EHP Orange Pollution Incident Response Management Plan

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Introduction

This Pollution Incident Response Management Plan (PIRMP) covers the key actions to minimise occurrence of a pollution incident and the management during and after of pollution incident if one occurs. This PIRMP does not cover the treatment of injured persons or the remediation of the environment following a pollution incident.

This PIRMP has been prepared for managing the impact to human health (employees and nearby neighbours) and the environment (onsite and offsite).

Electrolux Home Products (EHP) Orange has environmental Protection Licence (EPL 1351) which covers the premises. The EPL outlines specific conditions for environmental monitoring and reporting.

In the event of an incident, the site Environmental Sensitive Areas map can be viewed to identify the source and the likely near receptors. The Chemical Spill Flowchart (Appendix 1) enables a quick assessment of the magnitude of the incident and the propensity for escalation. The Risk Assessment Matrix reveals the most significant risks with current mitigations. More detailed risk information can be obtained from the Product Risk Analyses (Appendices).

Responsibilities

Chief Warden

The Chief Warden on becoming aware of a Pollution Incident is responsible for:

- Responding and taking control, as appropriate;
- Ascertaining the nature of the pollution incident and determining appropriate actions;
- Ensuring appropriate emergency services and relevant authorities have been notified;
- Ensuring that members of the ECO are advised of emergency situations;
- If necessary initiating evacuation and response activities;
- Restricting access to areas affected by the incident;
- Monitoring the progress of the evacuation and ensuring that any action taken is recorded in an incident log (IMS-DOC-06-056 Incident Occurrence Checklist).

Deputy Warden (Emergency Response Team)

The Deputy Warden (ERT) is responsible for the following:

- Ascertaining the nature of an emergency and determining appropriate response;
- Activating ERT;
- Coordinating response activities with the with evacuation;
- Communicating status of response activities to Chief Warden;
- Communicating with ERT Leader status of evacuation and arrival of emergency services.

Emergency Response Team

The ERT main role is to provide advice to assist in the management of an emergency situation. They primarily work with the Chief Warden to provide immediate solutions to issues as they arise.

The ERT teams have experience and expertise to advice on site-related hazards including:

- Fire related incidents/issues; or
- Chemical & Plant and machinery incidents/issues; or
- Electrical & Premises Incidents/issues; or
- Medical incidents/issues.

The ERT Members are responsible for the following:

- Responding to emergencies when the ERT is activated
- Carrying out appropriate response activities as directed by the ERT Leader
- Ensuring the safety of themselves and other ERT members when conducting response activities
- Assisting Emergency Services as required

References

Protection of the Environment Operations Act 1997 No 156

Protection of the Environment Legislation Amendment Act 2011

Protection of the Environment Operations (General) Regulation 2009

Local Government Act 1993

WHS Act 2011

Work Health Safety Regulation 2011

AS 3745 Planning for Emergencies in facilities.

HB 76-2004: Dangerous Goods – Initial emergency response guide

IMS-PRC-06-001 Risk Management Procedure

IMS-PRC-06-035 Hazardous Chemicals Procedure

IMS-PRC-06-037 Risk Management- Environmental Spills Management

IMS-PRC-06-038 Emergency Response Procedure

IMS-PRC-06-047 Classified Dangerous Goods Procedure

Definitions

AGST: Above Ground Storage Tank

APDC: Asia Pacific Development Centre

CSHEC Central Safety Health and Environment Committee

ECO: Emergency Control Organisation. The ECO is Electrolux's key response team to ensure that all personnel are safely evacuated and accounted for. The Command structure of the ECO comes from the Chief Warden down and is structured so to allow for command to be taken by any member of the ECO if and when necessary.

EHP: Electrolux Home Products

EPC: Emergency Planning Committee. Made up of the Chief Wardens, Worker Representatives and ERT Representatives

ERT: Emergency Response Team. The ERT is made up of Electrolux personnel, drawn together by the Chief Warden with accurate and essential information during an emergency situation. The ERT includes personnel familiar with all areas of the plant who can manage emergencies including:

a) Fire/explosion incidents
b) Chemical & Plant/machinery incidents
c) Electrical & Premises incidents
d) Medical Emergencies

HIPS: High Impact Polystyrene

HSE: Health Safety and Environment

Immediate: Has its ordinary dictionary meaning of promptly and without delay.

IMS: Integrated Management System consisting of Health, Safety, Environmental and Quality policies, procedures and documentation.

JDS: Job Detail Sheet

LPG Liquid Petroleum Gas

MDI: Methylene Diphenyl Isocyanate

PIRMP: Pollution Incident Response Management Plan

Shall As reasonably practicable take actions having regarded to:

- the likelihood of the hazard or the risk concerned occurring, and
- the degree of harm that might result from the hazard or the risk, and
- (what the person concerned knows, or ought reasonably to know, about:

- o the hazard or the risk, and
- o ways of eliminating or minimising the risk, and
- the availability and suitability of ways to eliminate or minimise the risk, and

after assessing the extent of the risk and the available ways of eliminating or minimising the risk, the cost associated with available ways of eliminating or minimising the risk, including whether the cost is grossly disproportionate to the risk

UST: Underground Storage Tank

VMS: Visual Management System

WHS: Work Health & Safety

Pollution incident

Pollution incident means an incident or set of circumstances during or as a consequence of which there is or is likely to be a leak, spill or other escape or deposit of a substance, as a result of which pollution has occurred, is occurring or is likely to occur. It includes an incident or set of circumstances in which a substance has been placed or disposed of on premises, but it does not include an incident or set of circumstances involving only the emission of any noise.

A pollution incident is required to be notified if there is a risk of 'material harm to the environment', which is defined in section 147 of the POEO Act as:

- harm to the environment is material if:
  - o it involves actual or potential harm to the health or safety of human beings or to ecosystems that is not trivial, or
  - o it results in actual or potential loss or property damage of an amount, or amounts in aggregate, exceeding $10,000 (or such other amount as is prescribed by the regulations), and
- loss includes the reasonable costs and expenses that would be incurred in taking all reasonable and practicable measures to prevent, mitigate or make good harm to the environment.

For the purposes of this Part, it does not matter that harm to the environment is caused only in the premises where the pollution incident occurs

EHP shall report pollution incidents immediately to the EPA, NSW Health, Fire and Rescue NSW, WorkCover NSW and the local council.

Actions to minimise an Incident

All personnel that use or manage chemical substances etc shall have an understanding of the Safety Data Sheet for the products, including the special requirements for spill control such as the type of fire extinguisher required, incompatible substances, and reactivity with substances

such as water or air. Where a substance is unknown, or is an experimental substance that does not have an SDS, it shall be treated as HIGH RISK.

Wherever practicable, the storage and use of the chemicals etc shall be in an area which can contain or restrict the flow from a spill site. On benches, this can be assisted by a raised lip at the front of the bench, or by the use of spill trays.

Refer to IMS-PRC-06-037 Risk Management- Environmental Spills Management

Action during an Incident

In the event of an incident, the following immediate actions are required to be taken by competent personnel:

- Clear the affected area;
- Determine if evacuation is necessary;
- Check for any contamination of personnel;
- Identify hazards and evaluate risk;
- Isolate spill if safe to do so;
- Contact Area Supervisor/Maintenance for low risk spills
- Contact Chief Warden for high risk spills (see Emergency Control Organisation located on area VMS board).

Actions Following a Pollution Incident

All personnel involved in the clean up of the spilled substance shall be debriefed after the incident has been resolved;

All spill control supplies are to be restocked;

All damaged or used equipment shall be repaired or refilled; and

When the area is deemed clear, it can be re-opened for normal operations.

The Engineering Manager shall communicate a summary of the debriefing to the CSHEC and the HSE Committee. The summary of the debriefing findings shall be included in the HSE Committee minutes, which shall be made available to all workers.

Notification of an Incident

Under section 150 of the amended POEO Act, the information about a pollution incident that must be notified is:

- the time, date, nature, duration and location of the incident
- the location of the place where pollution is occurring or is likely to occur
- the nature, the estimated quantity or volume and the concentration of any pollutants involved, if known

- the circumstances in which the incident occurred, including the cause of the incident, if known
- the action taken or proposed to be taken to deal with the incident and any resulting pollution or threatened pollution, if known
- other information prescribed by the regulations.

What needs to be reported?

A leak, spill or emission (say gas or fumes from a fire) which is not trivial (i.e. not of small value or importance – must be over $10,000) and involves actual potential harm to the environment or human health

The following information (as a minimum and where known) should be reported:

- Location of the pollution incident.
- Type of pollutant.
- Quantity of the pollutant.
- Circumstances of the incident.
- Persons or environmental media impacted or at risk following the incident.
- Weather conditions (if relevant) such as wind speed, wind direction and whether it is raining

Notifying Neighbours

Where a Notifiable pollution incident has the potential to impact neighbouring properties, occupants of those potentially impacted properties will be notified of the situation. The nature and directional impact of the incident will determine the most appropriate properties to be notified

Information prepared for distribution to the community will be tailored to the needs of the target group and approved by the EHP Orange General Manager before release. It may address progress, traffic disruptions and controls, temporary detours, work outside normal hours and will be provided in one or more of the following mediums:

- a community notice
- advertisements (e.g. progress updates, road closures, disruption to traffic)
- newsletters
- brochures
- internet updates
- notice board information

- door knocking
- in a display/information area.

Key community groups include:

- local Council
- local landholders and businesses
- interest groups (environmental and commercial)
- adjacent residential communities

Safety Equipment

All equipment, controls, incident response plans and management plans will be maintained to prevent any possible harm to human health and the environment. Inspection, testing and review of equipment, controls, documents and systems currently in place on the project will depend on issues raised for concern and results from previous checks.

- Fire extinguishers are located in all site buildings, the Bulk Chemical Storage, etc and all site vehicles. (IMS-DOC-06-OO2-SCID Map)
- First Aid Room located within the site compound and mobile kits at various areas around the site
- Defibrillators located in the first aid room and components department
- Spill kits located in all areas of the site except office areas (IMS-DOC-06-OO2-SCID Map)
- Drager Pentane detectors kept at the Guardhouse & Maintence Department, with JDS's at relevant VMS Boards
- Gas Mate Detector located in the Weld Bay Area & Maintenance Department with the relevant JDS kept on appropriate VMS Boards.
- Relevant SDS's are kept in all areas of the site located on the individual area VMS Board
- Site Manifest of all chemicals kept at the Guardhouse (IMS-DOC-06-085 Electrolux Guardhouse Emergency Services Information Manual)
- 2 x Scissor Lifts kept at the Maintenance Department
- 1x Boom lift kept in the crating area

Likely Scenarios

At EHP Orange operations, these pollution incidents are most likely to result from large chemical spills or acts of vandalism/arson on our equipment. If there is doubt, Contact the site Compliance Office immediately. Immediately means immediately

Scenario	Likely status
Major chemical spill from storage tank that is contained within safety bund.	Not reportable, provided no discharge from bund and the damage is not in excess of $10,000 cleanup costs need to also be included.
Major chemical spill from storage tank that is NOT contained within safety bund	Reportable, damage is in excess of $10,000 and cleanup costs need to also be included.
Major chemical spill from pipe work or hoses that is NOT contained within a safety bund	Reportable, damage is in excess of $10,000 and cleanup costs need to also be included.
Major chemical spill from pipe work or hoses that is NOT contained within a safety bund and goes off site i.e. enters storm water	Reportable to relevant authorities and affected neighbours etc.
Hydraulic hose cut spilling onto premises	Not reportable provided contained with site spill kits
Jerry can of fuel spilling	Not reportable
Jerry can of fuel spilling and starting large fire	Reportable – assuming that fire causes damage in excess of $10,000. E.g. destroys a piece of plant
Leaching of chemical or pollutants in to ground water, storm water or soil	Reportable to relevant authorities and affected neighbours etc.

Contacts

EHP Orange Contacts			
Position	**Name**	**Phone No. (Bus. Hours)**	**Phone No. (After Hours)**
Chief Warden	Brett Ballard	(02) 63606625	0418 427 964
Chief Warden	Geoff Drummond	(02) 63606114	0418 689 051
Deputy Warden Emergency Response Team (ERT)	Ron Finch	(02) 63606561	0429 691 317
Deputy Warden A/Shift	Rodney Parkes	(02) 63606402	0448 322 000
Manufacturing Engineer	Andrew J Coyte	(02) 63606546	0400 037 743

If a pollution incident occurs, all necessary action should be taken to minimise the size and any adverse effects of the release. If adequate resources are not available to contain the release and if it threatens public health, property or the environment, the NSW Fire Brigades should be contacted for emergency assistance - phone 000.

In addition, if advice is needed on cleaning-up the incident or on the disposal of any resulting waste materials, EPA staff can be contacted 24-hours/day via Pollution Line on 131 555. If the NSW Fire Brigades are called, they may notify the EPA if they consider the environment or public health to be threatened. Notification by the NSW Fire Brigades does not negate the need for person carrying on the activity or the occupier of the premises to notify the EPA.

Relevant Authorities	
Environmental Protection Authority (EPA)	13 15 55
WorkCover	13 10 50
Ministry of Health	(02) 9840 3603
Orange Fire Brigade	000 or (02) 6361 2205
Ambulance	13 12 33
Police	000 or (02) 63636399
State Emergency Services	13 25 00
Integral Energy	13 00 03
Essential Energy (Elect. & Nat. Gas)	13 20 80
Elgas (LPG)	13 20 80
Orange City Council	1300 650 511

Hazard & Risk assessment

In conjunction with External consultants the Compliance Department shall conduct Hazard and Risk Assessments to clearly identify the likelihood of Pollution risks on all aspects of Orange EHP business.For all criteria marked as "Hazard", the team shall assign a risk rating using the Hazpak Risk Assessment Matrix (see below).

How Severe? (Consequence)	How likely? (Likelihood) ++ Very Likely-Could Happen Any time	+ Likely Could Happen Sometime	- Unlikely Could Happen But Very Rarely	-- Very Unlikely Could Happen But Probably Never Will
Catastrophic - Kill or cause permanent disability or eventual death. Toxic release off-site with detrimental environmental impact. Huge financial loss.	1	1	1	3
Major - Long term illness or serious injury. Off-site release contained with outside assistance and little detrimental environmental impact. Major financial loss.	1	2	3	4
Moderate - Medical attention and several days off work. On-site release contained with or without outside assistance. Minimal environmental impact. High or medium financial loss.	2	3	4	5
Minor/ Insignificant First aid needed. On-site release contained. No or negligible environmental impact. Medium or low financial cost.	3	4	5	6

The process of implementing measures to reduce the risk associated with a hazard must follow the hierarchy of controls are outlined in section 5.6 of IMS-PRC-06-001 “Risk Management” Procedure

Inventory of Potential Pollutants

Description	Location	Chemwatch SDS No.	UN Number	Estimated Maximum Quantity
MDI	Northwest corner of the site	7604-45	None	140000 Litres
Polyol	Northwest corner of the site	22-4760	None	85000 Litres
Cyclopentane	Northwest corner of the site depot 2	28-7813	1265	55000 Litres
HIPS	Central east side of the site,	18-5276	None	124 Tonne
R600a	Central western side of the site depot 11	1969-1	1969	972 Litres
R134a	Central western side of the site depot 10	6012627	3159	28000 Litres
R600a Spare pallet	South western side of site depot 12	1969-1	1969	972 Litres
LPG Tank	South eastern end of site depot 5	1075	1075	2800 Litres
LPG Tank TT Logistics	Southern end of site depot 9	1075	1075	2800 Litres
Oxygen Bulk Tank	Northwest corner of the site depot 4	1073	1073	7000 Litres
Nitrogen Bulk Tank	Northwest corner of the site depot 3	1977	1977	7000 Litres
Flammable Goods Store	Southern end of site depot 6	Various see manifest		Approx. Various 36400 Litres

Identified Hazards

MDI

MDI is an Isocyanate used in the production of polyurethane foams. It is stored in a twin-layer above ground 140 m3 steel, bunded tank at the northwest corner of the site abutting with Churchill Street. (See appendix 4)

Polyol

Polyol is a polymeric amine comprising 25% epoxylated and propoxylated toluene diameine and 3% N,N,N',N',N'' pentamethylene diamine that is used in the production of polyurethane foams. It is stored in a twin-layer above ground 85 m3 steel, bunded tank at the north west corner of the site abutting with Churchill Street. (See appendix 5)

Cyclopentane

Cyclopentane is the blow gas used to expand (inject bubbles into) the rigid polyurethane foam formed by polymerisation of isocyanate and polyol components. It is stored in a twin-layer underground 55 m3 fibreglass tank (Depot 2) at the northwest corner of the site abutting with Churchill Street (See appendix 6)

HIPS

HIPS are the main polymer used in the manufacture of refrigerator and freezer plastic components. It is stored in Silo's at the central eastern side of the site, abutting with Edward Street, beside the North east entrance to the site. (See appendix 7)

ABS

ABS or Acrylonitrile-Butadiene-Styrene is also used in the manufacture of refrigerator/freezer housings. Refrigerator drip trays are the major component requiring ABS. A second 'Thermotolerant ' ABS containing bromine antimony is also potentially used. Risk analysis is limited by a knowledge of the qualities, storage and toxicity, although a recent study of acrylonitrile generation during injection mould purge, will enable a more representative assessment at the first revision of the PIRMP. (See appendix 7)

R600a

R600a or iso-butane is the main refrigerant gas used in the compressors of Electrolux refrigeration products. R600a is stored as a bank of cylinders (2 pallets) at the western side of the property between the engineering workshop and the freight loading facility, a third pallet is stored in Depot 12 (See appendix 8)

R134a

R134a or 1,1,1,2 tetrafluorethane is a refrigerant gas used in the compressors of Electrolux refrigeration products. R134a is stored in large volume (28kL) in 14kL AST, adjacent to the R600a cylinder store at the western side of the property between the engineering workshop and the freight loading facility. (See appendix 9)

Thinners

Duthin 140 is the minor thinner used in pad print operations, the major solvents of which are acetone and xylene. Multi-Midway Thinners is the major thinner used, comprising largely toluene. Acetone is a moderately flammable, oxygenated hydrocarbon solvent with high water solubility that will ignite in a naked flame or under heated conditions. Toluene and xylene are highly flammable aromatic hydrocarbons, with low water solubility. (See appendix 10)

Acetylene

Acetylene is the fuel gas used for welding training at the APDC (off site at the corner of Edward Street and Churchill Avenue) and welding by maintenance in various areas of the site. Acetylene is stored as one pallet of 432 kg in a lockup shed on the east side of the APDC and one pallet in open-air at the northern end of the maintenance building on the west side of the factory near the railway line. (See appendix 11)

Liquid Petroleum Gas (LPG)

LPG - essentially propane is the fuel gas used for refill of gas-powered forklifts used to conduct pallet transit and storage on site, LPG is stored in two separated above ground storage at depots 5 & 9. (See appendix 12)

Oxygen

Oxygen is the oxidant gas used with Natural Gas to generate the high temperatures required for cutting and welding of metals primarily copper on the tracks and with acetylene for cutting and welding of steel etc at APDC and for maintenance operations. Oxygen is stored in a 7000 Litre AGST located at Depot 4 at the Northern end of the property. (See appendix 13).

Nitrogen

Nitrogen is the gas used to maintain an inert gaseous blanket above the surface of MDI, Polyol, Cyclopentane and Day tanks. The presence of the inert N2 blanket protects against premature volatilization and egress of cyclopentane as well as lowering the risk of oxidative polymerization/crystallisation of Polyol and MDI by displacing air containing oxygen.

It is also used as an inert gas in the operation of the laser cutting machines and leak checking in the sniffy machines. Nitrogen is stored in a 7000 Litre AGST located at Depot 3 at the Northern end of the property. (See appendix 14).

Training

The Chief Warden, in consultation with the General Manager, APDC Coordinator, Compliance Office and Site Nurse shall plan and implement Emergency Response training consistent with the requirements of IMS-PRC-12-001 “Training Procedure”.

Emergency Response Training shall be designed to ensure that:

- The emergency evacuation procedures are adequate and understood by staff;
- The emergency assembly areas work appropriately to isolate staff from risk of injury;
- The emergency communications systems achieve their outcome of providing information to the Chief Warden and distributing commands from the Chief Warden;
- The ECO knows exactly what their individual roles are during an evacuation;
- The ERT can demonstrate the appropriate knowledge and response for diverse and varied emergency and disaster scenarios.

- ECO and ERT members may take part in emergency exercises and table top drills where different disaster scenarios are played out

A record of training of ECO and ERT team members shall be kept by the APDC in the site's training records.

The EHP Orange Training Plan shall include warden training to systematically meet skills gaps and to provide refreshers for experienced response team members. A full site evacuation shall be conducted at least once per year.

The Chief Warden shall ensure that the ECO and ERT are at full complement throughout the year.

ECO members, including deputies shall attend skill retention activities at intervals of not greater than 6 months.

Records & Documentation

All documentation associated with Incident shall be kept for a period not less than 7 years. Such documentation shall include but not be limited to:

- Evacuation Briefing & Evaluation IMS-DOC-06-003;
- Incident Reports
- Fire Warden Training;
- ERT training;
- First Attack Training
- Chemical Spill training

Review and Evaluation

EPC meets at least once a year to plan training, response and contingency for emergencies. The EPC evaluates and reviews ECO and ERT performances during the previous year.

The Compliance Office will conduct an annual audit to determine the level of compliance to the general requirements for preparing a Pollution Incident Response Management Plan (PIRMP) as issued by the Environment Protection Authority.

<u>Related Procedures & Documents</u>

IMS-PRC-06-001 Risk Management Procedure

IMS-PRC-06-035 Hazardous Chemicals Procedure

IMS-PRC-06-037 Risk Management- Environmental Spills Management

IMS-PRC-06-038 Emergency Response Procedure

IMS-PRC-06-047 Classified Dangerous Goods Procedure

IMS-DOC-01-018 Maintenance Contacts

IMS-DOC-02-028 Complaint Lodgement Form

IMS-DOC-02-048 Medical Testing Record Sheet

IMS-DOC-06-009 Asbestos Management Plan

IMS-DOC-06-056 Incident Occurrence Checklist

IMS-DOC-06-084 Emergency Response Security Incident Report

IMS-DOC-06-085 Electrolux Guardhouse Emergency Services Information Manual

IMS-DOC-06-090 Environment Spill Incident Response Record

JDS-1419 Clean Up & Disposal Procedure in the Event of a Isocyanate B1001 (MDI) Spillage

JDS-1426 Clean Up & Disposal Procedure in the Event of a Elastocool (Polyol) Spillage

JDS-1434 Clean Up & Disposal Procedure in the Event of a Cyclopentane 64 Spillage

JDS-1634 Procedure for Operating Drager X-AM 200 Portable Pentane Detector

JDS-1649 Procedure for Operating Drager PacEx2 Portable Pentane Detector

JDS-1827-Procedure for Disposing of Waste Chemicals

JDS-1858 Operation of the Gas-Mate Combustible Gas Detector

JDS-2074 Procedure for Control of Minor Environmental Spills

JDS 2150 Shutdown of Chemical Plant in the Event of an Emergency

Appendices

Appendix 1 Chemical Spill Procedure Flow chart

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Appendix 3 IMS-MAP-06-002 SCID Site Plan Map

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Appendix 10 Thinners Hazards

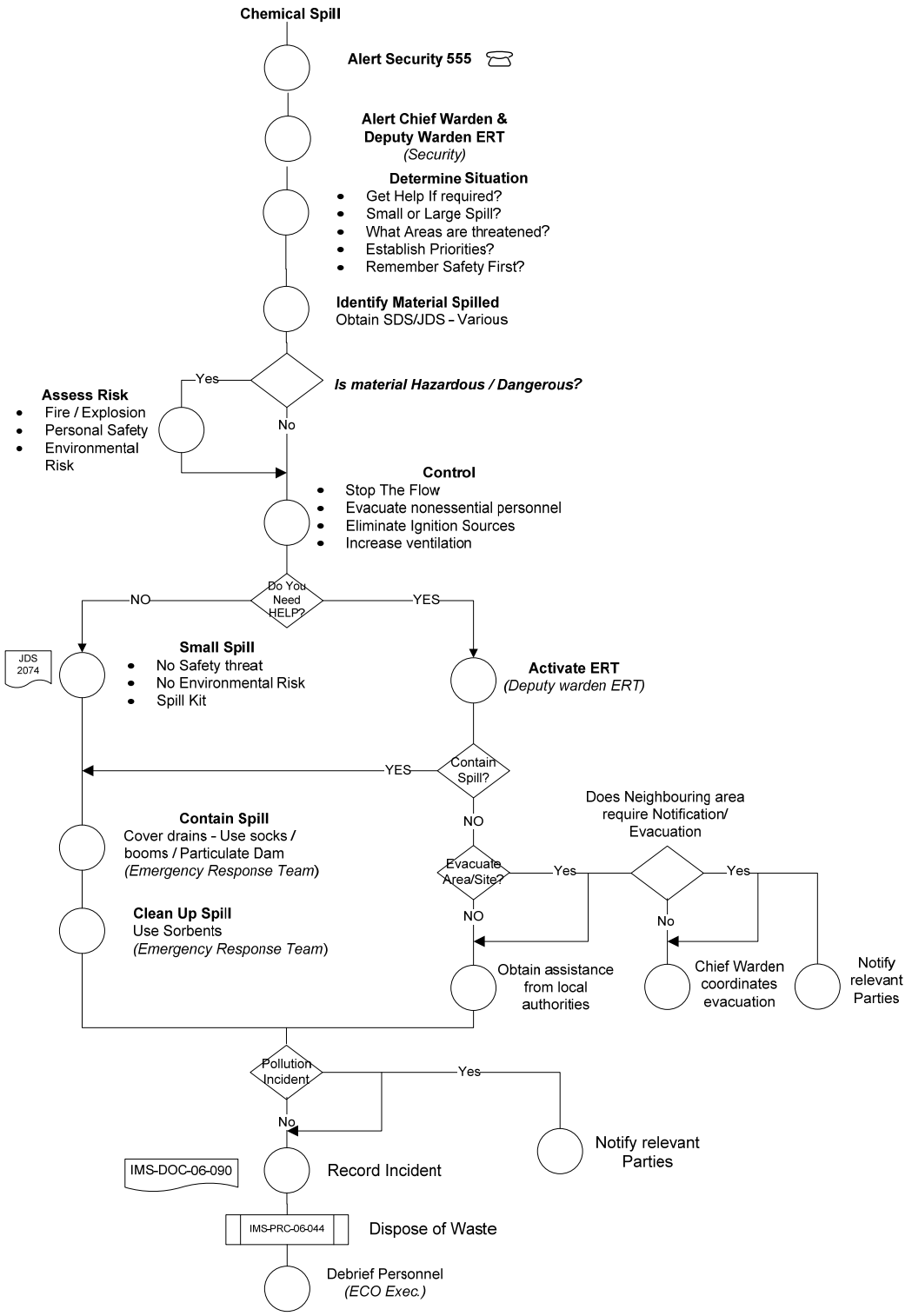
Appendix 11 Acetylene Hazards

Appendix 12 LPG Propane Hazards

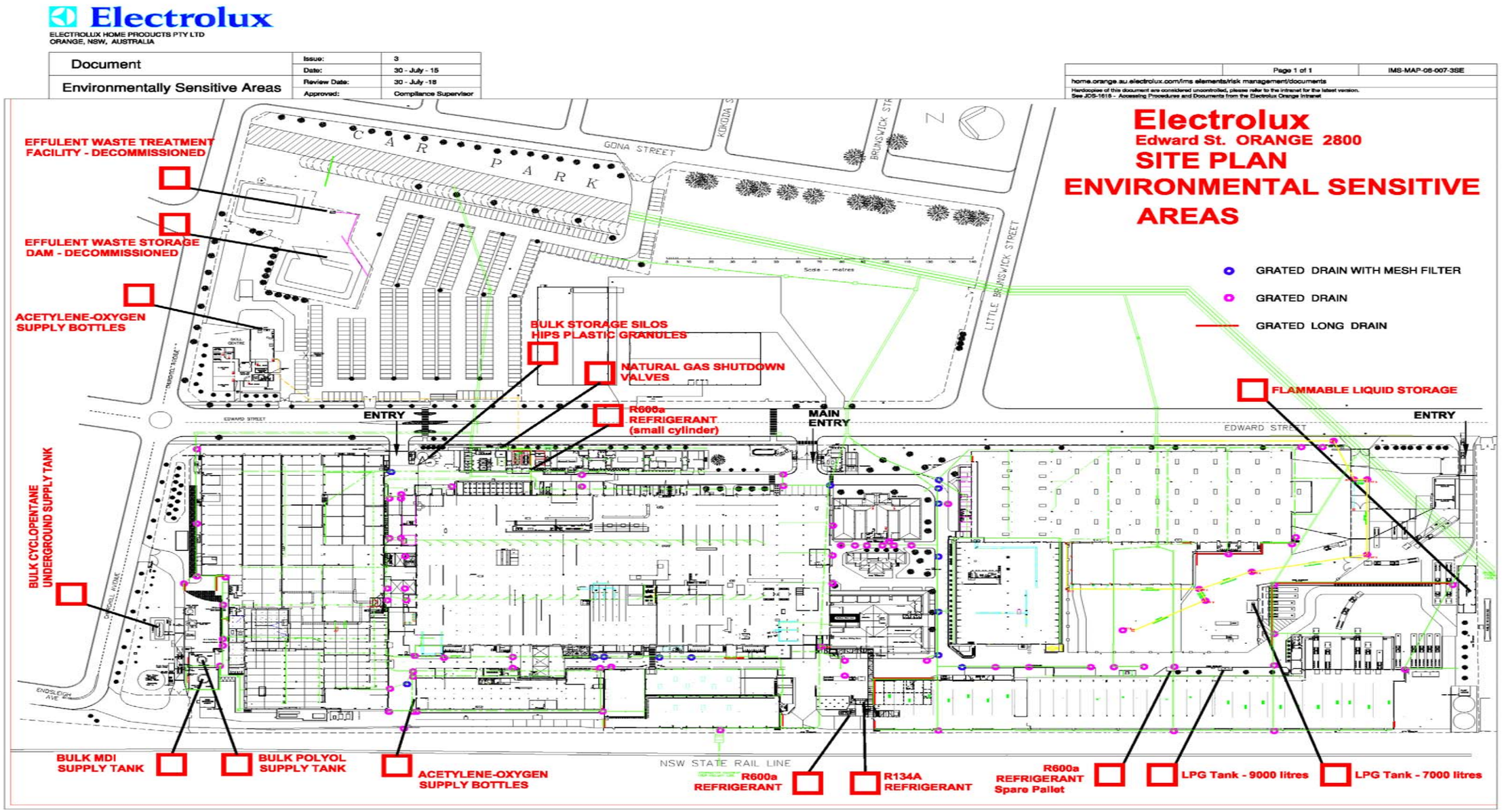
Appendix 13 Oxygen Hazards

Appendix 14 Nitrogen Hazards

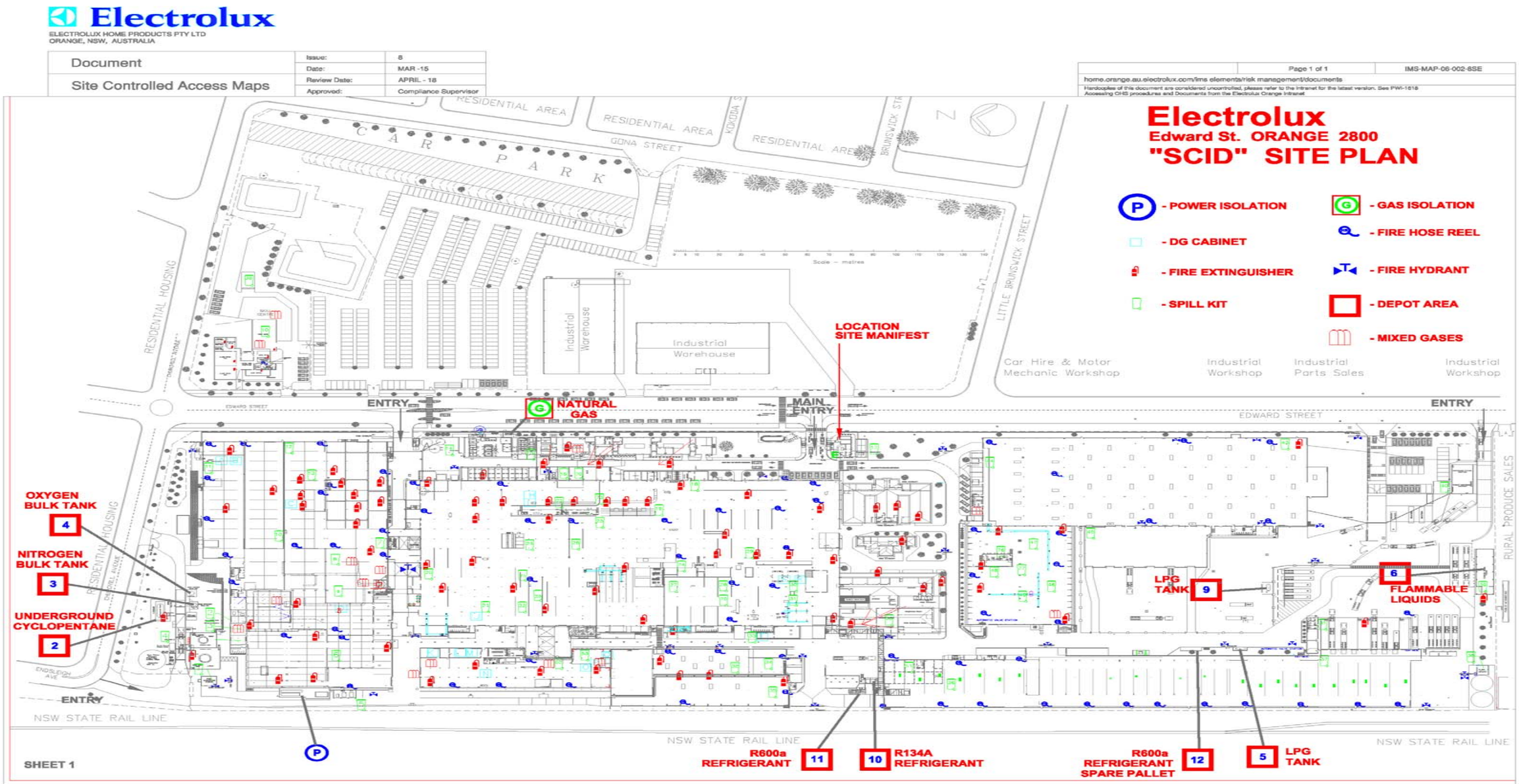
Appendix 1 Chemical Spill Procedure Flow chart



Appendix 2 IMS-MAP-06-007 Environmental Sensitive Areas Map



Appendix 3 IMS-MAP-06-002 SCID Site Plan Map



Appendix 4 MDI Hazards

Component	Failure	Hazard	Risk	Mitigations	Mitigated Risk
Tank	Explosion/implosion, fire	Lightning, tank fatigue, corrosion at joins, ingress of moisture; heat, CO2 generation and distortion of tank, explosion of Cyclopentane pipe work or tank generating projectiles, firestorm ; 140 m^3 dumped into bund with splash over; toxic fumes and NOx COx to atmosphere; Drift to residential area - respiratory sensitizer; projectiles and product directed to residential and vapour produced by fire/heat likely to flow down into storm water drains, factory and rail line	1	Bund is >160% of tank volume; flammable sources have spark arresting measures; tank atmosphere positive pressure under nitrogen blanket; replicated high pressure water supply for sprinklers; Compound rendered immobile by addition of water, although COx and heat emissions still an issue.	3
Isotainer	Truck fire/ impact	Explosion of volatile fumes from truck ignition/engine; impact of truck with delivery system, spillage of isotainer contents, overflow across grassed area into storm water with concurrent hazardous fume cloud to residential area	2	Truck entry at 10 kph; Supervision; sole vehicle; Truck engine off & chassis grounded pre-unloading; neighboring volatile fuel sources, sealed and electric sources isolated with intrinsically safe glands, starters and joiners; non-smoker; no naked flames	3
Injection	uncontrolled release	MDI released during polyurethane injection/formation, inhalation and splash risk from faulty injector(s) housing/cabinet	2	With holding period of 2 minutes prevents access to recently formed polyurethane foam, pressure sensors inline solenoid valves, manual override, routine preventative maintenance	3
Tank	Corrosion	Hole permits ingress of water vapour, oxygen for potential ignition and generation of heat and CO2,	2	tank double skinned; inert nitrogen atmosphere; pressure sensors detect an atmospheric pressure drop; 12 monthly PM schedule by Tony Wassiel Inmenco Ingleburn	4
compressor	stoppage	Safety rail improperly deployed or collapses, possible fall	2	Safe Work Procedure prohibits climbing the ladder attached to the isotainer until the rail is deployed. Access to top of isotainer is required once at start of unloading. Programmed preventative maintenance ensures hose and compressor integrity	4
bund	Volume	Splash over with major tank failure and or wall damage	3	Bund capacities 146 - 161% of tank volume. Splash over possible under catastrophic event, unlikely unless tank empties < 1 minute	4
Nitrogen supply	Delivery	Blocked supply, empty tank, damaged tank, damaged supply lines, increased risk of air ingress and reactive/explosive atmosphere	3	Nitrogen supply replicated, vapour pressure for MDI moderate, preventative maintenance on 12 month schedule; feedback controls on tank pressure, volume and flow. Permit contingency planning	4
sump	pump failure/rain/tank failure	Pump in bund sump fails because sump is water filled. MDI reacts with water and generates heat and CO2 that could have a cascade effect - especially if it rains when the MDI is stored in the bund	3	Sump pump tested as part of preventative maintenance schedule. Sump pumped dry with level detection system. Provision of a roll over tarp and a receiving vessel for the MDI dumped to sump from tank or isotainer. Sump pump capacity sufficient to clear bund in less than 12 hours - minimum 3L/s	5
Valves	Seize/disengage	Manual valves not shut before hose disconnection; solenoid valves, isolated from current; mechanical valves, corroded or worn; pressure build-up in pipe work, blockage, backflow spillage.	3	Manual override ; Programmed maintenance and testing, component replacement within warranty period, training for contingency of product leak	5
Pipe work	Voild/solids	pressure build up with loss increased shear force from partial crystallization, temperature drop, water condensation, cross contamination with Polyol	3	Heater is used to keep temperature >12 C; Isotainer is unloaded within 1 hour of commencing flow; pipe work integrity checked annual as part of programmed preventative maintenance	5
Control Panel	LED	Failure of LED component, means volume in tank and temperature of product through pump cannot be accurately quantified. Overfill of tank or pressure buildup risks	3	Same volume used weekly, similar production volumes, means overfill unlikely. External mechanical tank depth guage. Heater usually not required unless heavy frost or extended delivery delays	5
Hoses	Disconnection,	Residual product in delivery hose, at outlet from Isotainer and the inlet to gear pump. Hose shielded with stainless steel braiding and an impact resistance plastic sheath	3	Dry-Break® couplings at Isotainer and inlet to pump; pump runs for several seconds after isotainer valve shuts off to ensure hoses are free of residual product	5

Pipe work	Breakage/ uncontrolled release	breakage of pipe within factory. Pipe crosses road to Engineering, impact with vehicle.	4	Pipe > 3 m above road, road not accessed by high mast forklifts or High loads; pressure drop in pipe shuts off upstream valve;	5
Pump	Stoppage/ingress	Increased shear force from crystallization of product due temperature drop, stoppage of flow from isotainer, water condensation	4	Mesamoll® plasticer at pump gear maintains fluidity, heater used to ensure fluidity in frosty conditions; enthalpy of product is high; heat loss from isotainer minor over 24 hours; unloading procedure is continuously attended	6
Heater	stops	Failure of hot water heater, on cold mornings, can increase viscosity of product, pump shear and pipe pressure	4	Immediate transit of product from Melbourne factory to Blayney and the next day transit to Orange, ensures that heat loss is minor and delivery is at acceptable viscosity.	6

MDI is an isocyanate used in the production of polyurethane foams.

MDI is stored in a double-skinned-above-ground 140 m3 steel, bunded tank at the north west corner of the site abutting with Churchill Street (Sector I)

MDI exists in monomeris and polymeric forms. The monomer is more harmful than the polymeric, though present in small amounts

MDI has a low vapour pressure and high gas density, meaning it will evaporate slowly unless heated by fire. The vapour will travel along the ground and accumulate in low lying area such as cellars, storm water conduits and railway lines

MDI is incompatible with many organic nucleophiles such as amines, alcohols, bases and water. It forms an insoluble urea when mixed with water, giving off heat and carbon dioxide.

MDI is combustible when heated by fire and releases toxic atmospheric pollutants, potentially hydrogen cyanide

MDI had moderate to low oral and dermal but high inhalation toxicity in mammals. It is a pulmonary sensitizer, causing asthma like symptoms in some people, particularly those who have previous exposure to MDI.

MDI is apparently harmful to aquatic invertebrates and algae, despite being effectively insoluble in water. Data is limited and frequently conflicting

MDI is present in large volume (140 kL), adjacent to residential dwellings. It irritates the eyes and is harmful to the lungs causing asthma like symptoms, but is of low human toxicity. It reacts with other organics and water giving off heat and carbon dioxide which is an asphyxiant. This reaction renders the product insoluble; therefore mobility in water is low. Although there is evidence that small concentrations <0.2 mg/L kill aquatic invertebrates and algae. A real concern is fire. MDI will not spontaneously combust, but will burn if heated above 113 C. The heat produces more vapour which flows to low points such as cellars and storm water drains. Confined space strategies apply. Combustion, produces oxides of carbon and nitrogen which are harmful to people and the environment. There is also potential for cyanide generation. PPI should include full face respirator and eye protection, particularly if fire and hot weather is involved

Appendix 5 Polyol Hazards

Component	Failure	Hazard	Risk	Mitigations	Mitigated Risk
compressor	stoppage	Safety rail improperly deployed or collapses, possible fall	2	Only required when operator climbs ladder to top of Isotainer, hose integrity, preventative maintenance	4
Valves	Seize/disengage	Manual valves not shut before hose disconnection; solenoid valves, isolated from current; mechanical valves, corroded or worn; pressure build-up in pipe work, blockage, backflow spillage.	3	Manual override ; Programmed maintenance and testing, component replacement within warranty period, training for contingency of product leak	5
Tank	Corrosion	Hole permits ingress of water vapour, oxygen and release of liquid to bund below	3	Tank double skinned; inert nitrogen atmosphere; pressure sensors detect an atmospheric pressure drop; 12 monthly PM schedule by Tony Wassiel Inmenco Ingleburn, unlikely to be a large structural failure	5
Tank	Explosion/implosion, fire	85 m^3 dumped instantly into bund with splash over; toxic fumes and NOx COx to atmosphere; Drift to residential area; projectiles and combustion fumes/smoke directed to residential area. Some product likely to deposit on surfaces and flow down into storm water drains, with high mobility and assumed moderate aquatic toxicity	1	Bund is >160% of tank volume; flammable sources have spark arresting measures; replicated high pressure water supply for sprinklers; Compound not toxic to fish, potentially low toxicity to invertebrates, although COx and NOx emissions still an issue.	3
Isotainer	ignition/ vapour/explosion	Explosion of volatile fumes from Cyclopentane with short/spark from truck ignition/engine; impact of truck with delivery system, spillage of isotainer contents, overflow across grassed area into storm water with concurrent hazardous fume cloud to residential area	1	Truck entry at 10 kph; Supervision; sole vehicle; Truck engine off & chassis grounded pre-unloading; neighboring volatile fuel sources, sealed and electric sources isolated with intrinsically safe glands, starters and joiners; non-smoker; no naked flames	3
Sump	sump pump failure/overflow	Pump in bund sump fails because sump is water filled. Outlet of sump pump disconnects from receiving vessel. Polyol deposited on soil and or runs into storm water	3	Sump pump tested as part of PM schedule. Sump pumped dry with level detection system. Sump pump capacity sufficient to evacuate bund in less than 12 hours - minimum 3L/s. Quick Break couplings prevent outflow if hose inadvertently disconnected	5
Pipe work	Voild/solids	pressure build up with loss increased shear force from partial crystallization, temperature drop, water condensation, cross contamination with MDI	4	Heater is used to keep temperature >12 C; Isotainer is unloaded within 1 hour of commencing flow; pipe work integrity checked annual as part of PM program; Polyol and MDI systems share no common infrastructure	6
Control panel	LED	Failure of LED component means volume in tank and temperature of product through pump cannot be accurately quantified. Overfill of tank or pressure buildup risks	3	Same volume used weekly, similar production volumes, means overfill unlikely. External mechanical tank depth gauge. Heater usually not required unless heavy frost or extended delivery delays	5
Hoses	Disconnection,	Residual products in delivery hose at outlet from Isotainer, and inlet to gear pump. Vehicle runs over hose.	3	Dry break couplings at Isotainer and inlet to pump; pump runs for several seconds after isotainer valve shuts off to ensure hoses are free of residual product. Hose shielded with stainless steel braiding and an impact resistance plastic sheath	5
Pipe work	Breakage/ uncontrolled release	Damage to factory delivery pipe work. Pipe crosses road to Engineering, impact with vehicle	4	Pipe > 3 m above road, road not accessed by high mast forklifts or High loads; pressure drop in pipe shuts off upstream valve; low volatility reduces human inhalation risk. Low dermal toxicity reduces splash risk	5
bund	Volume	Splash over with major tank failure and or wall damage	3	Bund capacities 146 - 161% of tank volume. Splash over possible under catastrophic event, unlikely under tank empting > 1 minute	4
Pump	Stoppage/ingress	Increased shear force from crystallization of product due temperature drop, stoppage of flow from isotainer, water condensation	4	MP -20C, likely to remain liquid under all climatic conditions, even worst frost. Heat loss from isotainer minor over 24 hours; unloading procedure is continuously attended	6

heater	stops	Failure of hot water heater, on cold mornings, can increase viscosity of product, pump shear and pipe pressure	4	MP - 20C, not likely to significantly affect viscosity.	6
Injection	uncontrolled release	Polyol released during polyurethane injection/formation, inhalation and splash risk from faulty injector(s) housing/cabinet	3	Withholding period of 2 minutes prevents access to recently formed polyurethane foam, pressure sensors, inline solenoid valves, manual override, routine preventative maintenance	5
Nitrogen supply	Delivery	Blocked supply, empty tank, damaged tank, damaged supply lines, increased risk of air ingress and reactive/explosive atmosphere	4	Nitrogen supply replicated, vapour pressure for polyol low, preventative maintenance on 12 month schedule; feedback controls on tank pressure, volume and flow. Permit contingency planning	6

Polyol is a polymeric amine comprising 25% epoxylated and propoxylated toluene diameine and 3% N,N,N',N',N'' pentamethylene diameine. It is used in the production of polyurethane foams.

Polyol is stored in a twin-layer above ground 85 m3 steel, bunded tank at the north west corner of the site abutting with Churchill Street (Sector I)

Polyol components exists in polymeric forms, with small amounts <5% of monomer. The monomers or precursors are more harmful than the Polyol components, though present in small amounts

Polyol has a low vapour pressure meaning it will evaporate slowly unless heated by fire. The vapour density is unknown, though it will likely travel along the ground and accumulate in low lying area such as cellars, storm water conduits and railway lines

Polyol is incompatible with metal oxides particularly copper; and oxidizing compounds such as potassium dichromate, which can cause auto ignition and subsequent combustion hazards

Polyol has low flammability, but is combustible when heated by fire or contacted with oxidants and releases toxic atmospheric pollutants

Polyol has inadequate toxicity data, to determine potential health and environmental effects. The major constituent has moderate to low oral and dermal toxicity. Inhalation toxicity is low by virtue of a low vapour pressure.

The main constituent of Polyol is harmful to the golden orfe fish. Ecotoxicity data is inadequate. Because of the relatively high miscibility in water ecotoxicity is assumed to be at least moderately low.

Polyol is present in large volume (85 kL), adjacent to residential dwellings. It irritates the eyes and skin, but appears to be of moderately low human toxicity. It reacts with oxidants and some metals to potentially auto ignite. Mobility in water is moderate. Although low in flammability. A real concern is the generation of toxic compounds by fire. Polyol will not spontaneously combust, but will burn if heated above 218 C. The heat produces more vapour which flows to low points such as cellars and storm water drains. Confined space strategies apply. Combustion, produces oxides of carbon and nitrogen which are harmful to people and the environment. PPI should include full face respirator and eye protection when fire and hot weather is involved

Appendix 6 Cyclopentane Hazards

Component	Failure	Hazard	Risk	Mitigations	Mitigated Risk
Isotainer	Truck fire/ impact	Lightning, tank fatigue, ingress of oxygen, moisture distortion of tank, ignition or impact of above ground manifold with truck; explosion of Cyclopentane pipe work or tank generating projectiles, firestorm ; 55 m^3 Cyclopentane combusted, toxic fumes and NOx COx to atmosphere; Drift to residential area; projectiles and product directed to residential and vapour produced by fire/heat likely to flow down into storm water drains, factory and rail line	1	Truck diesel fuel; Entry at 10 kph; Supervision of infilling; absence of other vehicles; Truck engine off before unloading Product; Truck chassis grounded; neighboring volatile fuel sources sealed and electric sources isolated with intrinsically safe glands, starters and joiners; non-smoker; no naked flames; possible vapour release ports from UST sealed with gas impervious resin	3
Tank	Explosion/implosion, fire	140 m^3 dumped into bund with splash over; toxic fumes and NOx COx to atmosphere; Drift to residential area - respiratory sensitizer; projectiles and product directed to residential and vapour produced by fire/heat likely to flow down into storm water drains, factory and rail line	1	Underground storage tank with above-ground isolated valves and pipe work and 8 m exclusion zone. Flammable sources have spark arresting measures; replicated high pressure water supply for sprinklers; virtually insoluble in water, though toxic to invertebrates and algae.	3
Pipe work	Breakage	Damage to Pipe work between UST manifold and factory injection points	1	Pipe diameter and distance minimized. Pressure sensors with automatic shut off. Pipe work protected by ducting, and/or pipe within a pipe	3
Pipe work	Fire	Uncontrolled release of Cyclopentane from fire damage at pipe work or injection point, compounding explosions and ignitions	1	Factory wide sprinkler system, served by two 2 ML tanks, activated by temperature thermostats & manual override . Pressure drop initiates valve closure	3
compressor	stoppage	Safety rail improperly deployed or collapses, possible fall	2	Only required when operator climbs ladder to top of Isotainer. Operator does not climb ladder unless safety rail deployed, unless assisted with fall gear. Hose integrity, preventative maintenance schedule includes compressor	4
Tanker	Spill/Uncontrolled release	Hose disconnected, or improperly attached, knock or punctured, releasing Cyclopentane to filling pad, and into Polyol, MDI bunds/sumps; into factory, soil, or onto road and into storm water	2	SOP for Cyclopentane, hose connection, valve activation sequenced to minimize risk of spill at filling. Intrinsically safe lighting and remote electrics. Pressure gauges and fill levels provide feedback on tank volume. Quick-Break couplings prevent outflow if hose is inadvertently disconnected. Uninterrupted supervision. Consider intrinsically safe electrochemical detector.	3
Pipe work	gaskets/voids	failure of gaskets, presence of voids, entrapment of air, pressure build up; water condensation, ingress of air, oxygen provides combustive interface/environment	2	12 month preventative maintenance program includes pressure test of gaskets, seals, pipe work integrity. Infilling is gravity assisted fed with return of vapours to tanker/Isotainer. Intrinsically safe pump	4
Valves	Seize/disengage	Manual valves not shut before hose disconnection; leakage from faulty valves, operator error	2	SOP and safe work method statements prescribe sequence of disconnection minimising neglect. Two operators are involved in Cyclopentane filling, at all times during infilling. Manual override ; Programmed maintenance and testing, component replacement within warranty period, training for contingency of product leak	4
Electrical	short/power out	Electrical fault provides ignition source, power out prevents solenoid valve closure, and enables continuous stream of gas	2	Default in power off is valve closure. Electrics proximal to injection point are intrinsically safe.	4
Pump	Seizure/ ignition	Pump failure trapping up to 9 tonnes of Cyclopentane in factory lines; auto ignition of Cyclopentane vapour from pipe damage, impact, puncture, fire, sparks friction of contacts and vanes etc.	2	Valves, solenoids truncate volume of entrapped cyclopentane, reducing effective volume available to ignition source. Preventative 12 month maintenance program includes pumps and pipe work. All pumps and valve intrinsically safe electrics and propulsion.	4
Tank	pump failure/rain/tank failure	Hole permits ingress of water, and oxygen and release of liquid/gas to soil vadose zone and groundwater, ecosystems	2	Tank double skinned; buried underground; pressure sensors detect an internal atmospheric pressure drop; 12 monthly PM schedule and pressure testing. Three sentinel bores beside UST to intercept leakage	5
Injection point	uncontrolled release	Failure at polyurethane injection mold cabinet, resulting in uncontrolled release to factory atmosphere	3	Amount of gas injected is limited to a few litres, via solenoid and timer controls. Cabinet remains closed for 2 minutes after release of polymer components and blow gas, minimising risk of human exposure	5

Hoses	Disconnection/ damage	Residual product in delivery hose, at outlet from Isotainer, and pipe work to UST. Hoses protected with impact resistant stainless steel shielding and plastic sheath	3	Dry break couplings at Isotainer and inlet to pump; pump runs for several seconds after isotainer valve shuts off to ensure hoses are free of residual product. SOP order of valve shut off minimizes fugitive emission of vapours. Exclusion zone prevents contact of hose during infilling	4
Control panel	Display/Integrity	Display inaccuracy or failure, the emission of sparks or short circuit	3	Control panel situated outside 8 m exclusion zone. Same volume used weekly, similar production volumes, means overfill unlikely. External mechanical tank depth gauge. Pressure sensor feedback,	4

Cyclopentane is the blow gas used to expand (inject bubbles into) the rigid polyurethane foam formed by polymerisation of isocyanate and polyol components.

Cyclopentane is stored in a twin-layer underground 55 m3 fiberglass, tank at the north west corner of the site abutting with Churchill Street (Sector I)

Cyclopentane is an unsaturated liquid hydrocarbon that become a gas above 50 C.

Cyclopentane has a high vapour pressure meaning it readily evaporates . Vapour density is twice that of air, so vapour will accumulate in low lying area such as cellars, storm water conduits and railway lines

Cyclopentane is violently reactive with strong oxidizers such as chlorine, fluorine and hydrogen peroxide

Cyclopentane is highly flammable under even mild ambient conditions. It ignites when heated by fire or contacted with oxidants and releases toxic atmospheric pollutants

Cyclopentane tends to evaporate rapidly, and has low solubility in water hence toxicity is low. Inhalation toxicity is low though risk of asphyxiation is high.

Cyclopentane aquatic toxicity is high, with EC50 at about 20 mg/L for Daphnia ssp. and 120 for algae. Although solubility in water is low thereby reducing the risk of catastrophic exposure

Cyclopentane is present large volume (85 kL), adjacent to residential dwellings. It may irritate the eyes and skin, but appears to be of moderately low human toxicity. Extreme flammability means that it is potentially the fuel source for multiple explosions with a capacity for escalation of combustion, producing toxic gases and compounds. The proximity of a pressure vessel containing liquid oxygen is also a risk since Cyclopentane is violently reactive with oxidants. I It reacts with oxidants to potentially auto ignite. Mobility in water is low, although toxicity to aquatic invertebrates and algae is high. The heat produces more vapour which flows to low points such as cellars and storm water drains. Confined space strategies apply. Combustion, produces oxides of carbon and nitrogen which are harmful to people and the environment. PPI should include full face respirator and eye protection when fire and hot weather is involved

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Appendix 7 Hips & ABS Hazards

Component	Failure	Hazard	Risk	Mitigations	Mitigated Risk
Tank	Explosion/ fire	Lightning, tank fatigue, corrosion at joins, ingress of moisture; heat, CO2 generation and distortion of tank, explosion of Cyclopentane pipe work or tank generating projectiles, firestorm ; 140 m^3 dumped into bund with splash over; toxic fumes and NOx COx to atmosphere; Drift to residential area - respiratory sensitizer; projectiles and product directed to residential and vapour produced by fire/heat likely to flow down into storm water drains, factory and rail line	1	Minimization of spilled HIPS prill under and adjacent to silos. Natural gas manifolds 50 m SE. Residual prill swept up and deposited into silo bin at completion of unloading. Never more than 250 L of product in bin and on ground. Fire suppression system and scheduled routine of preventative maintenance.	3
Product	Fines/fumes	Presence of fine ABS dust provides extreme increase in surface area and concomitant increase in explosion risk, as does presence of unpolymerised butadiene, styrene, acrylonitrile	2	Specification sheet for each batch confirms < 1 mg fines/kg or similar, and SDS confirms unpolymerised material < 0.1% forwarded prior to receipt of load, ensuring that no fines or vapour producing compounds are contaminants of the ABS	4
Silo	Corrosion/ vapour/static	Corrosion, puncture, fatigue of silo fabric and or supports; static electricity build up during transfer of ABS, with enhanced flammability in atmosphere of vapour generated by unpolymerised styrene, butadiene, acrylonitrile	2	Product is essentially inert at normal ambient temperature and humidity. Silos are galvanised and earthed to sacrificial anode, with static discharge function. Programmed routine maintenance and inspection of silo structure	4
Injection point	uncontrolled release	Failure of ABS injection mould metering valves, injectors, heat exchangers, permitting build up of organic vapours, potentially explosive, toxic to workers and atmospheric pollutants	2	Amount of molten HIPS or ABS injected at one time is limited to a few litres, via solenoid and timer controls. COMI or comparable injection mould enclosure remains closed for 10 seconds after release of moulded fitting from mould; vacuum exhaust directs fumes through activated charcoal and lime scrubber minimising risk of human exposure and providing future means of controlling atmospheric release	4
Pipe work	Fire	Uncontrolled release of Cyclopentane from fire damage at pipe work or injection point, combining with ABS fuel feedstock compounding explosions and ignitions	2	Factory wide sprinkler system, served by two 2 ML tanks, activated by temperature thermostats & manual override . Pressure drop initiates valve closure, Blow gas and HIPS & ABS conduits segregated until point of injection	4
Auger/generator	collapse/explosion	collapse of augur during infilling from fatigue, impact, vibration working loose fasteners; failure or explosion at generator fuel source	3	SOP, SWP Job Safety Assessment for secure positioning and insertion of auger and boot. Use of intrinsically safe electrical generator, or preference for diesel over petrol generator	4
Isotainer	Truck/impact	Impact of truck with Silo footings, spilling 42 m3 and/or 62 m3 product ± tipper contents onto concrete driveway and or spillage of tipper tray contents east across fence and path to Edward Street and into storm water, size of prill passes through storm water mesh, residual unpolymerised acrylonitrile, styrene, butadiene with aquatic environmental toxicity	3	Entry at 10 kph; Supervision of infilling; absence of other vehicles; trained and experienced, fatigue-free driver, temporary exclusion zone demarked during unloading, Safe Work Plan with Job hazard Analysis	5
Pipe work	Breakage	Damage to overhead pipe work between Silo and factory, from high loads, masts, erected structures, corrosion, impact, lightning	3	Pipe diameter and distance reduced mass of HIPS & ABS potentially dumped, manual overlies valves for vacuum delivery, Pressure sensors with automatic shut off. Pipe work protected by strut work.	5
Tipper	Spill/Uncontrolled release	Tail gate or hydraulic ram failure, delivers HIPS prill to concrete drive with flow across boundary to roadway and storm water; slip hazard	3	SOP sequenced so tailgate opens when auger is operational. Only portion of tailgate open at any one time. Transport tipper subject to routine preventative maintenance.	6
Valves	Seize/disengage	Automatic valves fail at signal, timing gradually alters, sequence of mitigation events is interrupted by power or signal adjustment	4	Manual override ; Programmed maintenance and testing, component replacement within warranty period, training for contingency of product leak, feedback loop on tolerance exceedances, shuts down COMI until extraction evacuates confined spaces	5
Tipper	Noise	Noise of generator set powering auger conducting HIPS prill to silo exceeds C-weighted peak sound pressure level LC peak, of 140 dB (C)	4	Bollards are installed around tipper and auger during unloading. Unloading is a relatively brief procedure, taking less than 1 hour, delivery of prill is scheduled for daytime hours only, operators are not compelled to stand in front of the generator set	6
Electrical	short/power out	Electrical fault provides ignition source, power out prevents solenoid valve closure, and enables continuous stream of gas	4	HIPS & ABS prill is evacuated using a vacuum, that pulls from a source distal to the silos. Manual override default is power -off if valve closure. Electrics proximal to injection point are intrinsically safe. No return flow to the silos	6

Component	Failure	Hazard	Risk	Mitigations	Mitigated Risk
Temperature	Operator exposure to vapours	HIPS & ABS stored at ambient temperature, higher vapour pressure on hot days, possibly deriving from constituent monomeric compounds such as butadiene. These compounds are suspected or known carcinogens	4	Unpolymerised compounds at low concentration as per SDS, dynamic flow of contents on 24/7 production schedule, continuously equilibrates a potential increase in vapour pressure, with the ambient air pressure temperate climate	5
Hoses	Damage/ Disconnection	Damaged or disconnected hoses spill product onto hot surface permitting ignition	4	Hoses replaced by auger and ductwork/pipe work	6

HIPS (High Impact Polystyrene) or Styrene A is the main polymer used in manufacture of refrigerator and freezer housings

HIPS is stored in (See appendix 2) at the central north east of the EHP site, abutting with Edward Street, beside the North east entrance to the site

HIPS are essentially an inert solid once polymerised. The injection mould process re-melts a pre-weighed slug of the product, which is injected by mean of Cyclopentane blow gas. It is composed of mostly hydrocarbon with some nitrogen cross links

HIPS has minimal vapour pressure, unless co-contaminated with unreacted butadiene. Solid density is slightly more than that of water, so prill spilled into the storm water is likely to sediment a short distance from the source unless heavy rainfall and strong currents prevail

HIPS is incompatible with strong acids such as sulphuric, also bases and some metals including copper & aluminum. HIPS is incompatible with strong oxidizers such as perchlorate, nitrates, chlorine, oxygen, since oxidizers provide the conditions for depolymerization and spontaneous combustion, at elevated temperatures

A HIP does not generate much vapour. It is not spontaneously combustible, but is highly flammable when the ignition source and a flammable intermediate is present, such as residual butadiene or Cyclopentane. Combustion produces noxious gases including COx and monomeric constituent compounds,

HIPS polymer is of low toxicity to humans and the environment. However unpolymerised or de-polymerised organic constituents are toxic, carcinogenic and/or asphyxiant. Further, the products of combustion are also toxic to humans and the environment

HIPS are of low aquatic toxicity until depolymerized or unless coated with unpolymerised styrene and butadiene monomer. The major constituent of HIPS (styrene 90%) in the monomeric form is considered toxic to fish (EC_{50} 4-29 mg/L), invertebrates (EC50 5-23 mg/L) and algae (0.6 mg/L) ie Chlorella.

HIPS is present in large mass (106 t), adjacent to a factory entrance and crossing to car park. It appears to be of moderately low human toxicity. Low flammability means that it is unlikely to spontaneously ignite, but the largely hydrocarbon composition is an excellent fuel source for relatively slow and incomplete combustion, which if unchecked will escalate generating large amounts of heat and noxious gases to the atmosphere, and potentially residential development. These partially combusted products and depolymerized constituents are carcinogenic and toxic to aquatic ecosystems. Proximity of oxidants provides the potential for explosive combustion and great mass flow of atmospheric contaminants, though the combustion will likely be cleaner. Mobility of the solid prill in water is low, unless carried away by strong storm water currents. Toxicity to aquatic invertebrates and algae is higher than expected. This is reduced significantly if the product is relatively free of unpolymerised compounds. Heat and fire release compounds that are denser than air and vapour which flows to low points such as cellars and storm water drains. Confined space strategies apply. Vapours of acrylonitrile are highly toxic to all life. Combustion, produces oxides of carbon and nitrogen which are harmful to people and the environment. PPI should include full face respirator and eye protection when fire and hot weather is involved

ABS or Acrylonitrile-Butadiene-Styrene is also used in the manufacture of refrigerator/freezer housings. Refrigerator drip trays are the major component requiring ABS. A second 'Thermo tolerant ' ABS containing bromine antimony is also potentially used. Risk analysis is limited by knowledge of the quantities, storage and toxicity, although a recent study of acrylonitrile generation during injection mould purge, will enable a more representative assessment at the first revision of the PIRMP.

ABS is stored in low volume in the North Building- (See appendix 2)

ABS is essentially an inert solid once polymerised. The injection mould process re-melts a pre-weighed slug of the product, which is injected by mean of Cyclopentane blow gas. It is composed of mostly hydrocarbon with some nitrogen cross links

ABS has minimal vapour pressure, unless co-contaminated with unreacted butadiene . Solid density is slightly more than that of water, so prill spilled into the storm water is likely to sediment a short distance from the source unless heavy rainfall and strong currents prevail

ABS is incompatible with strong oxidizers such as perchlorate, nitrates, chlorine, oxygen, since oxidizers provide the conditions for depolymerization and spontaneous combustion, at elevated temperatures

ABS does not generate much vapour. It is not spontaneously combustible, but is highly flammable when the ignition source and a flammable intermediate is present, such as residual butadiene or Cyclopentane. Combustion produces noxious gases including COx, NOx and monomeric constituent compounds,

ABS polymer is of low toxicity to humans and the environment. However unpolymerised or depolymerized organic constituents are toxic, carcinogenic and/or asphyxiant. Further, the products of combustion are also toxic to humans and the environment

ABS aquatic toxicity data is limited. More data is available on the constituent monomers, all of which have at least moderate aquatic toxicity. ABS polymer is reported to be toxic to fish (EC50 12 mg/L Pimephales promelas, and 18 mg/L common carp. This is likely due to the presence of traces of unreacted monomer on the polymer surface.

ABS is present in as yet unknown quantities, likely in the North building (Plastics). It appears to be of moderately low human toxicity. Low flammability means that it is unlikely to spontaneously ignite, but the largely hydrocarbon composition is an excellent fuel source for relatively slow and incomplete combustion, which if unchecked will escalate generating large amounts of heat and noxious gases to the atmosphere, and potentially residential development. These partially combusted products and depolymerized constituents are carcinogenic and toxic to aquatic ecosystems. Proximity of oxidants provides the potential for explosive combustion and great mass flow of atmospheric contaminants, though the combustion will likely be cleaner. Mobility of the solid prill in water is low, unless carried away by strong storm water currents. Toxicity to aquatic invertebrates and algae is higher than expected. This is reduced significantly if the product is relatively free of unpolymerised compounds. Heat and fire release compounds that are denser than air and vapour which flows to low points such as cellars and storm water drains. Confined space strategies apply. Vapours of acrylonitrile are highly toxic to all life. Combustion, produces oxides of carbon and nitrogen which are harmful to people and the environment. PPI should include full face respirator and eye protection when fire and hot weather is involved

Appendix 8 R600a Hazards

Component	Failure	Hazard	Risk	Mitigations	Mitigated Risk
Cylinders	Fire/explosion	Coincidence of emission of iso-butane either by venting, valve leak, regulator attachment, release, failure, tap engagement; with ignition source such as cigarette, spark from impact of metal on metal, hot engine housing/cowling, fire, hot work, naked flame. Ignition of secondary toxic sources such as MDI.	1	Training, SOP, SWMS for effective regulator insertion pressure check, pipe work connection, volume estimation from pressure dial. Exclusion zone from Hot work, naked flame, combustion engine, petrol generator set. Total volume of cylinders in any of three locations never exceeds two pallets or 864 kg. Overhead pipes conducting MDI and Polyol are ideally > 20 m from stored cylinders	3
Cylinders	Impact/projectile	Impact of cylinders with forklift, fall from pallet during transport, impact of valve with concrete, releasing compressed gas, converting cylinder into airborne projectile; impact with persons or fabric of building, causing injury or structural failure debris and secondary projectiles, causing injury or impact with flammable sources causing fire and or explosion(s)	2	Transport of pallet on forklift at half height of cylinder reduces angle of impact and risk of valve dislodgement; changing of cylinders together during transit and transit speed 15 kph or less increases stability; Pallets unloaded from pantec as close to truck as practical, and lowered to minimum mast height before transit.	4
Cylinders	damaged or corroded	One or more of full cylinders delivered is deformed or corroded and therefore inherently weaker than standard; impact or fire exposes weakness, enabling explosion or impact	2	Cylinders are tested and the testing procedure conducted as per Australian standard, with auditing of the gas supply company to ensure that checks are conducted without compromise	4
Pipe work	impact/disconnection/ fire	Damage of pipe work between cylinder and injection point for refrigerator/freezer condensers, releasing iso-butane, which is a suspected carcinogen and asphyxiant and flammable gas	3	Length of pipe work is reduced, due to transport of cylinder to injection point, or protected by conduit	4
Injector	emission	Iso-butane gas emission to atmosphere, potentially inhaled by workers during infilling of compressors for refrigerator/freezer	3	Infilling of compressors commences after the regulated gas supply is attached by swage lock or similar fittings. The process is conducted in a pressurized cabinet that is sealed and evacuated before a subsequent unit is gassed.	4
Valves	slow leak	slow leak of gas from the cylinder builds up in a confined space providing asphyxiation or fire risk	3	Gas cylinders stored in well ventilated area. Valves and regulators tested as part of annual preventative maintenance schedule	5
Regulator	failure	Regulator failure releasing iso-butane into factory, exposing workers, aspiration causes pneumonitis (non infectious pneumonia)	3	Regulators are tested and where necessary replaced; Routine testing as party of preventative maintenance schedule; SOP , SWIM for insertion of regulator	5
Gas	chronic exposure	Potential for chronic exposure of low dose over several years for operators engage in transferring cylinders and attaching regulators to enable gas supply to compressors	4	Training and SOP, SWMS ensure operator is informed of possible carcinogenic effect of repeated exposure to refrigerant. Automation of valve activation reduces human exposure risk	5

R600a or iso-butane is a refrigerant gas used in the compressors of Electrolux refrigeration products

R600a is mostly stored in K (2 pallets) at the western side of the property between the engineering workshop and the freight loading facility, a third pallet is stored in (See appendix 2) at the Freight loading facility and a spare cylinder resides in (See appendix 2) south of the ABS silos

R600a is an extremely flammable, moderately toxic gas

R660a has a high vapour pressure around 205 kPa. Dissolution to the atmosphere is rapid, unless confined, in which case explosion risk is high. As a gas, dissolution in water is a minor concern

R600a is incompatible with strong oxidizers such as perchlorate, nitrates, chlorine, oxygen, fluorine, nickel, carbonyl since these compounds facilitate ignition

R600a is extremely flammable. A single injection of 45g to a freezer generates 1 m^3 of flammable gas. Auto ignition risk increases dramatically above 50°C

R600a is of moderately low toxicity to humans and the environment, although long term exposure is suspected to cause cancer.

R600a has moderately low toxicity to aquatic invertebrates (*Daphnia magna* LC_{50} 930 mg/L) but is a little more toxic to fish (rainbow trout LC_{50} 430 mg/L)

R600a or iso-butane is present in acceptably low storage amounts ranging from 48 to 864 kg (1.35t total) at three locations on site. The greatest concentration is at the western boundary of the site, adjacent to the railway line. It appears to be of moderately low human toxicity. It is extremely flammable. A significant risk is the potential to ignite other more toxic chemicals on site, such as MDI. Such a fire would generate large amounts of heat and noxious gases to the atmosphere, and potentially residential development. Some of these partially combusted products and depolymerized constituents are carcinogenic and toxic to aquatic ecosystems. Proximity of oxidants provides the potential for explosive combustion and great mass flow of atmospheric contaminants, though the combustion will likely be cleaner. Mobility of the gas is high in air, and low in soil and water, due to partitioning into air. Toxicity to aquatic invertebrates and algae is therefore low. Heat and fire releasing the denser than air gas may pose a confined space risk in cellars and storm water drains. Confined space strategies apply. Combustion, also produces oxides of carbon and nitrogen which are harmful to people and the environment. PPE should include full face respirator and eye protection when fire and hot weather is involved.

Appendix 9 R134a Hazards

Component	Failure	Hazard	Risk	Mitigations	Mitigated Risk
Above ground tanks	uncontrolled release/asphyxiation	Uncontrolled release of 14 -28 cubic metres of gas from faulty valve or from pipe work during refilling, flows along low ground into storm water, sewer, railway line, or factory engulfing factory, trade waste or rail workers, causing death or injury through loss of consciousness, fall, impact, drowning, suffocation.	1	Tank valves are subject to regular programmed maintenance. Gas is refilled at low frequency of 8tonne every 6 months, using a standard operating procedure involving two trained people, familiar with SWMS. Further security is afforded by portable GC-FID detector during infilling. Alternative detectors include infrared absorption spectroscopy or quantum cascade laser.	4
Above ground tanks	Impact/projectile	Impact of tanks with forklift, isotainer transport or other vehicle, releasing compressed gas coincident with hot work or flammable sources causing fire and or explosion(s). Or coincident with impact of R600a store, releasing highly flammable iso-butane, combustion and production of extremely corrosive hydrofluoric acid and noxious gases	2	Tanks off-set from vehicular access, no requirement for forklift at west boundary of site, bollards protect AGSTs, vehicles limited to 10 kph speed limit	4
Above ground tanks	damaged or corroded	One or two 14kL tanks corroded and therefore inherently weaker than standard; impact or fire exposes weakness, enabling uncontrolled release and/or explosion or impact	2	Programmed preventative maintenance schedule includes R134a tanks. Tanks are double skinned with pressure difference sensors. R600a store can be further segregated by distance or barrier wall.	4
Injector	emission	1,1,1,2 tetrafluorethane gas emission to atmosphere, potentially inhaled by workers during infilling of compressors for refrigerator/freezer, causing dizziness or fainting, with possible impact injury	2	Infilling of compressors commences after the regulated gas supply is attached by swage lock or similar fittings. The process is conducted in a pressurized cabinet, that is sealed and evacuated before a subsequent unit is gassed.	4
Above ground tanks	Fire/explosion	Large storage volume, and emission of 1,1,1,2 tetrafluorethane either by bulk release from faulty valve, coincident with conduct of hot work with sustained naked flame.	2	R134a has low flammability. Hot work or naked flame exclusion zone	5
Pipe work	impact/disconnection/ fire	Damage of pipe work between tank and injection point for refrigerator/freezer condensers, releasing 1,1,1,2 tetrafluorethane, an asphyxiant and greenhouse gas. Possible impacts on workers and the environment	3	Pipe work is covered by schedule of programmed preventative maintenance. Injects are enclosed in air-tight cabinet with a 2 minute wait between subsequent evacuation and injection into new refrigerator/freezer	5
Valves	slow leak	slow leak of gas from feed line builds up in a confined space providing asphyxiation or fire risk	3	Valves and regulators tested as part of programmed preventative maintenance schedule, refrigerant has moderately low flammability and human toxicity	5
Hoses	void volume	release of residual gas from hoses following infilling of tanks poses inhalation and atmospheric pollution risk	3	Adherence to Electrolux JDS "Procedure for Evacuating Hoses Prior to & after delivery of R134a" should ensure that no product remains within the void volume of the hoses after tank infilling.	6
Bulk Delivery Tanker	uncontrolled release/asphyxiation	Premature pumping/release of R134a from bulk delivery tanker during in-filling of AST or UST, evaporation a associated asphyxiation and atmospheric pollution risks	3	Adherence to Electrolux Work Instruction "Procedure for Unloading R134a Refrigerant from Bulk Delivery Tanker" should ensure that no product is inadvertently spilled during bulk delivery.	5
Gas	chronic exposure	Potential for chronic exposure of low dose over several years for operators engaged in pressure testing compressors or at injector cabinet	4	Training and SOP, SWMS ensure operator is informed of possible carcinogenic effect of repeated exposure to refrigerant. Automation of valve activation reduces human exposure risk	5

R134a or 1,1,1,2 tetrafluorethane is the main refrigerant gas used in the compressors of Electrolux refrigeration products

R134a is stored in large volume (28kL) at Depot 10 in 14kL AGST's, adjacent to the R600a cylinder store at the western side of the property between the engineering workshop and the freight loading facility

R134a has moderately low flammability, but will ignite in a naked flame or under heated conditions. It is not an ozone depleting gas. It is a greenhouse gas.

R134a has an extremely high vapour pressure around 605 kPa. Dissolution to the atmosphere is rapid, unless confined, in which case explosion risk is moderate. Dissolution of this gas in water is low at 1.5 mg/L

R134a is incompatible with reactive alkali and alkali earth metals, including potassium, calcium, magnesium as well as transition metals aluminum and zinc

R134a has low flammability at ambient temperatures, but is flammable when heated or exposed to a naked flame.

R134a is of moderately low toxicity to humans and the environment, although cardiovascular irregularities may be promoted by exposure. Liquid product has MP -103°C therefore frostbite tissue damage is a significant risk

R134a aquatic toxicity data is limited, largely because the flammable nature and gaseous state translate to an atmospheric dispersal rather than soil or water. Combustion by-products include highly corrosive and harmful hydrofluoric acid

R134a is present in large volume in two 14m^3 tanks, concentrated at the western boundary of the site, adjacent to the railway line. It appears to be of moderately low human toxicity. It is extremely flammable. A significant risk is the asphyxiant potential from a large uncontrolled release on humans in the vicinity. Ignition risk is moderately low for a hydrocarbon, however, once ignited, highly corrosive halogenic acids are byproducts, and these are significant risks to metallic infrastructure and human health. The propensity for production of toxic and noxious gases to the atmosphere, and potentially residential development, also exists, when extensive fire ignites other sources such as MDI and Polyol. Storage of reactive metals such as galvanised (zinc plated) metals and aluminum in proximity of the tanks should be avoided, since these metals accelerate oxidation and combustion of the gas . Mobility of the gas is high in air, and low in soil and water, due to partitioning into air. Toxicity to aquatic invertebrates and algae is therefore low. However, fish and microbial populations are considered moderately susceptible. Heat and fire releasing the denser than air gas may pose a confined space risk in cellars and storm water drains. Confined space strategies apply. Combustion, also produces oxides of carbon and nitrogen which are harmful to people and the environment. PPE should include full face respirator and eye protection when fire and hot weather is involved.

Appendix 10 Thinners Hazards

Component	Failure	Hazard	Risk	Mitigations	Mitigated Risk
20L Drums	spill or cap omission	20L drum spilled generates 150m^3 of vapour at 100 x TWA in a 150 m^3 room. Possible inhalation hazard or asphyxiation	2	Flammable store fitted with ventilation fans, Volume of airspace approximates 1000 m^3, drums are stored on clean raised bund pallets enabling recovery of spills from drums damaged on handling	4
20L drums	operator narcosis	operator overcome by fumes when transferring thinners from 20L drums to receptacles	2	Drums are transported by trolley to the east side of the pad print room, which resides in the north factory building, which is both well ventilated and of volume approximating 100,000m^3. The drum is fitted with an automated delivery line, minimizing exposure during transfer. Drums are replaced in the cool of the morning where practicable.	4
20L drums	impact and spill	One or more drums of thinner is impacted by vehicle or floor while being transported, in an area of the factory that is populated and/or confined	2	Single drums are transported at one time by hand trolley or electric cart. Drums are secured with ties, and not accompanying incompatible materials that could puncture, ignite or accelerate combustion.	4
20L drums	fire in storage	One or more 20L drums loses contents through fall, slip, trip and ignites minimum 120 L Midway thinners, 200 L Duthin 140 and 400L of oil. Semi trailers parked along north wall of flammable liquid storage provide fuel source for further escalation of fire	2	Pallets contain only a single layer of drums, and are segregated by a distance of 5 m. Flammable Liquid Storage is fire retardant, well ventilated, cool, fitted with detection and sprinkler systems. Volume of flammable liquids are the minimum required for effective factory operations	3
pallet drums	impact and spill	pallet of drums falls during unloading from transport or impact on forklift with building or vehicle, solvent enters storm water drain (higher risk with Duthin 140 than Midway), or flows under inaccessible pilings providing a source of vapour to occupants etc.	2	Pallets of solvent in 20L drums are loaded from flat tray or pantech truck directly into flammable liquids store. Loads are secured and single pallets moved at a time, as close to ground level as practicable. Store men have dangerous goods training, transfer of drums occurs during low traffic and cool of the day. Transport of chemicals throughout the site is via a bund container.	5
waste solvent	wash bay containment	Thinners are used to clean pad print parts at completion of printing shifts by means of an airtight cabinet. Waste paint/solvent mixture is decanted by gravity from sink of wash cabinet into a 20L drum. Opening of cabinet door during inspection of hard to clean parts, exposes operator to above STEL concentrations of thinners. Overfill of drum is also a risk	3	Improved visibility and tactile flexibility of cabinet, by keeping Perspex clean and adjusting solvent outlet to a fine directional jet. Short term - operator can wear solvent excluding full face mask with gas filters (eg Moldex 9000 & 9100 filters), opening of the cabinet mid clean is proposed. Medium term - positioning of an exhaust hood over area immediately south of cabinet or replacement of cabinet with fume hood with high extraction fan. Fitting of pad print operator with electrochemical sensor that alarms when STEL concentration is breached. Consideration of lower VP solvents.	5
Pad printer	operator narcosis	pad print operator exposed to near-TWA concentrations of thinners during the pad print process, long term exposure to solvents such as toluene and xylene, have chronic organ damage potential	3	Maintenance of positive pressure extraction exhaust above pad print bays. Routine testing of pad print bays to ensure adequate flow rate and acceptable inhalation concentrations during routine to heavy shifts.	5
Pad printer	dermal exposure	Operator dermal absorbs thinner solvents, through ripped, cut-off or permeable gloves.	3	Operator dons Nitrile gloves during printing and cleaning	6
waste solvent	disposal	waste solvent is stored in temporary waste bay, impacted and spilled, lost to atmosphere, soil and/or storm water	3	waste solvent drums sealed, secured and removed from Pad Print room to flammable liquids store for audited collection by solvent recycling contractor. Long Term - solvent recovery through re-distillation, fractionation and chromatographic analysis, enables solvent cycling at reduced input cost and environmental load.	5

Duthin 140 is the minor thinner used in pad print operations, the major solvents of which are acetone and xylene. Multi-Midway Thinner is the major thinner used, comprising largely toluene	Use
Duthin 140 (200 L) and Midway thinners (120 L) are stored in the flammable liquid store in Depot 6 at the south west boundary of the site	Location
Acetone is a moderately flammable, oxygenated hydrocarbon solvent with high water solubility that will ignite in a naked flame or under heated conditions. Toluene and xylene are highly flammable aromatic hydrocarbons, with low water solubility	Nature
Acetone has a moderately high vapour pressure at 184 mmHg. Toluene has a moderate VP (22 mmHg). Both solvent evaporate readily in warm conditions. Confined atmospheres are explosive. Acetone dissolves readily in water, Toluene sparingly. Duthin 140 is therefore more mobile in water than Midway	Mobility
Acetone and toluene are incompatible with strong oxidizers and acids. Acetone is incompatible with a variety of organic chemicals as well as carbon and air.	Compatibility
Acetone and toluene are flammable liquids at ambient temperatures, highly flammable when heated or exposed to a naked flame.	Flammability
Acetone has moderately low mammalian toxicity, and low toxicity to aquatic organisms. Toluene has moderate human toxicity and moderate toxicity to aquatic organisms	Toxicity

Acetone readily dissolves in water and is rapidly transported in waterways. However toxicity to fish, invertebrates and algae is low. As is bioaccumulation due to relatively polar nature. Toluene dissolves slightly in water, and so travels as a slick rather than a solute, but is more toxic and bio-accumulative.	Environmental
Duthin 140 and Midway thinners are housed in the flammable liquid store at the west boundary of the site Depot 6. Duthin 140 is of moderately low human toxicity; Midway is moderately toxic to mammals. Both products are flammable. A significant with the high acetone content Duthin 140 is the defatting effect on skin and the reactivity of acetone with other organic compounds, acids and oxidants; this is of significance if fire causes contact between partial combustion products of MDI and Polyol and vaporized acetone. A significant risk with toluene, the main constituent of Midway thinners is the damage to lung tissue of humans as well as susceptibility and bioaccumulation of aquatic organisms. Both compounds can displace oxygen to asphyxiate. Toluene is also a suspected tetarogen. Ignition risk is moderately high. The propensity for production of toxic and noxious gases to the atmosphere is also high since both thinners contain at least 30% aromatic hydrocarbons. Risk to neighboring residences is moderately low on the basis of location of the store and inventory maintained. Heat and fire releasing the denser than air gas may pose a confined space risk in cellars and storm water drains. Confined space strategies apply. Combustion, also produces oxides of carbon and nitrogen which are harmful to people and the environment. PPE should include full face respirator and eye protection when fire and hot weather is involved.	Take Home

Appendix 11 Acetylene Hazards

Component	Failure	Hazard	Risk	Mitigations	Mitigated Risk
Cylinders	Fire/explosion	Coincidence of emission of acetylene either by venting, valve leak, regulator attachment, release, failure, tap engagement; with ignition source such as cigarette, spark from impact of metal on metal, hot engine housing/cowling, fire, hot work, naked flame. Ignition of secondary toxic sources such as MDI.	1	Training, SOP, SWMS for effective regulator insertion, pressure check, pipe work connection, volume estimation from pressure gauge. Exclusion zone from Hot work, naked flame, combustion engine, petrol generator set. Total volume of cylinders in any of three locations never exceeds one pallet or 432 kg. Overhead pipes conducting MDI and Polyol are ideally > 20 m from stored cylinders. Cylinders are stored 100 m south of MDI and Polyol tanks	3
Cylinders	Escalating explosion/fire	Acetylene cylinders co-stored with oxygen cylinders ensuring that initial explosion impacts additional fuel and oxidant, producing a cascade of cylinder explosions and associated debris and fireball	1	Segregation of Oxygen and Acetylene so that ignition of either does not escalate by impacting the other. For example fire retardant barrier 1.5 m high with a fire resistance rating of >30 minutes	3
Cylinders	Impact/projectile	Impact of cylinders with forklift, fall from pallet during transport, impact of valve with concrete, releasing compressed gas, converting cylinder into airborne projectile; impact with persons or fabric of building, causing injury or structural failure debris and secondary projectiles, causing injury or impact with flammable sources causing fire and or explosion(s)	2	Transport of pallet on forklift at half height of cylinder reduces angle of impact and risk of valve dislodgement; changing of cylinders together during transit and transit speed 10 kph or less increases stability; Pallets unloaded from pantech as close to truck as practical, and lowered to minimum mast height before transit.	4
Cylinders	damaged or corroded	One or more of full cylinders delivered is deformed or corroded and therefore inherently weaker than standard; impact or fire exposes weakness, enabling explosion or impact	2	Cylinders are tested and the testing procedure conducted as per Australian standard, with auditing of the gas supply company to ensure that checks are conducted without compromise	4
Pipe work	Acetylene conduit	Damage of pipe work between acetylene cylinder and weld rod, releasing acetylene an asphyxiant, impairing welder performance, causing loss of consciousness, vicarious injury or ignition of fuel source	2	Scheduled maintenance to include hose and pipe work integrity. Fittings, e.g. Ferrules inspected for cross threading burring, cracks and distortions - replaced.	4
Pipe work	Oxygen conduit & or valve	Damage of pipe work between oxygen cylinder and leaking or faulty mixing valve, releasing oxygen, a fire accelerant, enabling ignition source and oxidant outside of the weld flame	2	Scheduled maintenance to include hose and pipe work integrity. Fittings, e.g. Ferrules inspected for cross threading burring, cracks and distortions - replaced.	4
Valves	slow leak	slow leak of gas from the cylinder builds up in a confined space providing asphyxiation or fire risk	3	Gas cylinders stored in well ventilated area. Valves and regulators tested as part of annual preventative maintenance schedule	5
Regulator	failure	Regulator failure releasing acetylene into factory, or APDC exposing workers/trainees	3	Regulators are tested and where necessary replaced; Routine testing as party of preventative maintence schedule; SOP , SWIM for insertion of regulator. Gas supply is always stored with tap in closed position	5

Acetylene is the fuel gas used for welding training at the APDC and welding operations by maintenance at various places around the factory.	Use
Acetylene is stored as one pallet of 432 kg in a lockup shed on the east side of the APDC and one pallet in open-air at the west side of the factory near the railway line north end of the maintenance workshop.	Location
Acetylene is an extremely flammable, moderately toxic gas	Nature
Acetylene has a high vapour pressure around 4535 kPa at 22°C. Dissolution to the atmosphere is rapid, unless confined, in which case explosion risk is high. As a gas, dissolution in water is a minor concern	Mobility
Acetylene is violently reactive with strong oxidizers such as perchlorate, nitrates, chlorine, oxygen, fluorine, nickel, carbonyl since these compounds facilitate ignition	Compatibility
Acetylene is extremely flammable. Flash point is -19°C. Auto ignition risk increases dramatically above 50°C and is initiated at 305°C	Flammability
Acetylene is of moderately low toxicity to humans and the environment.	Toxicity
Acetylene toxicity to aquatic invertebrates is considered to be low since the gas diffuses into the atmosphere . It is moderately toxic to fish (river trout LC_{50} 200 mg/L).	Environmental
Acetylene is present in acceptably low storage amounts 432 kg at 2 locations on site, NE and W respectively. The population density at the APDC is moderate, and this is compensated for, by segregation in a locked vented store. Acetylene is of moderately low human toxicity However if released in sufficient quantity displaces air and is therefore a an asphyxiant. It is extremely flammable. A moderately low risk is the potential for escalating fires due to the impact of one cylinder with other stored in the vicinity, particularly in the presence of compressed oxygen. Temperatures generated would be sufficient to melt mild steel structures and impact residential development with flying debris and smoke and heat, particularly the APDC supply. There exists a low risk of ignition of other more toxic chemicals on site, such as MDI. Such a fire would generate large amounts of heat and noxious gases to the atmosphere, and potentially residential development. Some of these partially combusted products and depolymerized constituents are carcinogenic and toxic to aquatic ecosystems. Proximity of oxidants provides the potential for explosive combustion and great mass flow of atmospheric contaminants, though the combustion will likely be cleaner. Mobility of the gas is high in air, and low in soil and water, due to partitioning into air. Toxicity to aquatic invertebrates and algae is therefore low. Heat and fire releasing the lighter than air gas may poses a confined space risk in buildings with low ceilings. Confined space strategies apply. Combustion, also produces oxides of carbon which are harmful to people and the environment. PPE should include full face respirator and eye protection when fire and hot weather is involved.	Take Home

Appendix 12 LPG Propane Hazards

Component	Failure	Hazard	Risk	Mitigations	Mitigated Risk
Above ground tank	Fire/explosion	Coincidence of emission of LPG (major gas is propane) either by venting, over-filling, valve leak, regulator attachment, release, failure, tap engagement; with ignition source such as cigarette, spark from impact of metal on metal, hot engine housing/cowling, fire, hot work, naked flame. Ignition of secondary toxic sources such as MDI.	1	Forklift Cylinders are filled to 80% maximum. Filling is conducted by trained operators. A dead man switch is activated by button or string to engage a cutoff valve. Instructions are clearly written at the fill site. Tanks are situated away from high traffic areas. Training, SOP, SWMS for effective forklift tank filling, pressure check, pipe work connection, volume estimation from pressure gauge. 15 m exclusion zone from Hot work, naked flame, combustion engine, petrol generator set. Overhead pipes conducting MDI and Polyol are ideally > 100 m from stored tanks. Buildings are >40 m from tanks	3
Above ground tank	Escalating explosion/fire	Acetylene oxygen or isobutylene cylinders co-stored proximal to LPG tanks, providing accelerants and less secure fuel sources ensuring that initial explosion from impact/ignition/leak produces an explosion capable of rupturing the LPG above ground storage tank. Further risk associated with projectiles and associated debris and fireball	1	Segregation of Iso butane, oxygen and acetylene so that sufficient distances > 40 m separate potential sources. The spare iso-butane pallet of 433 kg liquid resides within a steel frame in Depot 12, although less than 20 m from the western wall LPG AGST, the risk of cylinder fall/impact is low.	3
Above ground tank	Impact/projectile	Impact of above ground tank (2) with forklift, delivery transport, freighters at loading bay during transport causing tank rupture, severance of supply lines, breakage of valves/hoses, releasing compressed gas, providing spontaneous emission conditions, generating mild steel projectiles; impact with persons or fabric of building, causing injury or structural failure debris and secondary projectiles, causing injury or impact with flammable sources causing fire and or explosion(s)	1	Forklifts speed limited, vehicular traffic low and limited to once daily per forklift for purposes of refill. Bollards substantial and deflective, particularly for western wall AGST, which is protected on all sides. Freighters speed limited and loaded from bay >50 m south west of LPG. Random testing of Freighters and forklift operators for fatigue, residual alcohol and narcotics.	4
Above ground tank	damaged or corroded	One or more of above ground tanks develops a weakness, corrodes or wears at a connection and is therefore inherently weaker than standard; impact, gas leak or fire exposes weakness, enabling explosion or impact	2	Above ground tanks are tested as per Australian standard, as part of routine programmed maintenance. Fixtures are replaced when worn or deformed. Gas supply/ refill operator is appropriately trained and able to assess potential faults and weaknesses compromise	4
Pipe work	LPG Conduit	Damage of pipe work between LPG AST and Gas dispenser releasing propane an asphyxiant, impairing forklift driver performance, causing loss of consciousness at or after refueling, vicarious injury or ignition of fuel source	2	Scheduled maintenance to include hose and pipe work integrity. Fittings, e.g. Ferrules inspected for cross threading burring, cracks and distortions - replaced.	4
Forklift Tank	Overfill, weakness, damage or leak	Damage of forklift fuel tank cylinder, overfilling, faulty connections, corrosion, weakness from inadvertent impacts on a earlier occasion or faulty battery/electrics converts forklift to potential explosion source, with cascading effect on adjacent LPG tank and surrounds	2	Scheduled maintenance to include Forklift electrics, tank, valves and pipe work integrity. Fittings, e.g. Ferrules inspected for cross threading burring, cracks and distortions - replaced.	4
Valves	slow leak	slow leak of gas from the cylinder builds up in a confined space providing asphyxiation or fire risk	3	Gas cylinders stored in well ventilated area. Valves and regulators tested as part of annual preventative maintenance schedule	5

LPG - essentially propane is the fuel gas used for refill of gas-powered forklifts used to conduct pallet transit and storage on site LPG is stored in two separated above ground storage tanks 40 m apart in open space at the south west of the site line

LPG - Propane is an highly flammable, moderately low toxicity gas

Propane has a high vapour pressure around 933 kPa at 20°C. Dissolution to the atmosphere is rapid, unless confined, in which case explosion risk is high. As a gas, dissolution in water is a minor concern

Propane is highly reactive with strong oxidizers such as perchlorate, nitrates, chlorine, oxygen, since these compounds facilitate ignition

Propane is highly flammable. Flash point is -104°C. Auto ignition risk increases dramatically above 50°C and is initiated at 466°C

Propane is of low toxicity to humans, however asphyxiant properties increase the risk significantly

Propane toxicity to aquatic invertebrates is considered to be moderate with EC50 values for fish, crustacean and algae at 50 - 12 mg/L. This is partly because of slight solubility in water at 40g/L. although the gas readily diffuses into the atmosphere

LPG is present at significant volume in two above ground tanks at 7 and 9 kL. The population density at the south west corner of the site is moderate, due mainly to the activity of freighters (semi-trailers) receiving inventory for distribution off-site. This is moderated by the low refueling frequency of forklifts. Propane is of low human toxicity However if released in sufficient quantity displaces air and is therefore an asphyxiant. It is highly flammable. A moderately low risk is the potential for escalating fires due to the impact of freighters with the mesh fence enclosing one LPG AST, particularly in the presence of accelerants such as windblown paper. Temperatures generated would be sufficient to melt mild steel structures although impact on residential development with flying debris and smoke and heat would be at most moderate, due to the distances to residential from Depots 5 & 9. The risk of ignition of other more toxic chemicals on site, such as MDI is very low, although the spare pallet of iso-butane is close enough to participate in a firestorm escalation. Such a fire would generate large amounts of heat and oxides of carbon and nitrogen but ought to burn cleanly unless other more complex fuel sources such as the flammable liquid store are ignited. Distances are sufficient to make this risk very low. Unless fire escalation spreads to include polymerous feed sources the risk of generation of partially combusted products and carcinogenic and toxic constituents is low. Mobility of the gas is high in air, low in soil and moderately low water. Toxicity to aquatic invertebrates and algae is moderate, due to slight solubility in water. Heat and fire releasing the heavier than air (2.4 x) gas may pose a confined space risk in buildings with cellars and sumps. Confined space strategies apply. Combustion, also produces oxides of carbon which are harmful to people and the environment. PPE should include full face respirator and eye protection when fire and hot weather is involved.

Appendix 13 Oxygen

Component	Failure	Hazard	Risk	Mitigations	Mitigated Risk
Above Ground Storage Tank	Failure & Fire/explosion +/ escalation	Tank ruptures releases 7kL oxygen, with pressure gradient toward cyclopentane tank. Ignition source and concommitant leak of cyclopenetane results in catostrophic explosion, cascading explosions and ignition of MDI and/or Polyol tank, causing ejection of projectiles, emmission of toxic fumes, heat and atmospheric contaminants, conveyed by prevaling wind to residential development and people within. Further risk of spotfires and engulfment of residential dwellings	1	Oxygen tank is maintained under positive pressure, which is monitored through feedback loop. Pressure drops above the normal rate of distribution are detected. Tank integrity is checked under routine programmed maintenance. Exclusion perimeter and intrinsically safe electrics strategies are employed to lower risk of cyclopentane ignition. Nirogen blanket in MDI, cyclopentane and Polyol tanks furher reduce risk og autopolymerization and combustion	5
Cylinders	Failure & Fire/explosion +/ escalation	Coincidence of emission of oxygen either by venting, valve leak, regulator attachment, release, failure, tap engagement; with ignition source such as cigarette, spark from impact of metal on metal, hot engine housing/cowling, fire, hot work, naked flame &provision of a fuel source such as acetylene or isobutane	1	Segregation of oxygen and fuel sources such as acetylene isobutane and LPG/propane so that ignition of fuel source(s) does not escalate by provision of oxygen. Maintenance of safe distances of separation between potential fuel sources and oxygen. Storage location having fire retardant barrier 1.5 m high with a fire resistance rating of >30 minutes	3
Cylinders	Impact/projectile	Impact of oxygen cyclinders with forklift, fall from pallet during transport, impact of valve with concrete, releasing compressed gasconverting cyclinder into airborn projectile; impact with persons or fabric of building, causing injury or structural failure, debris and secondary projectiles, causing injury or impact with flammable sources causing fire and or explosion(s)	2	Transport of pallet on forklift at half height of cylinder reduces angle of impact and risk of valve dislodgement; changing of cylinders together during transit and transit speed 10 kph or less increases stability; Pallets unloaded from pantec as close to truck as practical, and lowered to minimum mast height before transit	4
Cylinders	Damaged or Corroded	One or more of full cylinders delivered is deformed or corroded and therefore inherently weaker than standard; impact or fire exposes weakness, enabling explosion or impac	2	Cylinders are tested and the testing procedure conducted as per Australian standard, with auditing of the gas supply company to ensure that checks are conducted without compromise	4
Pipe work	Cuts, breaks, creasing or obstruction	Damage of pipe work between oxygen cylinder and regulator, releasing oxygen an accelerator of combustion initiating ignition of fuel sources such as acetylene, R600A, LPG; resulltant fires more intense and hotter than without oxygen casuing serious burns or death	2	Scheduled maintenance to include hose and pipework integrity. Fittings, e.g. Ferrules inspected for cross threading burring, cracks and distortions replaced. Operator inspection prior to conduct of hot work	4
Valves	Slow leak	slow leak of gas from the cylinder builds up in a confined space providing enhanced fire risk	3	Gas cylinders stored in well ventilated area. Valves and regulators tested as part of annual preventative maintenance schedule	5
Regulator	Failure	Regulator failure releasing oxygen into factory, or Skill Centre exposing workers/trainees	3	Regulators are tested and where necessary replaced; Routine testing as party of preventative maintence schedule; SOP , SWIM for insertion of regulator. Gas supply is always stored with tap in closed position	5
Above Ground Storage Tank	Failure & Engulfment	Tank ruptures releases 7kL oxygen, engulfing workers at the MDI. Polyol or cyclopentane tanks	3	Oxygen is marginally heavier than air. On a calm day a blanket of oxygen could engulf workers within 10 m of the above ground tank. However, above ground tank is situated in open air >40 m from rollerdoor of north building, and risk of excessive inhalation proting nausea, is low, and virtually negligible after a few minutes.	5

Oxygen is the oxidant gas used with acetylene to generate the high temperatures required for cutting and welding of metals, primarily steel, at the Skills Centre.

Oxygen is stored as one pallet of 432 kg in a lockup shed on the east side of the Skills Centre in section E in segregation from equivalent volume of acetylene.
A second pallet is stored in openair at the west side of the factory near the railway line in sector J. Oxygen is also stored in a 7kL above ground storage tank in sector I, immediately east of the Nitrogen AGST.

Oxygen is not flammable, it supports or increases flammability of fuel,e.g. Hydrocarbons

Oxygen dissolution to the atmosphere is rapid. 21% of the atmosphere is oxygen. Oxygen at concentrations > 70% causes nausea. As a gas, dissolution in water is a minor concern. Maximum solubility in cold water is about 9 mg/L

Oxygen is the second most electronegative element. It therefore reacts with a broad range of compounds, causing oxidation, combustion and polymerization

Oxygen is not inherently fammable . Autoignition risk of a fuel compound increases, because the activation energy required to combust is lowered.

Oxygen released to the air is rapidly diluted by nitrogen becoming of no toxicity to humans and the environment. Once diluted, it is actually beneficial, since 21% of air is oxygen, and water requires oxygen to oxidise pollutants and support life

Oxygen toxicity to aquatic invertebrates, fish and algae is negligible. A maximum of 9 mg/L oxygen can be dissolved in col water, the remnant evaporates to the atmosphere. Aquatic toxicity is frequently associated with a lack of oxygen (anoxic conditions).

Oxygen is present in acceptably low storage amounts 432 kg at 2 locations on site, NE and W respectively. The population density at the Skill Centre in sector E is moderate, and this is compensated for, by segregation in a locked vented store. Oxygen is of low human toxicity, unless in confined space. Release of the contents of one pallet of oxygen inside a room would significantly increase the risk of combustion arising from even a weak spark. A high risk is the potential for escalating fires due to the ignition of fuel gases such as acetylene or R600a stored in the vicinity. Temperatures generated in an oxygen enriched environment would be sufficient to melt mild steel structures. Escalation of the fire is dependent on the availability of fuel. Atmospheric oxygen is present at adequate concentration to maintain a fire, provided fuel sources remain accessible. Impact of residential development with flying debris and smoke and heat, particularly the Sector E supply, is a real risk, once the temperature of the fire escalates to ignite plastics, wood and reactive metals such as aluminum. There exists a low risk of ignition of other more toxic chemicals on site, such as MDI. Such a fire would generate large amounts of heat and noxious gases to the atmosphere, and potentially residential development. Some of these partially combusted products and depolymerized constituents are carcinogenic and toxic to aquatic ecosystems. Mobility of the gas is high in air, and low in soil and water, due to partitioning into air. Toxicity to aquatic invertebrates and algae is low. Mass release of oxygen may poses a confined space risk in buildings with low ceilings. Confined space strategies apply. Combustion, also produces oxides of carbon which are harmful to people and the environment. PPE should include full face respirator and eye protection when fire and hot weather is involved.

Appendix 14 Nitrogen

Component	Failure	Hazard	Risk	Mitigations	Mitigated Risk
Above Ground Storage Tank	Failure	Tank ruptures releases 7kL nitrogen, asphyxiating workers at the MDI. Polyol or cyclopentane tanks	1	Nitrogen is marginally lighter than air, air pressure and currents may cause temporary lack of oxygen at base of tank, but risk is low, since tanks are elevated on a plinth and situated > 40 m from the factory rollerdoor	3
Cylinders	Explosion in a fire	Cylinders heated in an existing fire explode due to expansion of compressed gas, ejecting metal fragments and/or the cylinder body, potentially rupturing or impacting fuel source escalating fire or impacting people and/or property	2	Nitrogen is inert and stored in an above ground storage tank designed to rupture at seams rather than explode	3
Cylinders	Impact/projectile	Impact of nirogen cyclinders with forklift, fall from pallet during transport, impact of valve with concrete, releasing compressed gas, converting cyclinder into airborn projectile; impact with persons or fabric of building, causing injury or structural failure, debris and secondary projectiles, causing injury or impact with flammable sources causing fire and or explosion	2	Only a few nitrogen cylinders remain on site. Transport of pallet on forklift at half height of cylinder reduces angle of impact and risk of valve dislodgement; changing of cylinders together during transit and transit speed 15 kph or less increases stability; Pallets unloaded from pantec as close to truck as practical, and lowered to minimum mast height before transit	4
Cylinders	damaged or corroded	One or more of full cylinders delivered is deformed or corroded and therefore inherently weaker than standard; impact or fire exposes weakness, enabling explosion or impact	3	One or more of full cylinders delivered is deformed or corroded and therefore inherently weaker than standard; impact or fire exposes weakness, enabling explosion or impact	5

Nitrogen is the gas used to maintain an inert gaseous blanket above the surface of MDI, Polyol, Cyclopentane and Day tanks. The presence of the inert N2 blanket protects against premature volatilization and egress of cyclopentane as well as lowering the risk of oxidative polymerization/crystallization of Polyol and MDI by displacing air containing oxygen.

Nitrogen is stored in a 7kL above ground storage tank in sector I. It is the westernmost of the two tanks east of the cyclopentane UST

Nitrogen is not a flammable gas. It is employed to lower the flammability risk of other raw material feedstocks

Nitrogen dissolution to the atmosphere is rapid. 78% of the atmosphere is nitrogen. Atmospheres of > 80% nitrogen represent an asphyxiation risk, since oxygen is displaced, and atmospheric oxygen contents below 20% are likely to be narcotic and/or lethal. Dissolution in water and aquatic organism toxicty is negligible

Nitrogen does not react unless catalysed by strong oxidants, temperatures or pressures.

Nitrogen is inflammable. Auto ignition risk of a fuel compound decreases in a nitrogen atmosphere, because oxygen is less available

Nitrogen released to the air is rapidly diluted by the predominantly nitrogen atmosphere. It affords no toxicity to humans and the environment. An exception is the production of nitrous/nitric oxides in a fire. These compounds are harmful to life and the environment. Nitrogen can also be sequestered during combustion of reactive organic chemicals to form amide/amine, cyanide, diazo and a number of potentially toxic metabolites.

Nitrogen toxicity to aquatic invertebrates, fish and algae is negligible.

Nitrogen is present as 7kL above ground stored gas in sector I at the north end of the site. A nitrogen generator maintains a constant supply of this gas, so that the stored gas is not depleted and inert blankets are maintained. Reaction with other chemicals is negligible. There is a negligible risk of ignition or enhancement of ignition of other feedstock chemicals. NOx and nitrogen moieties such as cyanides can be generated with cocombution of chemicals such as MDI and Polyol. However, this risk is naturally present due to the atmosphere containing 80% nitrogen, and therefore cannot be controlled. Some of these partially combusted products and depolymerized constituents are carcinogenic and toxic to aquatic ecosystems. Mobility of the gas is high in air, and low in soil and water, due to partitioning into air. Toxicity to aquatic invertebrates and algae is negligible. Mass release of nitrogen may poses a confined space risk in small buildings with low ceilings. Confined space strategies may apply in special circumstances. PPE should include full face respirator and eye protection when confined space conditions, fire and hot weather are involved