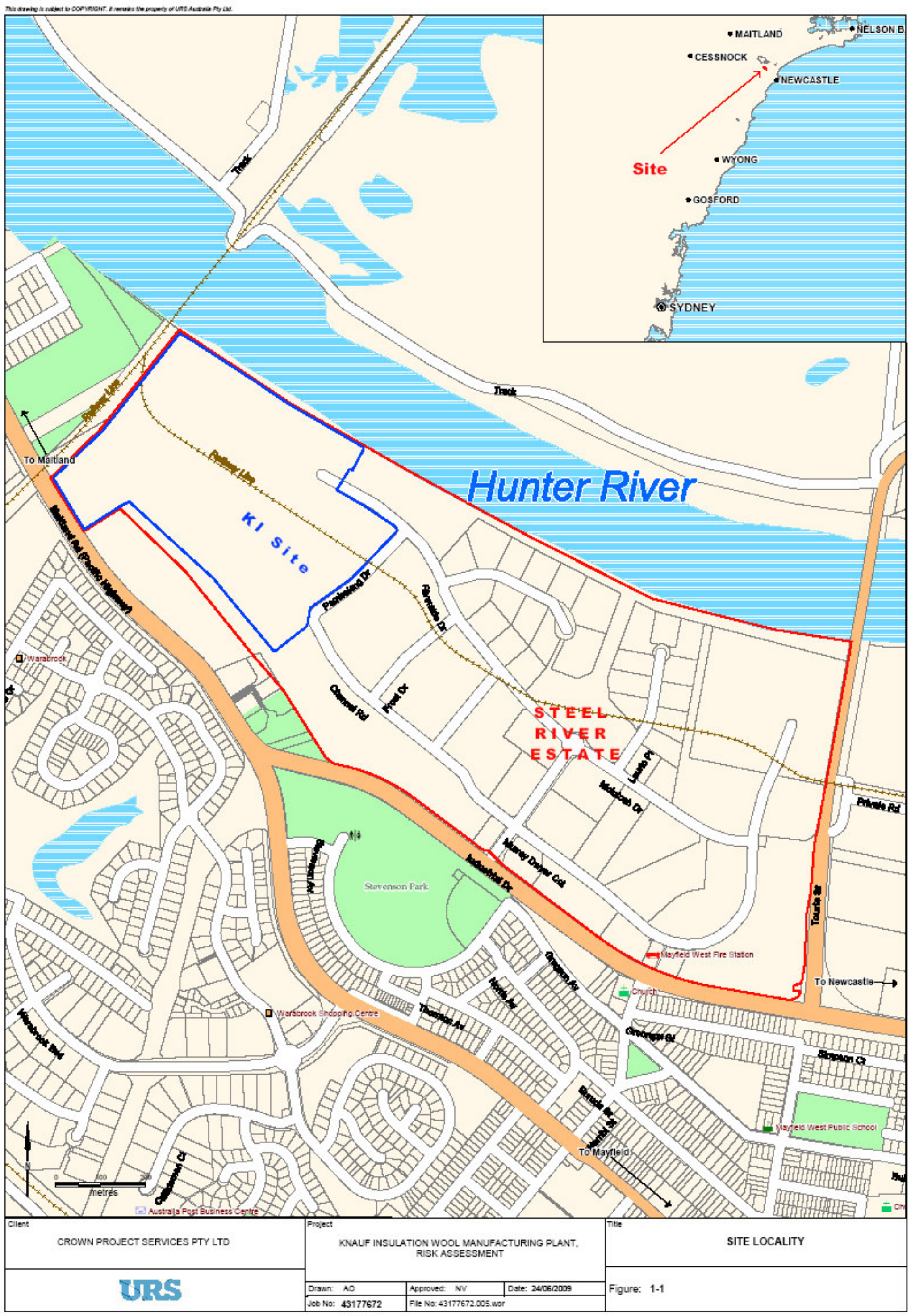
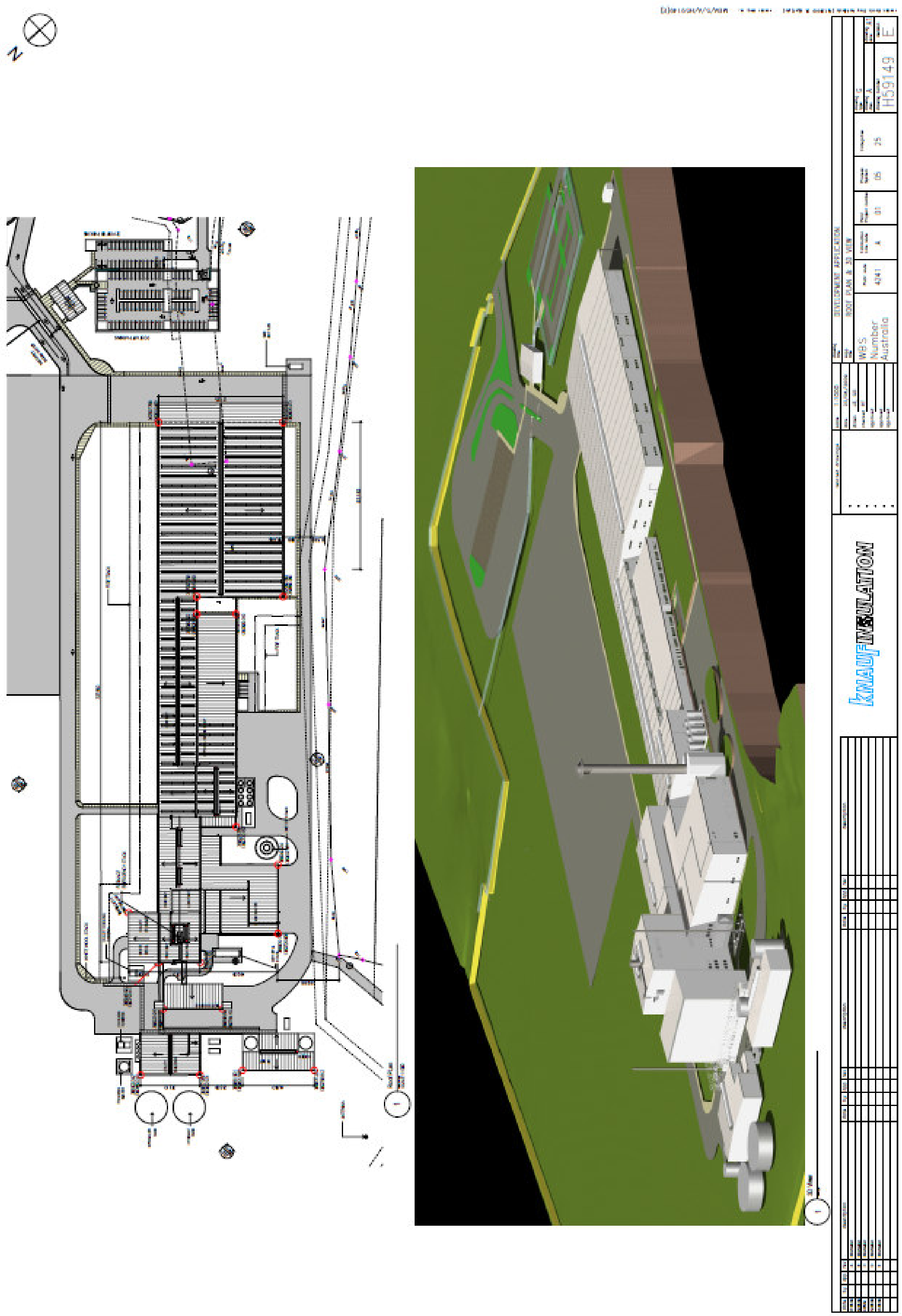


Figure 2 – Site Layout and Side Elevation



4.3 SITE INFRASTRUCTURE

Site infrastructure will be as follows (refer to Figure 2 above:

- In the middle of the site is the *High Bay Area*, including:
  - oxy-gas fired furnace;
  - forming;
  - dry electrostatic precipitator;
  - cooling tower;
  - cullet storage (west of the High Bay building) and
  - Wash Water.
- Also in the middle of the site, running Northwest to Southeast *Low Bay Area*, including:
  - offices;
  - canteen;
  - laboratories;
  - Multi Pack System (MPS) and
  - Binder.
- On the Western side of the site, away from other process buildings and storage areas is the Oxygen plant;
- The Utilities building is located slightly to the North of the Oxygen plant;
- West of the High Bay area is located the Batch house;
- Cooling towers and process water tanks;
- Diesel generators;
- LPG station;
- Four emission stacks, the highest being approximately 60 metres high;
- The storage area for finished products is located to the North of the site at an (uncovered) area of 20,000m^2;
- Utilities building (for compressors, cooling water and firewater pumps);
- Fire water tank; and
- Internal road system to create a circular truck access route, guardhouse, parking areas and retention pond.

4.4 Site Security

The site will have normal security arrangements, including a 2 metres high fence (with inward bend and barb wire) to side boundaries, as well as a back-to-base alarm system with established Security firm (to be determined). Each gate will be locked or maned by a security guard (the main gate will be a boom gate with security hut).

4.5 Operations on Site

An overview of the processes to be conducted on site is presented in Figure 3 below. The process flow diagram is presented in Figure 4 below. The operations on the site are as follows:

4.5.1 Glass Wool Manufacturing

One line for glass wool manufacturing. The raw materials for glasswool, mainly sand and recycled glass bottles, will be mixed and conveyed into a gas fired furnace at 1200°C and transformed into molten glass. This molten glass is then converted into *wool fibres* through centrifugal force. A solution of binder is sprayed on the fibres forming a ‘blanket’ of glasswool which, after curing is ‘cut to size’ and compression packed as roll or in batt.

4.5.2 White Wool Manufacturing

One line for white wool manufacturing. The melted glass from the same gas fired furnace is fiberized but not sprayed with any binder. Instead, fibres are crushed, sprayed by silicone, oil and antistatic material and packaged in bags. Final application of the product is done through a blower machine.

4.5.3 Yellow Wool Manufacturing (Recycling Line)

Off-spec ‘blankets’ of glass wool or off-cuts from the production line, are crushed and recycled and then packaged in bags.

Figure 3 – Overview of Process Operations

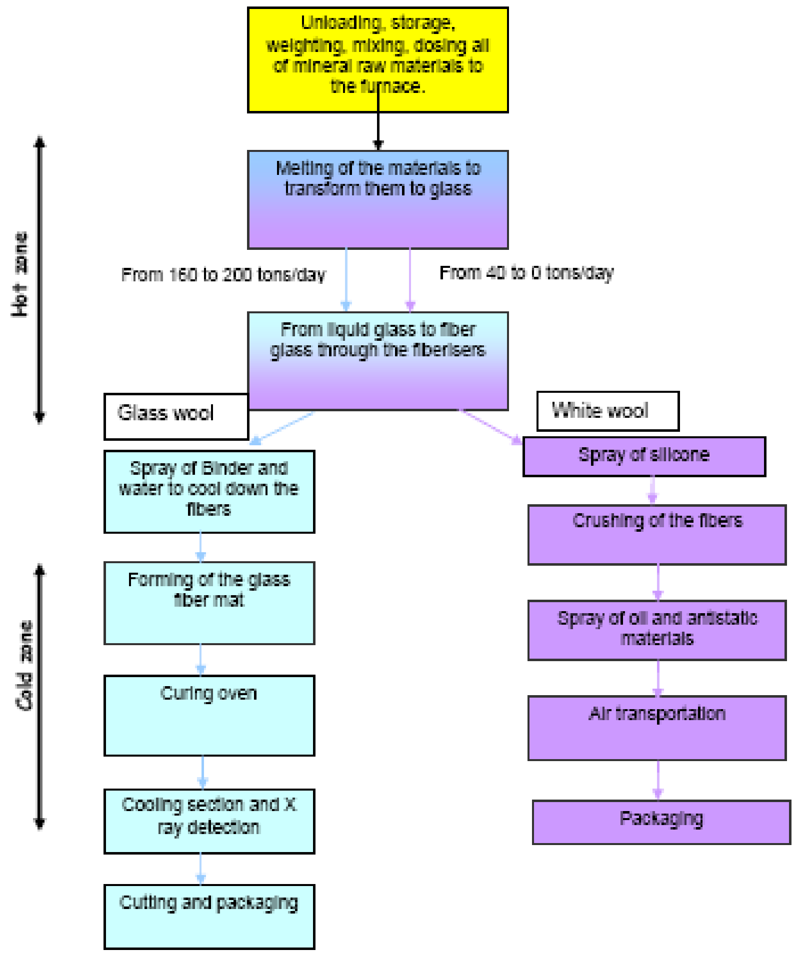
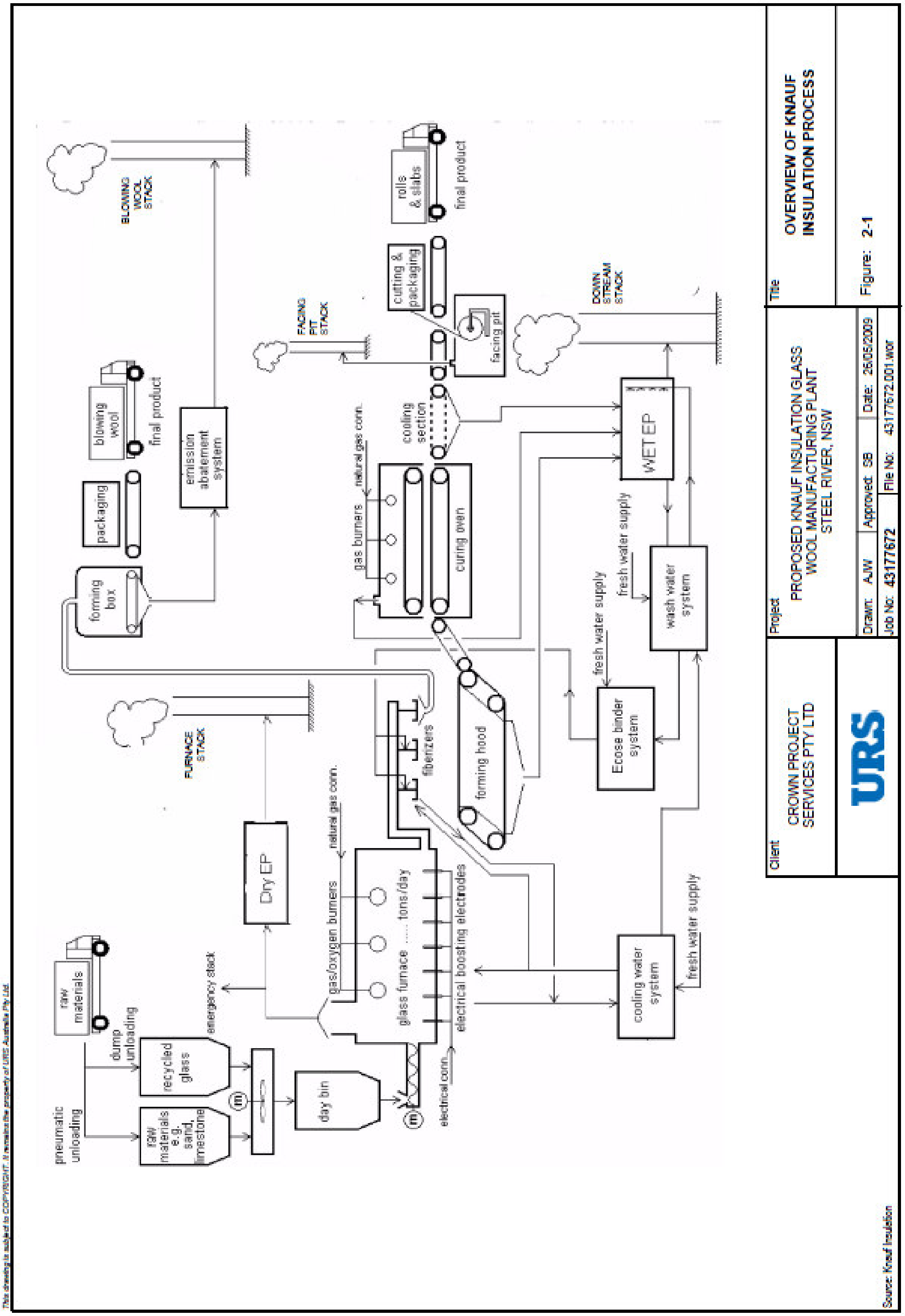


Figure 4 – Process Flow Diagram



4.6 Production Capacity

The line will be designed to support a product range of Glass wool and White wool that can vary between following two limits (tonnes of molten glass per day):

	Glass wool	White wool
Limit 1	200 t/day	0 t/day
Limit 2	160 t/day	40 t/day

Off-cuts from the production line are recycled in a separate production line to produce Yellow Wool.

4.7 Materials Storage

4.7.1 Raw Material

The storage capacity for the raw materials will be designed for 3 to 4 days storage. The number of daily incoming trucks is 12. The furnace will be designed for an external cullet ratio of 15%. Raw Materials will be stored in the Low Bay building on the North Side of the Site.

Off loading of raw materials from trucks into hoppers will be dune using pneumatic system. Tip truck unloading will be used for cullet and sand. There will be no rail cart unloading. Mixed batch / cullet charges will be conveyed by belt conveyors to the furnace day bins.

The yearly consumption of raw material is as follows:

Type	Raw material in (Ton/year)
Sand	31,368
Soda ash	10,382
Borax	6,350
Nepheline	2,334
Dolomite	3,494
Limestone	6,122
Plate or Bottle Cullet (15%)	10,596

4.7.2 Finished goods storage

An outside, uncovered storage area of 20,000m^2 will be provided, allowing the storage of Finished product stacked 2 pallets high. Transport 24 hrs on working days except for on Saturdays, Sundays or Public Holidays. The number of daily trucks is about 50.

4.7.3 Furnace

At the heart of the glass wool manufacturing plant is the furnace which is made by refractory bricks with a steel structure frame. The design capacity of the furnace is 200tons/day and 60,000tons/yr of molten glass (with a maximum capacity of 80,000t/yr of molten glass).

The furnace is fuelled by a mixture of natural gas and oxygen. Natural gas is provided to site through a gas main. The oxygen is produced on site using mainly an adsorption system. As a back-up, two tanks of liquid oxygen are also added.

The exhaust is cooled by outside air, pass through a so called *Dry EP* and goes to the stack. There is an emergency stack which is used in case of Dry EP maintenance (estimated to be a few hours each year).

4.7.4 Oxygen Manufacturing

The furnace is fuelled by a mixture of oxygen and natural gas. Oxygen produced on site limits environmental impact such as reduced need for truck transportation, and reduction of NO_x emissions from fuel furnaces.

The oxygen plant will be supplied as a turn-key skid-mounted unit to the site and will be housed in a separate building located to the North West of the site. It is shown in the blue rectangle in Figure 2 above.

The supplier of the oxygen plant has not been determined as yet. However, the general principles of the oxygen generation technique to be used at the site is known (note that other Knauf Insulation plants around the world use the same or similar techniques).

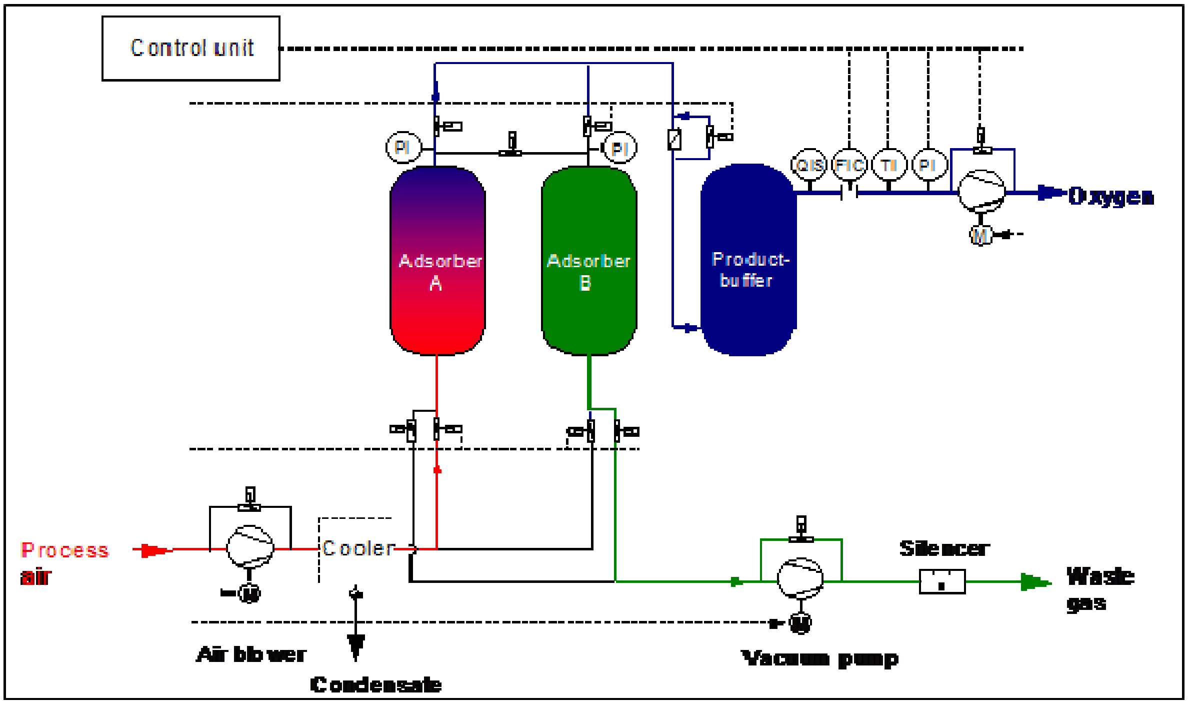
In essence, oxygen will be produced in the oxygen plant to a purity of 90% and delivered directly for use in the furnace or alternatively it will be compressed and stored in two liquid oxygen storage vessels for use as back-up in case of unit shut-down.

The oxygen plant will use dried, filtered and cooled atmospheric air and remove nitrogen from the air through adsorption. The oxygen will then be compressed from ambient pressure to the pressure required for the process.

The plant will be designed to generate gaseous oxygen 24-hours-a-day, with a back-up system which provides uninterrupted oxygen in case of a unit shut-down.

A process flow diagram of the oxygen plant is presented in Figure 5 below.

Figure 5 – Process Flow Diagram Oxygen Plant



4.8 OTHER PROCESSES ON SITE

4.8.1 Fiberizers and Curing Oven

The glass wool produced in the furnace will pass through the fibrizers where the glass fibre mat is formed and where the binder (Ecose) is applied. The fibre mat is then cured in the curing oven.

4.8.2 Cooling

Some of the parts in the process need to be cooled down with water. To do so, open cooling tower(s) will be used. The typical cooling power is 6000kW.

There is also an independent cooling water system which cools down the molten glass when the fibres production is stopped. The glass is transformed in cullet and re-used afterwards in the furnace as raw materials.

4.8.3 Cutting and Packaging

The glass wool is finally cut and package before dispatched as finished product to storage.

4.9 TRANSPORTATION OF GOODS

It is intended that shipment of raw materials to the site and distribution of finished products will be by road. Proposed truck movements into the site will average about 3,000 raw materials trucks per year and out of the site will average about 11,000 finished goods per year. Out of these the very large proportion are non Dangerous Goods (non DGs). The following Dangerous Goods transport will occur:

- Four (4) aqueous ammonia trucks per year (27 tonnes per truck).
- Trucks deliveries of LPG bottles for use as fuel for fork lift trucks.

5 HAZARD IDENTIFICATION

5.1 HAZARDS ASSOCIATED WITH THE MATERIALS USED AND PRODUCED

The materials used and produced at the site are to the large proportion non hazardous and not classified as Dangerous Goods. All the raw materials used for the vitreous mixtures are of mineral origin and are virtually hazard free.

Some materials, while not in themselves hazardous, can produce hazardous decomposition products if involved in a fire. Further, some materials may present hazardous reactions if inadvertently mixed.

In Table 6 below is a listing of the identification of hazard potential associated with the type of products and their conditions of use. For each area of activity the table below presents:

- Description of the products and conditions of use.
- Analysis of the Material Safety Data Sheets (MSDSs).
- Inventory of hazard potentials considered.

5.2 POTENTIAL HAZARDOUS INCIDENTS

Hazardous incidents have been identified and are summarised in the Hazard Identification Word Diagram shown in Table 7 below. The causes and consequences of the events identified, together with any preventative and protective features that are part of the proposed site are summarised in tabular form.

Table 6 – Potentially Hazardous Properties of Materials Used and Produced

PRODUCT NAME	USE	COMPOSITION	LABEL-LING	RISK PHRASES	MAIN PHYSICAL AND TOXIC CHARACTERISTICS	CHEMICAL PROPERTIES DANGEROUS REACTIONS (STABILITY AND REACTIVITY)	FIRE HAZARDS
BULK STORAGE OF RAW MATERIALS							
Various raw materials	Raw materials for glass wool production Storage method: Silos or bulk storage (from tip truck)	Various vitreous materials. 4 day storage: Sand 350t; Soda ash 114t; Borax 70t; Nepheline or Feldspar 60t; Dolomite 40t; Limestone 70t; Plate/Bottle Cullet 380t.	N/A	N/A	Solids unloaded from trucks into silos via pneumatic transfer station or by tip truck onto bulk storage. Materials are non toxic.	Stable. No hazardous consequences in case of inadvertent mixture. Some environmental consequence by contamination of materials possibly making them useless.	Non combustible minerals. No risk of ATEX (dust) explosion.
FINISHED PRODUCTS							
Mineral wool	Finished product	Mineral wool	N/A	N/A	Solids.	N/A	Mineral wool is non combustible and does not contribute to the propagation of fires, In addition, in case of exposure to fire, no fumes and no toxic gas is given off. Nevertheless, fire risk is present due to the fact that glass wool is stored on wooden pallets and wrapped in plastics (see below).

PRODUCT NAME	USE	COMPOSITION	LABEL-LING	RISK PHRASES	MAIN PHYSICAL AND TOXIC CHARACTERISTICS	CHEMICAL PROPERTIES DANGEROUS REACTIONS (STABILITY AND REACTIVITY)	FIRE HAZARDS
Pallets, Packaging material	Storage of finished products	Wood, cardboard, plastics	N/A	N/A	Solids.	Stable.	Stocked in large quantities, these products essentially have a major heat potential should a fire start, liable to generate potential effects for third parties.
MATERIAL USED AND PRODUCED IN THE BINDERS							
50% Urea solution	Bonding binder. Storage method: Silos of 70 m3	50% urea 50% water	N/A	N/A	Slight ammonia smell. Boiling point 100°C No flashpoint. Solubility in water = 590 g/l	Avoid mixing with nitrates, nitrites and oxidising agents (not present on site)	Can decompose into ammonia if involved in fire.
Silane	Bonding binder. Storage method: 5 drums of 200L	gamma-methacryloxypropyltrimethoxysilane > 98%	N/A	N/A	Liquid Boiling point = 255°C Flashpoint = 108°C (C1 combustible) Vapour pressure < 1.33 hPa at 20°C	Stable	Can decompose into carbon oxides and silicon carbons if involved in fire.
Shellflex 790 HP	oil emulsion	Hydro carbonated substance with HAP content < 3% (m/m)	N/A	N/A	Liquid Flashpoint = 267°C (C2 combustible)	Stable	Can decompose in carbon oxides if involved in fire.

PRODUCT NAME	USE	COMPOSITION	LABEL-LING	RISK PHRASES	MAIN PHYSICAL AND TOXIC CHARACTERISTICS	CHEMICAL PROPERTIES DANGEROUS REACTIONS (STABILITY AND REACTIVITY)	FIRE HAZARDS
Ammonium sulphate	Bonding binder. Storage method: Polyethylene bags, max capacity = 20,000 kg	Ammonium sulphate	N/A	N/A	Solid.	Stable.	Can decompose with ammonia if involved in a fire
Lignin or ammonium lignosulphonate	Bonding binder. Storage method: Silo of 70 m3	lignosulphonic acid ammonium salt	N/A	N/A	Liquid Boiling point = 100°C Non-flammable	Stable. Avoid mixing with concentrated acids (e.g. nitric acids), strong bases (potassium soda), very strong oxidising agents (not present on site)	Can decompose in sulphur dioxide, carbon dioxides, nitrous oxides if involved in fire.
Dow Corning 1581 Water Repellent	Oil emulsion. Storage method: 2 to 3 multiboxes of 1000 L	Silicone emulsion with 1% Dimethyl cyclosiloxanes	N/A	N/A	Liquid Flashpoint > 100°C	Stable Reacts in contact with strong oxidising agents (not present on site)	Can decompose in silica, carbon oxides and traces of combustion residues of carbon compounds if involved in fire.
BC 96/004		Silicone emulsion: < 5% sodium dodecylbenzene suphonate < 5% ethoxylate alcohol	N/A	N/A	Non inflammable emulsion	Undetermined	Undetermined
Mineral oils	White wool	Oils	N/A	N/A	Non inflammable emulsion	Undetermined	Can decompose in carbon oxides if involved in fire.

PRODUCT NAME	USE	COMPOSITION	LABEL-LING	RISK PHRASES	MAIN PHYSICAL AND TOXIC CHARACTERISTICS	CHEMICAL PROPERTIES DANGEROUS REACTIONS (STABILITY AND REACTIVITY)	FIRE HAZARDS
BAKELITE (RESIN)	Bonding binder. Storage method: 2 tanks of 70 m3	Base of: Formaldehyde < 10% Sodium hydroxide < 2% Phenol < 0.5 %	Harmful	R20/21/22 : Harmful to inhale, by skin contact and swallowing R36/37/38 = Irritating for eyes, airways and skin. R40 = carcinogenic effect suspected – insufficient proof. R43 = can cause an allergy by contact with skin.	Liquid Flashpoint not applicable	Strong reaction with acids (not present on site) Polymerisation by giving off heat	Can decompose in phenol and formaldehyde if involved in fire.
Ammonia solution	Bonding binder. Storage method: Storage vessel (metal) of 30m3	Aqueous ammonia solution with 25% ammonia.	Environmental risk Corrosive DG Class 8 PGIII	R34=Causes burns R36/37/38 = = Irritating for eyes, airways and skin	Liquid Flashpoint not applicable. Auto-ignition temperature of 661°C for ammonia vapours	Avoid materials of type copper and alloys, aluminium and its alloys as well as phenol and polyester resins (not present on site)	In a fire, the ammonia vapours can form an explosive mixture with air (limits of 15 to 30%) if involved in fire.

PRODUCT NAME	USE	COMPOSITION	LABEL-LING	RISK PHRASES	MAIN PHYSICAL AND TOXIC CHARACTERISTICS	CHEMICAL PROPERTIES DANGEROUS REACTIONS (STABILITY AND REACTIVITY)	FIRE HAZARDS
OTHER MATERIALS USED IN THE PRODUCTION OF GLASS WOOL (SERVICES ETC.)							
Natural Gas	As fuel in the furnace. Supplied via a delivery station with pressure reduc. to 2.5-3 bars and then delivered via underground piping (DN150 pipe diam.).	Methane (CH_4): 86 to 98 %; Ethane (C_2H_5): 2 to 9 % ; Carbon dioxide: < 3 %; Trace elements.	DG Class 2.1	-	Colourless gas, density 0.6. Odourless in natural state, the gas is odorized using sulphur additives (THT). Methane's non toxic nature and its low density in relation to air enable the toxic and anoxia risks not to be taken into consideration.		Combustion prods = water and carbon dioxide. Auto-ign. T >530°C at atm. pressure. LEL =5%; UEL = 15% (relatively restricted field of flammability).Consequences of fires can be major, incl. burns, material loss, explosion if accumulation (most probable explosion result is deflagration (INERIS [3]).
Oxygen	Used in the furnace Supplied from oxygen plant to furnace via pressure piping. Stored in 2 pressure vessels (for use as backup supply) 2x x49m3	Pure oxygen	DG Class 2.2 Subsidiary Risk Class 5.1	N/A	Colourless, odourless and flavourless; it is non toxic and slightly denser than air. It is not an inflammable gas, but strongly contributes to combustion. Flashpoint at 1.103 bars: - 183°C.	Liquid oxygen were trapped in a closed volume, the pressure that could be reached, by heating the vaporised gas would be in the order of 850 bars, resulting in the risk of piping exploding. Physical contact with liquid oxygen at - 183°C causes serious damage immediately..	A higher oxygen content activates burning. Can become vigorous & explosive, Most substances incl. organic materials (oils, fats, tissues, wood, paper, plastic material...) ignite in the presence of oxygen. Fatty substances can spontaneously ignite. Organic material (sawdust, bitumen...) impregnated with liquid oxygen can become explosive. Over-oxygenation of the atmosphere in a room or enclosed space makes it highly dangerous - a spark would ignite the combustible bodies.

PRODUCT NAME	USE	COMPOSITION	LABEL-LING	RISK PHRASES	MAIN PHYSICAL AND TOXIC CHARACTERISTICS	CHEMICAL PROPERTIES DANGEROUS REACTIONS (STABILITY AND REACTIVITY)	FIRE HAZARDS
Water treatment products	Air Cooling Towers	BD 1150: Biodispersant with < 0.5 % sodium hydroxide	N/A	N/A	Liquid	In view of the low quantities stored and the fact that each of these products is on specific storage, no risk is anticipated concerning these water treatment products. Note that these products are also used on site to counter a major event (risk of legionella emission in the cooling towers).	None
		NX1169	Class 8 corrosive	R34 = burns R42/43 = allergic reaction. R50/ R53 = toxic for aquatic org R20/22/23/25 = Toxic/harmful if inhaled/swallow. R36/38 = Irritat. eyes & skin	Liquid biocide		R8 = Ignition of combustible materials.
		OP8492	Class 8 corrosive	R43 = Can result in an allergic reaction by skin contact	Liquid. Corrosion and anti-scale inhibitor		None
		0X909: Sodium hydroxide (>5%) & bromine chloride (10 and 25%) biocide	Class 8 corrosive	R34 = Causes serious burns	Liquid.		None
		0X1203: Bromide based biocide	Class 8 corrosive	R22 =Harmful when swallowed R31 = toxic gas if contact w. acid. R34 = Serious burns R50= Very toxic for aquatic organisms	Liquid.		None

PRODUCT NAME	USE	COMPOSITION	LABEL-LING	RISK PHRASES	MAIN PHYSICAL AND TOXIC CHARACTERISTICS	CHEMICAL PROPERTIES DANGEROUS REACTIONS (STABILITY AND REACTIVITY)	FIRE HAZARDS
LPG	Fuel for use in fork lift trucks Storage method: in bottles, less than 10 tonnes total.	Propane (70%) and butane (30%) mixture	Class 2.1	F+, R12	Gaseous.	Narcotic gases, depress central nervous system (note: conc. liable to lead to nervous disorders or more seriously coma are higher than conc. causing risks of explosion). At high concentration, it is an asphyxiant by displacing oxygen. There are serious risks of burns (frost injuries).	Extremely flammable gas. LEL: 1.8-2.4%. UEL: 8.8-9.3%. If released into the atmosphere an ignition source may case a a jet fire or a rapid flash depending on the release conditions and level of confinement. Further, a Boiling Liquid Vapour Explosion (BLEVE) is possibly in case of an ignited leak impinging on the LPG bottle and causing destruction and immediate release of its contents.

Table 7 - Hazard Identification Word Diagram

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
1. Raw material: Loss of containment of raw material from storage vessel or container (silo, bag, drum) or spill during unloading operation.	Failed container / silo (corrosion, leak from valves and fittings, mechanical failure etc.). Impact involving truck or other vehicle during unloading.	The raw materials are stable. There are no hazardous consequences in case of inadvertent mixture between raw materials. No hazard potential concerning this storage. If contamination occurs then the material may have to be disposed off – environmental wastage issues. If spill occurs on unsealed ground outside of contained area then possibility of environmental pollution.	Clear signage. Induction training of truck drivers and/or operator present during unloading. Sealed ground. Robust design of containers, silos etc. Maintenance of containers, silos etc. Approved packaging. Impact protection. All the areas used for storage are designed with low point which collects any leaks to a storage pan.

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
2. Raw material: Loss of containment of aqueous ammonia	Failure of storage (corrosion, leak from valves and fittings, mechanical failure etc.). Impact involving truck or other vehicle during unloading. Drive-away during unloading. Failure of unloading hose assembly.	Loss of containment of corrosive liquid. Environmental pollution if not contained.	Transport and unloading assembly required to follow Australian Dangerous Goods Codes. Hose required to be tested according to Code requirements. Tank and associated piping of robust design. Unloading procedure and safeguards to be established. Storage and unloading areas to be designed in accordance with AS3780 for corrosive substances (incl. bunding).

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
3. <u>Finished products:</u> Fire involving finished products or pallets and packaging material (cardboard, plastics)	Ignition of combustible materials e.g. from failure of hot work permit system or unlawful smoking, lightning, propagation from nearby fire etc. Incorrect fusion of raw materials leading to a wool packet at 800°C which is found in finished product. This may be the origin of a hot spot and in time cause a fire in the finished product storage area.	Fire in the finished product storage area propagating to more and more combustible material. Large quantities of pallets and packaging material Major heat potential should a fire start, liable to generate potential effects for third parties due to: • The size of the heat radiation, and therefore propagation possibilities and burns, • Combustion fumes, potentially toxic in regard to some plastic materials, • Possibility of ground and water pollution associated with products being picked up by the fire extinguishing water if this is not controlled. • Possible propagation to binder area with resulting hazardous combustion products being generated.	Process control to minimise risk of hot spots carried out in finished product. Control of ignition sources on site. Fire services, including storage and production of fire water (including tanks, pumps, back-up, control system). The combustible material will be stored in a specific building. Compartmentalisation of storage area. Free access between the two areas of 2.5 meters, allowing rapidly isolation of a fire to a single compartment (of 2,000 m²). Binder storage at a distance from combustible material storage minimising risk of propagation. Hot work permit system will be established for all hot work such as welding, grinding etc. Location of hose reels and fire extinguishers will be determined in accordance with applicable Australian Standards. Fire water containment strategy will be established for the site.

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
4. Event during glass wool production: Loss of containment of material during production or during transport of raw materials to production area.	Failed pipe (corrosion, leak from valves and fittings, mechanical failure etc.). Impact involving forklift truck, crane or other moving machinery. The raw materials are transported to a mixer (preparation of the vitreous material to be fused together) then transported by hooded conveyor belts to storage tanks (day silos) located on the roof of the hot area of the main building.	As for scenario 1 above	As for scenario 1 above
5. Event during glass wool production: Flammable event in fibriser or during polymerisation.	Excessive natural gas concentration during blowing of hot gas originating from combustion of natural gas and oxygen sent from fiberisers. Ventilation failure (e.g. due to power cut, mechanical failure etc.) and stoppage of conveyor leading to a greater emission of solvent vapours. The injected air flow process recovers glass fibres from the mat and deposits them on the oven walls creating hot spot which can result in a fire.	Fire or explosion if ignition source coincides with flammable concentration of organic vapours or natural gas.	The combustion air being sent into unclosed chamber and equipped with large ventilation (Gas conc. < LEL) Process controls. Control of ventilation. Trips and alarms. HAZOP or other structured hazard identification technique will be used to determine adequacy of process controls, trips and alarms for oxygen plant and transport and for natural gas plant.

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
6. Furnace operation: Major loss of containment of hot vitreous product at the furnace.	Unsuitable conditions or incorrect application of construction rules and codes during design and/or construction of the furnace. Thermal shock by cooling water coming in contact with hot vitreous mixture causes instant vaporisation and physical explosion. Furnace rupture due to thermal chock through excessive rise in temperature (associated with phenomena of dilation of furnace walls) or excessive cooling. Excessive temperature cycling in the furnace.	Risk of furnace collapse causing vitreous mixture flowing out. Fire if presence of combustible in contact with vitreous mixture at 1,000°C. Personnel danger – burns and possible fatality. Possibility of propagation of fire to other areas where combustible material are present. Possible generation of toxic and harmful combustion products.	Furnace construction rules and standards. Maintenance and regular checks of furnace condition. Furnace arranged on a refractory brick enabling a glass leak to be confined. The furnace's support structures are protected by refractory materials. Separation of cooling water from hot vitreous mixture through design (closed loop). The only risk of water coming in contact with the vitreous mixture is at batch loader which has a small bore (6mm) cooling water circuit in its double casing. A water leak from this pipe would have little consequence and would be detected in the air cooling tower. The furnace is in continuous operation and is only stopped once every ten years. Controlled and slow heating up of the furnace (over a period of 7 days). Also controlled cooling. Furnace is placed on a mobile metal frame to compensate for the dilation phenomena during the furnace's rise in temperature. Cooling of furnace walls carried out with air blown from an external fan (not by water).

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
7. Furnace operation: Loss of containment of flammable natural gas used in the furnace.	Mechanical damage or wear and tear of pipe and associated equipment (valves, gauges etc.). Damage to pipe from mechanical impact. Corrosion. Failure of maintenance.	Release of flammable gas to the atmosphere. If source of ignition then possibility of fire (jet or flash) or explosion depending on the conditions of release. Fire may spread to other areas and other combustible materials (wooden pallets, plastics, building materials etc). Serious damage to neighbouring buildings and site infrastructure. Possibility of propagation to areas where raw materials and finished products are stored, leading to generation of hazardous combustion products such as ammonia, oxides of sulphur, nitrous oxides, phenol, formaldehyde etc.	Control of containment: Natural gas pipe design according to established codes and standards in Australia. Maintenance practices to be established. Control of ignition sources: Smoking only in designated areas. Hot work permit system. Fire services: Storage and production of fire water (incl. tanks, pumps, back-up, control system). Fire system strategy will be developed for the site). Separation: Binder storage at a distance from combustible material storage. Layout and design of natural gas pipe to minimise risk of leak (minimise risk of impact from moving machinery/vehicles, welded connections wherever possible). Hazardous Area Classification (zoning) will be prepared in accordance with Australian Standards. Electrical equipment to be determined in accordance with Hazardous Zones. Location of natural gas isolation valve will be determined to allow for rapid isolation from a safe location in case of an incident.

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
8. Furnace operation: Explosion of flammable natural gas accumulated in the furnace.	Failure of flame control allows ignition of unburned natural gas accumulated in the burner.	If unburned natural gas was allowed to accumulate inside the furnace it could ignite explosively once it encountered an ignition source.	However, this scenario is in impossible and is only included in this PHA for the records. The inside of the furnace is white hot and is permanently on fire, therefore there is no chance for unburned Natural gas to build up.

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
9. Oxygen production and transport: Loss of containment of oxygen causes ignition of combustible material in the vicinity.	Mechanical damage or wear and tear of pipe and associated equipment (valves, gauges etc.). Trapping of liquid oxygen between closed valves causes piping explosion.	Ignition of organic materials in the vicinity (oils, fats, tissues, wood, paper, plastic material). Explosion of organic material such as sawdust, bitumen... if impregnated with liquid oxygen. Over-oxygenation of the atmosphere in a room or enclosed space makes it dangerous, as a spark, a cigarette would ignite the combustible bodies which were in there: work clothes for example.	Oxygen Plant is located in a building which is separated from the rest of the operations on the site (in particular from combustible and flammable material). Oxygen Plant to be constructed in accordance with AS1894 (Ref 7). Layout and design of oxygen transport pipe to minimise risk of leak (minimise risk of impact from moving machinery/vehicles, welded connections wherever possible). Location of oxygen isolation valve will be determined to allow for rapid isolation from a safe location in case of an incident. Double block and vent valves will be provided, operated by low oxygen flow. AS 4326 *The storage and handling of oxidizing agents* and AS 4332 *The storage and handling of gases in cylinders* are both applicable.

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
10. Utilities: Loss of containment of flammable gas (LPG).	Mechanical damage or wear and tear of pipe, hose and associated equipment (valves, gauges etc.) or tank. Vehicle impact. Corrosion. External event. Lightning. Drive-away.	Release of flammable gas to the environment. If source of ignition then possibility of fire (jet or flash) or explosion. May spread to other areas and other combustible materials (wooden pallets, plastics, building materials etc.) Serious damage to neighbouring buildings and site infrastructure. Possibility of propagation to areas where raw materials and finished products are stored, leading to generation of hazardous combustion products such as ammonia, oxides of sulphur, nitrous oxides, phenol, formaldehyde etc.	Control of ignition sources: Smoking only in designated areas. Hot work permit system and Hazardous Area Classification. Control of containment: LPG bottles of robust design, to Australian Standards and Certified. Relatively small quantities on site. Fire services: Storage and production of fire water (incl. tanks, pumps, back-up, control system). Fire system strategy to be developed for the site.AS1596 *The storage and handling of LP Gas* (Ref 8) will be referred to in the design of LPG bottle storage.
11. Utilities: Legionella bacteria formation in cooling towers	Failure of control of cooling towers	Legionellas can colonise the towers' water then be transported into the outside air by picking up the aerosol of micro droplets. Air cooling towers can therefore be the origin of atmospheric contamination by legionella.	Risk assessment to be conducted and management plan to be prepared. Automatic biocide dosing.

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
12. Other: Fire in office building	Electrical fault, smoking, malicious fire setting	Fire may spread throughout the building burning combustible material. Serious damage to office building	Electrical system installed and checked by professional electrician. Maintenance and checks performed. No smoking allowed inside building. Security system, including security alarm to Chubb (or other). Fire extinguishers, escape doors and hose reels (connected to Towns Water) as per the requirements in Building Code of Australia.
13. Other: Fire in workshop	Electrical fault, smoking, faulty operation, malicious fire setting. Leak of acetylene bottle. Welding causes ignition of flammable/combustible materials.	As above	As above. Welding (in dedicated welding bay) equipped in compliance with AS 1674 Safety in Welding and allied Processes Also, minimal work performed in workshop.

6 RISK ASSESSMENT RESULTS

6.1 RISK LEVELS OF HAZARDOUS INCIDENT SCENARIOS

Table 8 below shows the hazardous events and their associated risk levels relative to human injury or fatality potential and to the potential to cause a threat to the natural environment. The risk levels have been determined in accordance with the methodologies in the Australian Standards for Risk Management (Ref 4) and for Technological Systems (Ref 5).

A series of assumptions have been formulated in the Hazard Identification Word Diagram in Table 7 above and summarised in Section 9.5 below. The risk scoring is based on these assumptions.

Table 8 – Hazardous Scenarios and Associated Risk Levels

EVENT	CONSE-QUENCE RATING	LIKELIHOOD	RISK
1. Raw material: Loss of containment of raw material from storage vessel or container (silo, bag, drum) or spill during unloading operation.	MINOR	PROBABLE	LOW
2. Raw material: Loss of containment of aqueous ammonia	MINOR	REMOTE	LOW
3. Finished products: Fire involving finished products or pallets and packaging material (cardboard, plastics)	SEVERE	OCCASIONAL	LOW
4. Event during glass wool production: Loss of containment of material during production or during transport of raw materials to production area.	MINOR	PROBABLE	LOW
5. Event during glass wool production: Flammable event in fibrizer or during polymerisation.	SEVERE	REMOTE	LOW
6. Furnace operation: Major loss of containment of hot vitreous product at the furnace.	MAJOR	IMPROBABLE	INTERMADIATE
7. Furnace operation: Loss of containment of flammable natural gas used in the furnace.	MAJOR	IMPROBABLE	INTERMADIATE

EVENT	CONSE-QUENCE RATING	LIKELIHOOD	RISK
8. Furnace operation: Explosion of flammable natural gas accumulated in the furnace.	NOT CREDIBLE	NOT CREDIBLE	NOT CREDIBLE
9. Oxygen production and transport: Loss of containment of oxygen causes ignition of combustible material in the vicinity.	SEVERE	REMOTE	LOW
10. Utilities: Loss of containment of flammable or combustible materials for utilities (LPG).	SEVERE	REMOTE	LOW
11. Utilities: Legionella bacteria formation in cooling towers	SEVERE	REMOTE	LOW
12. Other: Fire in office building	SEVERE	REMOTE	LOW
13. Other: Fire in workshop	SEVERE	REMOTE	LOW

The risk profile of human injury and environmental pollution associated with the proposed site is essentially ***Low***. This is due to the combination of low severity scores with low likelihood scores for most of the potential incident scenarios identified for the new site.

There are some incident scenarios that have been scored as of ***Intermediate*** risk, which in each case relates to the potential for a high severity score even though the likelihood score (i.e. the probability of occurrence of the incident) is low.

6.2 EVALUATION AGAINST ALARP

The concept of As Low As Reasonably Practical (ALARP) can be used to ensure the threat to Health & Safety and to the Environment is systematically reduced to a level which is as low as what could reasonably be expected. This concept has for example been designed into the Australian Standard Risk Management process for pipeline (Ref 9) and used in the present study to ensure risk management at the proposed site.

In particular, the methodology calls for a careful assessment for all scenarios that are classified as of "**Intermediate**" risk[2]. This is to ensure that the risk of these scenarios is either reduced to a "**Low**" level or that it can be regarded to be ALARP. Also those scenarios classified as ***Low*** have undergone the same level of assessment to ensure that they can be regarded as ALARP. Only the results for the ***Intermediate*** risk scenarios are listed below.

Table 9 - Evaluation Against ALARP

Hazardous Incident Scenario	Type of Risk	Evaluation Against ALAP
Major loss of containment of hot vitreous product at the furnace.	Intermediate	Current preventative features make this incident scenario highly improbable. However, the consequences to health & safety could potentially be lethal if the furnace is damaged and hot molten material spills out. This scenario is managed to an ALARP level.
Loss of containment of flammable natural gas used in the furnace.	Intermediate	Natural gas is a flammable material which may cause a vigorous fire or an explosion if released into the atmosphere. However, it is also a material which is commonly used in industry and which is strictly controlled using industry standards. The safeguards proposed and recommended are adequate for the management of the risks associated with the handling of natural gas at the site. This scenario is managed to an ALARP level.

Provided the assumptions formulated in this study are implemented (refer Section 9.5 below), all scenarios are managed in accordance with *As Low As Reasonably Practicable* (ALARP) principles.

[2] Further, in accordance with good risk management practices, such scenarios that are ranked as of "**Catastrophic**" or "**Major**" consequence level but with a "**Low**" risk level need to be evaluated to ensure that the risk level remains Low throughout the life of the facility. However, in this particular study, no scenarios were ranked with a Catastrophic consequence score and those scenarios ranked as of Major consequence were also associated with an Intermediate risk level.

7 FIRE DETECTION AND PROTECTION

The following provides a preliminary review of fire systems required for the Knauf Insulation Site as far as can be done at this stage of the design and as part of a preliminary hazard and risk assessment.

Knauf Insulation will prepare a Fire Risk Management Plan or other fire safety strategy review to determine fire safety requirements in further detail.

7.1 GENERAL SAFETY FEATURES (SAFETY SOFTWARE)

Appendix 1 describes some of the safety software which will be put in place at the site and which already exist on other Knauf Insulation sites.

These include Knauf Insulation's Policy on safety, health and environmental protection, the quality assurance system, training programs, and procedures for the control of modifications to plant and emergency response.

Systems which will be implemented on the site, and which will contribute to fire safety, are:

- The site will be dematched and smoking will be permitted only in designated areas.
- A permit to work system (including hot work permits) will be maintained on site.
- Access by vehicles to plant areas will be strictly controlled.
- A security fence will surround the site and site access will be controlled by automated gates with security cards.

7.2 FIRST AID FIRE PROTECTION

Procedures will be put in place to appropriately respond to a fire. This includes the use of first aid fire protection facilities (e.g. portable extinguishers), isolation of gas supply lines as well as contacting the NSW Fire Brigades and other relevant parties.

All alarms, e.g. smoke and heat detectors, will be displayed and alarmed in the Control Room. To ensure system reliability, critical alarms such as emergency systems will be routinely tested. The frequency of tests is chosen depending on the level of risk it is protection against. Should any test reveal a spurious fault, the alarm will need to be maintained to its correct working condition. Note: These tests will need to include proof testing that emergency isolation valves open and shut on demand.

In a similar approach to safety, critical duty process pipes will need to be routinely monitored to ensure their integrity (i.e. testing for leaks etc.). By testing and inspecting alarms, pipes, valves, etc. at regular frequencies as well as maintaining the fire protection systems to meet the requirements of AS1851, the adequacy of the systems the operators rely upon is ensured. This approach to systems reliability will ensure that protective systems are operational at all times to the operators, in particular when site manning levels are low.

Portable fire extinguishers will be strategically located at the plants and within the building as per Australian Standard and BCA requirements (Portable fire extinguishers will need to comply with *AS2444 Portable Extinguishers - Selection and Location* (Ref 10). The testing of the fire extinguishers should comply with *AS1850 Portable Fire Extinguishers, Classification Rating and Fire Testing* (Ref 11)).

The proposed hose reel system may provide access to water for cooling and first aid fire fighting if Knauf Insulation chooses to train their employees in the use of hose reels.

Warning signs (including exit signs and first aid fire fighting equipment use instruction signs) shall be provided at the appropriate locations around the plant.

7.3 Fire Detection and Alarm System

7.3.1 Smoke and Thermal Detectors

Smoke and thermal detectors will be provided to meet the requirements of AS1670. The type and number will be selected during detailed design and in consultation with the supplier of fire detectors. Areas where fire detection is likely to be required include natural gas transportation (within building(s)), furnace area and oxygen plant building,

Fire detection and alarm systems will comply with AS1940 (Ref 19), AS1670 (Ref 12), and AS1603.5 (Ref 13).

Note that the vapours from the raw materials may be susceptible to deactivate some brands of flammable gas detectors. Consultation with suppliers of detectors is required.

7.3.2 Glass Break Alarm Points and Evacuation Alarms

Manual break glass alarm points will be provided to meet AS1670 requirements. The exact locations of break glass alarm points will be determined in detailed design and agreed with fire brigades.

The evacuation alarm will need to be audible across the site, also within plant buildings (which may be noisy – strobe lights may be required to double up audible alarms).

7.3.3 Alarm Management

A Fire Indicator Panel will be required, to be located in the Control Room. Fire alarms will be identified on the panel.

7.4 Fire Water Supply

The fire water will be supplied in accordance with BCA requirements and in accordance with the outcome of the Fire Water Strategy which will be undertaken for the Site.

Fire water application rates and hence fire water demand will be determined as part of fire safety strategy.

Note that Australian Standards AS1940 (Ref 19) and AS2419.1 (Ref 14) require that booster connections be readily accessible to fire brigade personnel[3] - to be determined in the fire safety strategy.

7.5 Fixed Fire Hydrants, Hoses and Cabinets

Location of fire hydrants is to be determined in accordance with requirements by the Fire Brigade and the Building Code of Australia. Reference to the Australian Standards AS1940 for Combustible Liquids (Ref 19) and AS 1596 (Ref 15) for LPG will also be made.

Hydrants and hoses will comply with Standards and Code requirements, e.g. AS1940 (Ref 19) and AS2419.1 (Ref 14), AS1221 (Ref 16) and AS2441 (Ref 17).

Location of fire hose reels will be determined in accordance with the requirements in AS1940 (Ref 19), AS2419.1 (Ref 14) and Building Code of Australia (BCA). Hose reel needs to be compliant with AS1221 and AS2441.

7.6 Sprinkler Systems

In Australia the choice to sprinkler industrial buildings of the type propose by Knauf Insulation made in accordance with requirements of the BCA and through risk assessments. .

---

[3] *Booster connections to be readily accessible to fire brigade personnel and the booster connections are to be operable by fire brigade appliances located within 6 meters* (section 10.12.1 of AS1940).

Typically, the following areas would be sprinklered (subject to Knauf's fire safety strategy):

- Raw materials areas where combustibles are included;
- Areas where large amount of combustibles are stored, e.g. pallets, cardboard, plastics;
- Finished product storage areas within buildings (if any);
- LPG tank (sprinkler system in accordance with Australian Standard
- Areas which may need to be cooled so as to avoid propagation of a fire.

7.7 Emergency Access and Egress, Including Access for Fire Brigade

At least two emergency access points for the Fire Brigade will be provided for access to the site.

7.8 Maintenance of Fire Protection Equipment

All fire protection equipment will be maintained to AS1851 requirements (Ref 18).

7.9 Fire Retention Strategy

The maximum fire water retention requirements will be determined.

7.10 Emergency Plan

The site emergency management plan will be amended to cover any incidents on the site and how they are to be managed.

Site fire protection drawings will be prepared showing the exact location of all forms of fire protection once the detail design has finished, and that the emergency procedures include this drawing.

8 STANDARDS AND CODES REFERRED TO

Standards and Codes, in particularly for fire safety, have been referred to throughout this document. For ease of reference the following table has been prepared to list these standards. Note that there will be many other standards and codes that will be applicable for this development.

Table 10 – Listing of Standards and Codes Referred to in Risk Assessment

Standard / Code	Title
Fire Safety	
BCA	Building Code of Australia
AS1221	Fire Hose Reels
AS1670	Automatic Fire Detection and Alarm Systems - System Design, Installation and Commissioning
AS1850	Portable Fire Extinguishers, Classification Rating and Fire Testing
AS1851	Maintenance of Fire Protection Equipment
AS2444	Portable Extinguishers - Selection and Location
AS1603.5	Automatic Fire Detection and Alarm Systems
AS 2419.1	Fire hydrant installations, Part 1: System design, installation and commissioning
AS2441	Installation of Fire Hose Reels
Hazardous Materials Specific	
AS 4326	The storage and handling of oxidizing agents and
AS 4332	The storage and handling of gases in cylinders
AS1894	The storage and handling of non-flammable cryogenic and refrigerated liquids
AS1940	Storage and handling of flammable and combustible liquids and solids
AS3780	for corrosive substances (incl. bunding).
AS 1596	The storage and handling of LP Gas

9 Conclusion and Recommendations

9.1 Main Risk Events

The main risks associated with the proposed site are listed in Table 11 below.

Table 11 – Main Risks

HAZARD POTENTIAL	INSTALLATIONS OR AREAS CONCERNED
Fire	Combustibles building (wood, paper, cardboard, plastics storage) Finish product overhead storage area Polymerisation oven General fire issues in office building and workshop.
Emissions of toxic fumes following a fire in a storage area	Combustibles building (wood, paper, cardboard, plastics storage) Finish product at storage area
Fire / explosion following the formation of an explosive mixture	Fusion furnace Polymerisation oven Acetylene bottles Natural gas transport and use in the furnace LPG storage
Leak of oxygen	Oxygen plant Oxygen transport
Legionella emission	Air cooling towers
BLEVE	LPG bottle storage
Environmental pollution	Aqueous ammonia and storages of relatively benign raw materials. Spillages and contamination of raw materials.

9.2 Risk Rating of Site

The fire risk associated with the proposed development by Knauf Insulation at Steel River in NSW is **Low** in accordance with the methodologies for risk evaluation (Refs 4 and 5).

There are some incident scenarios that have been scored as of ***Intermediate*** risk. In each case these relates to the potential for a high severity score even though the likelihood score (i.e. the probability of occurrence of the incident) is very low.

These intermediate risk events include the potential for an explosive event relating to the use of natural gas and LPG, and, to a lesser degree, the use of acetylene in the workshop. The use of these flammable gases is standard practice around many industrial sites operating in NSW and does not constitute a major hazard potential for this particular site.

9.3 Fire Risk Management

Fire events are related to the potential for general flammable events in manufacturing buildings, finished products storage areas, office areas and warehouse and to the fuel that is used in the manufacturing of insulation products (natural gas and oxygen, LPG).

Potentially explosive events relate to the use of natural gas, acetylene and LPG which are general industrial flammable gases. Other potentially explosive events relate to the oxygen manufacturing.

9.4 Overall Conclusion

The preventative and protective systems proposed and recommended for the site match the hazard and hence the risk associated with the site is *low* to *intermediate* in accordance with the risk ranking methodology in AS4931 (Ref 5). The activities proposed for the site do not constitute a major escalation of existing hazards and risk in the area.

Given the low and intermediate risks associated with the raw materials and products, designing for the recognised hazards by using appropriate Company and regulatory Codes will provide adequate prevention and protection against hazardous events. The scoring of this development as not *Potentially Hazardous* in accordance with the Department of Planning Guidelines SEPP 33 appears consistent with these conclusions and further Departmental approval should not be required for this development.

9.5 ASSUMPTIONS

To ensure the risk from the site is kept at a minimum a series of recommendations have been formulated, as follows:

- Storage and unloading areas will be designed in accordance with AS3780 for corrosive substances (incl. bunding requirements).
- Hot work permit system will be established for all hot work such as welding, grinding etc.
- HAZOP or other structured hazard identification technique will be used to determine adequacy of process controls, trips and alarms, in particular for the oxygen plant and oxygen transportation and for the use of natural gas at the furnace.
- Hazardous Area Classification (zoning) required in accordance with Australian Standards. Electrical equipment design will be determined in accordance with Hazardous Zones.
- Location of natural gas isolation valve will be determined to allow for rapid isolation from a safe location in case of an incident.
- Location of oxygen gas isolation valve will be determined to allow for rapid isolation from a safe location in case of an incident.
- *The storage and handling of LP Gas* to be referred to in the design of the LPG storage.
- Knauf Insulation will prepare a fire safety strategy or other fire safety study to determine the required fire systems for the site.
- Hydrants and hoses will comply with standards and code requirements (as required in the fire safety strategy). The location of hose reels and hose reels will be determined in accordance with applicable Australian Standards (including AS1940, AS2419.1, AS1221 and AS2441) and with Building Code of Australia requirements.
- Portable fire extinguishers will be strategically located at the plants and within the building as per Australian Standard and BCA requirements. (Portable fire extinguishers will comply with AS2444. The testing of the fire extinguishers will comply with AS1850).
- Fire water application rates and hence fire water demand will be determined.
- Fire water containment strategy will be established for the site.
- .At least two emergency access points for the fire brigade will be provided to access the site.

- All fire protection equipment will be maintained to AS1851.
- Site fire protection drawings will be prepared to show the exact location of all forms of fire protection once the detail design has finished, and the emergency procedures will include this drawing.

Appendix 1

Safety Software

Risk Assessment, Knauf Insulation

Appendix 1 – Safety Software

Table A summarises the main procedures and safety management systems at the site.

Table A1 – Summary of Safety Related Site Procedures

PROCEDURE	PURPOSE
Operating Instructions	To clearly define the method of operations of the site to enable the handling requirements for the site to be met safely
Operator Training	To enable operators to run the site to meet throughput objectives safely. (This includes normal operation and dealing with abnormal situations)
Maintenance Procedures	To define for the operators and maintenance team the methods by which equipment may be safely and efficiently withdrawn from service, repaired and restored to safe efficient operating condition
Training of Maintenance Employees	To enable tradesmen to carry out maintenance work so that they are themselves safe and do not jeopardise the site safety systems or the safety of others
Contractor Safety Training	To ensure that all contractors working on the site are fully aware of the Company's commitment to safety and understand site safety requirements
Emergency Procedures	To facilitate effective response to emergency situations. To prevent or minimise the effect of potentially hazardous events by being prepared
Safety and Emergency Training	To provide people with an understanding of possible hazardous situations and the ability to respond appropriately. To provide an understanding of and practice in the use of basic emergency equipment which might be needed in tackling an emergency (e.g. self contained breathing apparatus, safety showers, fire monitors)
Control of Site Documentation	To ensure that accurate information about important aspects of the site design and its operations are available and up to date
Permit to Work	To safeguard tradesmen (and others) and the site by ensuring: • That the site is safe to work on • That the correct job is done on the right equipment • That any hazards and safety procedures are understood and adhered to • That operators know which parts of the site are being worked on • That the equipment is returned to safe condition before being returned to service
Control of Site Modifications	To ensure that proposed changes to both equipment and operating methods achieve the desired benefits without any unforeseen and undesirable side effects
Testing of Protective Systems	To ensure that protective systems are in a good state of repair and function reliably when required to do so. This includes scheduled testing of safety equipment and the testing of fire protection systems

PROCEDURE	PURPOSE
Unusual Incident Reporting and Investigation	To learn from “unusual incidents” which may or may not have had a hazardous outcome, but could have under different circumstances, so as to be proactive in preventing their occurrence
Scheduled Management Auditing of Procedures	To ensure that operating management are continually aware of how well the defined procedures and systems affecting safety and loss prevention are being followed in practice. To enable corrective action to be taken to improve adherence to such procedures

10 REFERENCES

1 NSW Department of Planning, Guideline Applying SEPP 33, 1997

2 NSW Department of Planning, Hazardous Industry Planning Advisory Paper no 6 – *Guidelines for Hazard Analysis*, 1997

3 NSW Department of Planning – *Multilevel Risk Assessment*, 1997

4 AS4360 - *Risk Management*, Australian Standard, Standards Australia

5 AS3931 - *Risk Analysis of Technological Systems*, Australian Standard, Standards Australia, 1998

6 Tweeddale H M, *Process Plant Risk Management,* The University of Sydney Dept of Chemical Engineering, 2001

7 Australian Standard AS1894-1997 *The storage and handling of non-flammable cryogenic and refrigerated liquids*

8 Australian Standard AS 1596 *The storage and handling of LP Gas*

9 AS2885.1 - *Pipelines – Gas and liquid petroleum*, Part 1: Design and Construction, Standards Australia, 1997

10 Australian Standards AS2444, *Portable Extinguishers - Selection and Location*

11 Australian Standards AS1850, *Portable Fire Extinguishers, Classification Rating and Fire Testing*

12 Australian Standards AS1670, *Automatic Fire Detection and Alarm Systems - System Design, Installation and Commissioning*

13 Australian Standards AS1603.5, *Automatic Fire Detection and Alarm Systems*

14 Australian Standards AS2419.1 —1994, *Fire hydrant installations*, Part 1: *System design, installation and commissioning*

15 Australian Standards AS 1596 *The storage and handling of LP Gas*

16 Australian Standards AS1221, *Fire Hose Reels*

17 Australian Standards AS2441, *Installation of Fire Hose Reels.*

18 Australian Standards AS1851, *Maintenance of Fire Protection Equipment*

19 Australian Standards AS1940, *Storage and handling of flammable and combustible liquids and solids*