AECOM

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24 September 2024

Marcus Peck
Senior Planning Officer
Planning Services
Office of the Coordinator General
Department of State Development and Infrastructure

Dear Marcus

Alpha HPA - Supplementary Response to Information Request - Special Industry and Linear Infrastructure Facility

AECOM Australia Pty Ltd (AECOM) writes on behalf of Alpha HPA (the Applicant) in response to further advice and information received from the Office of Industrial Relations (OIR) via the Office of the Coordinator General (OCG) on 3 September 2024 in relation to the Alpha HPA Stage 2 SDA change application (Ref: APC2024/005). The feedback received related to plant layout and requested additional controls to minimise risk so far as reasonably practicable.

A meeting following receipt of the further advice correspondence was held with the OCG and OIR on 17 September 2024 to discuss Alpha HPA's approach to addressing the further advice received.

The following information is provided to address the advice received from the OIR:

- OCG Further Advice/Information Request email dated 3 September 2024 (refer to Attachment A)
- Sherpa Consulting Technical Note – Response to OIR Queries dated 23 September 2024, Rev 0 (refer to Attachment B)
- List and quantities of hazardous chemicals for Alpha HPA Stage 2 project and site manifest for Stage 1 (refer to Attachment C)
- Updated State Code 21 response to demonstrate compliance with Performance Outcomes (PO) 6, 7, 8, 9 and 11 (refer to Attachment D).

For clarity, each further advice item is listed in Table 1 along with the location of the Alpha HPA response.

Table 1 OIR Further Advice Response

Item No.	OIR Further Advice Item	Response Provided
1	Identify via site plan and/or reports the radiant heat flux from a foreseeable natural gas jet fire incident. If determined necessary, provide details of passive measures to be implemented to prevent the ANS tanks receiving greater than 8 kW/m2 heat radiation.	See Section 3.1 of Sherpa Technical Note, Attachment B
2	Identify passive measures to be implemented to minimise the impact of a fire or explosion at the diesel generators on the ANS tanks.	See Section 3.2 of Sherpa Technical Note, Attachment B
3	Amend the site layout to separate the ammonia tanks from the ANS tanks as necessary to minimise the risk of ammonia tank damage by ANS tank explosion. Alternatively, justify why the ammonia tanks are located within a certain proximity of the ANS tanks and why the site layout is unable to be amended, including mitigation measures to be implemented to minimise risk of tank damage. Note: a blast berm may be considered to reduce the required separation distance, if demonstrated this can be effective.	See Section 3.3 of Sherpa Technical Note, Attachment B

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Item No.	OIR Further Advice Item	Response Provided
4	Consider if pipelines located above Reid Road can be located underground. If deemed unfeasible, justify why they must be located above ground and identify effective control measures to manage the risk of a vehicle collision with any overhead pipelines. Note: Bridge warning curtains (jingle bars) may be a suitable solution.	See Section 3.4 of Sherpa Technical Note, Attachment B
5	Provide a comprehensive list of all hazardous chemicals present or likely to be present and their quantities and locations. Note: Section 532 of the Work Health and Safety Regulation defines what inventories should be included. Non-schedule 15 hazardous chemicals need to be included because they can still have hazardous interactions with schedule 15 chemicals.	Refer to list and quantities of hazardous chemicals for Alpha HPA Stage 2 project and site manifest for Stage 1 provided in Attachment C. This information was previously provided by AECOM to the OCG on 12 September 2024.
6	Confirm whether the precursor facility will continue to operate after commissioning of Stage 2. This is required to determine whether the quantities of hazardous chemicals at the precursor facility need to be counted in the MHF aggregate quantity ratio.	The Stage 1 HPA facility will continue to operate after commissioning Stage 2 of the HPA facility.
7	Provide additional information to demonstrate compliance with State Code 21 PO6, PO7, PO8, PO9 and PO11*. It is noted that demonstrating compliance with the POs and minimising risk so far as reasonably practicable under Work Health and Safety legislation may require changes to the plant layout and or additional risk controls. Note: an MHF licence may be conditional on the applicant demonstrating compliance in their licence application.	An updated State Code 21 response is provided in Attachment D.

We trust this information sufficiently addresses the concerns raised by the OIR and the application will now be able to progress into the Decision Making phase. Should the OCG or OIR require any further information or clarification, please contact the undersigned.

Yours faithfully

Alexandra Isgro
Senior Environmental Planner
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Attachment A: OCG Further Advice/Information Request email

Isgro, Alexandra

From: Marcus Peck <Marcus.Peck@coordinatorgeneral.qld.gov.au>
Sent: Tuesday, 3 September 2024 10:16 AM
To: Isgro, Alexandra; Lau, Rouven; Matthew Callanan; ncurtis@alphahpa.com.au
Cc: hcfplanning; Catherine O'Neill
Subject: Further advice/information required following OIR meeting - APC2024/005

Follow Up Flag: Follow up
Flag Status: Completed

Good morning,

Following the meeting on 29 August 2024 RE Alpha HPA's findings on OIR's information request for APC2024/005, it was determined that OIR would specify the additional information required to assess the SDA in relation to their state interests.

Further advice in addressing the information request has been prepared below:

1. Identify via site plan and/or reports the radiant heat flux from a foreseeable natural gas jet fire incident. If determined necessary, provide details of passive measures to be implemented to prevent the ANS tanks receiving greater than 8 kW/m2 heat radiation.
2. Identify passive measures to be implemented to minimise the impact of a fire or explosion at the diesel generators on the ANS tanks.
3. Amend the site layout to separate the ammonia tanks from the ANS tanks as necessary to minimise the risk of ammonia tank damage by ANS tank explosion. Alternatively, justify why the ammonia tanks are located within a certain proximity of the ANS tanks and why the site layout is unable to be amended, including mitigation measures to be implemented to minimise risk of tank damage. *Note: a blast berm may be considered to reduce the required separation distance, if demonstrated this can be effective.*
4. Consider if pipelines located above Reid Road can be located underground. If deemed unfeasible, justify why they must be located above ground and identify effective control measures to manage the risk of a vehicle collision with any overhead pipelines. *Note: Bridge warning curtains (jingle bars) may be a suitable solution*.
5. Provide a comprehensive list of all hazardous chemicals present or likely to be present and their quantities and locations. *Note: Section 532 of the Work Health and Safety Regulation defines what inventories should be included.* Non-schedule 15 hazardous chemicals need to be included because they can still have hazardous interactions with schedule 15 chemicals.
6. Confirm whether the precursor facility will continue to operate after commissioning of Stage 2. This is required to determine whether the quantities of hazardous chemicals at the precursor facility need to be counted in the MHF aggregate quantity ratio.
7. Provide additional information to demonstrate compliance with State Code 21 PO6, PO7, PO8, PO9 and PO11*. It is noted that demonstrating compliance with the POs and minimising risk so far as reasonably practicable under Work Health and Safety legislation may require changes to the plant layout and or

additional risk controls. *Note: an MHF licence may be conditional on the applicant demonstrating compliance in their licence application.*

Note: Information to be provided to demonstrate compliance for each performance outcome:
PO6 – identify the fire risk hazardous chemical storage and handling areas and the fire detection system to be used for each one
PO7 – identify any storage and handling areas of packaged fire risk hazardous chemicals and the details of complying with PO7
PO8 – identify any storage and handling areas of fire risk hazardous chemicals in tanks and the details of complying with PO8
PO9 – details of any hazardous chemicals that may react dangerously and the means of segregating them
PO11 – identify hazard scenarios at Orica that may impact the development and controls proposed to minimise risk

Planning Guideline State Code 21: Hazardous chemical facilities may also be of assistance in clarifying State Code 21: https://www.worksafe.qld.gov.au/__data/assets/pdf_file/0021/19452/planning-guide-state-code-21.pdf

Please let me know if you have any queries or concerns.

Thanks,
Marcus

Queensland Government

Marcus Peck
Senior Project Officer
Planning Services – Office of the Coordinator-General
Department of State Development and Infrastructure

Microsoft Teams – meet now

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Attachment B: Sherpa Consulting Technical Note

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TECHNICAL NOTE

STAGE 2 HIGH PURITY ALUMINA (HPA) PLANT

RESPONSE TO OIR QUERIES

ALPHA HPA

Rev	Date	Description	Prepared	Checked	Approved	Method of issue
A	20-Sep-2024	Draft for review	J Polich RPEQ 24537	-	-	Email PDF
0	23-Sep-2024	Final issue	J Polich RPEQ 24537	-	-	Email PDF

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QA verified	-
Date	-

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Web: www.sherpaconsulting.com

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FIGURES

TABLES

1. INTRODUCTION

1.1. Background

Alpha HPA Limited (Alpha) is proposing to develop a commercial scale High Purity Alumina (HPA) plant in Yarwun, Queensland (Qld) in the Gladstone State Development Area which is zoned for industrial purposes. Alpha submitted a Development Application (DA) in 2020 and received approval for the project. The application was accompanied by a hazard assessment report in the form of a Quantitative Risk Assessment (QRA) to demonstrate compliance with Qld State Code 21 version 2.6 (Ref [1]) which was prepared by Sherpa Consulting Pty Ltd (Sherpa).

Alpha modified the approval in 2021 to include a Precursor Production Facility (PPF) which is a small scale version (Stage 1) of the full facility. The PPF has been constructed, is operational and will remain in use as a trial facility once the full scale facility (Stage 2) is operational. An update to the QRA was also prepared to cover the PPF in November 2021 (Ref [2]).

Alpha has made some minor changes to the layout and inventories in the proposed Stage 2 facility which requires another modification to the approval. There are no changes proposed for the PPF. An updated QRA was provided to the regulator to accompany the change application (Ref [3] and this also assessed the implications of the updated State Code 21 version 3 (released in February 2022 after the original approval).

The Office of the Coordinator General (OCG) raised some additional matters (email 3 September 2024) in relation to the changes.

Alpha has requested that Sherpa assist to respond to the matters raised by the OCG.

1.2. Scope

This technical note provides response to the items summarised in Table 1.1. Other items are not addressed in this technical note.

Table 1.1: Scope of response

Item (Email Marcus Peck OCG, 3 Sept 2024)	In scope of this report
1. Identify via site plan and/or reports the radiant heat flux from a foreseeable natural gas jet fire incident. If determined necessary, provide details of passive measures to be implemented to prevent the ANS tanks receiving greater than 8 kW/m2 heat radiation.	Yes See Section 3.1

Item **(Email Marcus Peck OCG, 3 Sept 2024)**	**In scope of this report**
2. Identify passive measures to be implemented to minimise the impact of a fire or explosion at the diesel generators on the ANS tanks.	Yes See Section 3.2
3. Amend the site layout to separate the ammonia tanks from the ANS tanks as necessary to minimise the risk of ammonia tank damage by ANS tank explosion. Alternatively, justify why the ammonia tanks are located within a certain proximity of the ANS tanks and why the site layout is unable to be amended, including mitigation measures to be implemented to minimise risk of tank damage. *Note: a blast berm may be considered to reduce the required separation distance, if demonstrated this can be effective.*	Yes See Section 3.3
4. Consider if pipelines located above Reid Road can be located underground. If deemed unfeasible, justify why they must be located above ground and identify effective control measures to manage the risk of a vehicle collision with any overhead pipelines. *Note: Bridge warning curtains (jingle bars) may be a suitable solution*.	Yes See Section 3.4
5. Provide a comprehensive list of all hazardous chemicals present or likely to be present and their quantities and locations. *Note: Section 532 of the Work Health and Safety Regulation defines what inventories should be included.* Non-schedule 15 hazardous chemicals need to be included because they can still have hazardous interactions with schedule 15 chemicals.	No
6. Confirm whether the precursor facility will continue to operate after commissioning of Stage 2. This is required to determine whether the quantities of hazardous chemicals at the precursor facility need to be counted in the MHF aggregate quantity ratio.	No

Item **(Email Marcus Peck OCG, 3 Sept 2024)**	**In scope of this report**
7. Provide additional information to demonstrate compliance with State Code 21 PO6, PO7, PO8, PO9 and PO11*. It is noted that demonstrating compliance with the POs and minimising risk so far as reasonably practicable under Work Health and Safety legislation may require changes to the plant layout and or additional risk controls. *Note: an MHF licence may be conditional on the applicant demonstrating compliance in their licence application.*	PO11 only addressed See Section 3.5

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2. PROJECT DESCRIPTION

2.1. Hazards

The main hazards associated with the process with the potential to cause serious harm to onsite or offsite personnel are:

- ammonia, a toxic gas
- concentrated ammonium nitrate solution (ANS greater than 80%) an oxidising solution which may decompose and explode under certain conditions such as overheating or contamination. ANS is not shock sensitive, ie explosion will not occur due to overpressure or projectiles.

2.2. Approach to minimising risk SFARP

State Code 21 v3.0 provides the following purpose statement which identifies the overall intent of the code:

*The development is designed and sited, **so far as reasonably practicable**, to ensure:*

1. *human health and safety, and the built environment are protected from off-site risks resulting from physical or chemical hazards;*
2. *hazardous chemical facilities are protected from:*
    a. *off-site hazard scenarios at existing hazardous chemical facilities;*
    b. *natural hazards.*

Depending on the final inventories, it is possible that the facility will also be determined as a Major Hazard Facility (MHF) and it will be required to demonstrate that risks associated with potential Major Incidents (MIs) have been reduced SFARP to obtain an MHF operating licence.

Therefore a structured SFARP assessment methodology similar to that applied for assessing whether additional control measures are 'reasonably practicable' as part of an MHF Safety Case was adopted to assess design options. Demonstrating risks are reduced SFARP requires determination whether additional risk reduction or control measures are 'reasonably practicable'. From the Qld WHS Act 2011 the term 'reasonably practicable' means:

> *18 What is reasonably practicable in ensuring health and safety In this Act, reasonably practicable, in relation to a duty to ensure health and safety, means that which is, or was at a particular time, reasonably able to be done in relation to ensuring health and safety, taking into account and weighing up all relevant matters including—*
>
> *(a) the likelihood of the hazard or the risk concerned occurring; and*
>
> *(b) the degree of harm that might result from the hazard or the risk; and*
>
> *(c) what the person concerned knows, or ought reasonably to know, about—*

(i) the hazard or the risk; and

(ii) ways of eliminating or minimising the risk; and

(d) the availability and suitability of ways to eliminate or minimise the risk; and

(e) 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.

Options can be directly accepted or subject to further review using a series of decision tests. The following questions are considered to assist with determination what is 'reasonably practicable':

- What else could be done?
  - Is it technically feasible? (e.g. existing/proven technology or application)
  - What is the safety benefit (relative to the starting point good practice design) and would the effect be quantifiable in the LOPA / QRA or some other way?
  - Would any new risks be introduced?
  - Would there be unmanageable operations/maintenance issues?
- Why wouldn't it be done?

If cost is the only reason for not adopting the control, a formal Cost Benefit Analysis (CBA) is required. These decision tests are shown in the form of a flowchart in APPENDIX B.

As part of the design process a SFARP decision register has been set up to transparently document the reasons for accepting or rejecting specific deign options relevant at the design stage.

The items relating to the issues raised by the OCG are summarised in APPENDIX B and have been referred to in the specific responses as relevant.

2.3. Changes to process

A number of minor changes to the process have been made. However it should be noted that:

- There are no new hazardous chemicals required for this process and no increase in stored quantities of the existing hazardous chemicals. No additional hazardous chemicals will be stored on site than what was included in the current SDA approval and the previous QRA.
- The total storage capacity of ammonium nitrate solution (ANS) has not changed.
- the risk associated with an ammonia (NH3) release has been lowered by reducing the maximum capacity of the largest storage vessel from 100 tonnes to 40 tonnes.

Refer to Figure 2.1 for process change summary.

2.4. Changes to layout

As the project design progresses the layout has evolved, largely because the footprint of some equipment has increased in size as more information has been received from vendors.

The proposed layout including changes from the SFARP review process is provided in Figure 2.2.

Note that changes to layout have been made to be consistent with the following risk minimisation principles to ensure that the layout choices reduce risk so far as reasonably practicable (SFARP).

Responses to the items raised by OCG in relation to layout are provided in this context.

Approach	Outcome	Reason
Maximise distance to occupied area (admin / control building) from onsite hazardous materials (ammonia, ANS, solvent area).	Occupied areas in south east corner of site ANS/ ammonia in north west corner of site	Minimise risk of exposure to onsite personnel to onsite hazardous materials
Maximise distance to occupied area (admin / control building) from offsite hazardous materials (Orica AN storage)	Occupied areas in south east corner of site (as far as possible from Orica to west)	Minimise risk of exposure to onsite personnel to offsite hazardous materials
Maximise distance from process fire risk area (solvent extraction, SX) to ammonia and ANS areas	ANS/ ammonia in north west corner of site SX in east of site	Minimise risk of escalation from process fire to ammonia storage and ANS storage
Minimise complexity and distance of ANS and NH_3 piping to / from Orica	ANS/ ammonia in north west area of site opposite Orica	Minimise isolatable inventory in pipelines Minimise leak sources Reduce risk of blockage in ANS piping (which may lead to decomposition and hazards to personnel when clearing blockages)

Approach	Outcome	Reason
		Simplify maintenance and operations
Provide some separation of ammonia, ANS to neighbouring Gladstone WTP to the north	Locate ANS / ammonia so that water containment basins provide separation to northern site boundary	Minimise risks to Gladstone WTP (Note that the Gladstone WTP is unmanned).

Figure 2.1: Changes in process

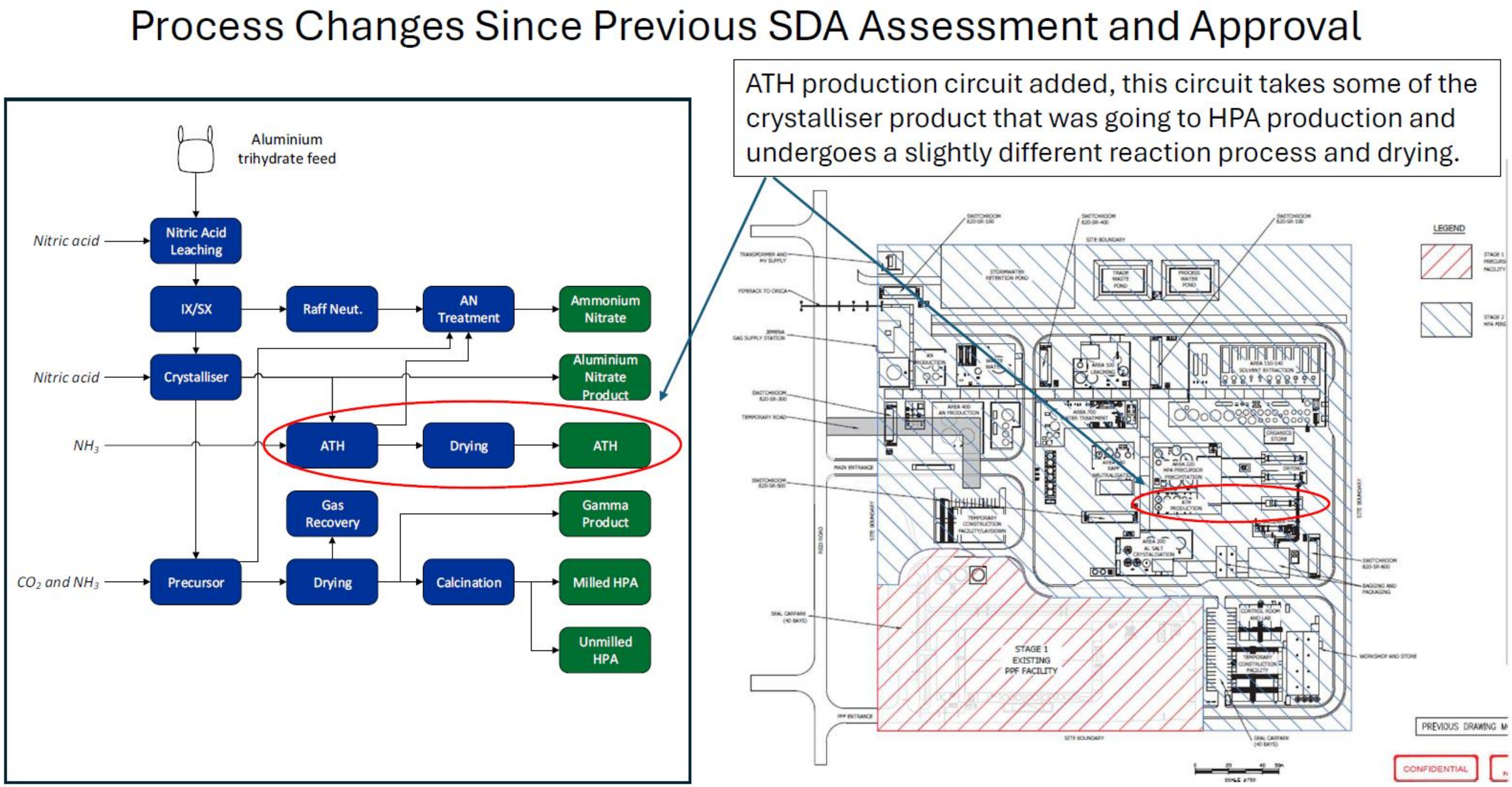
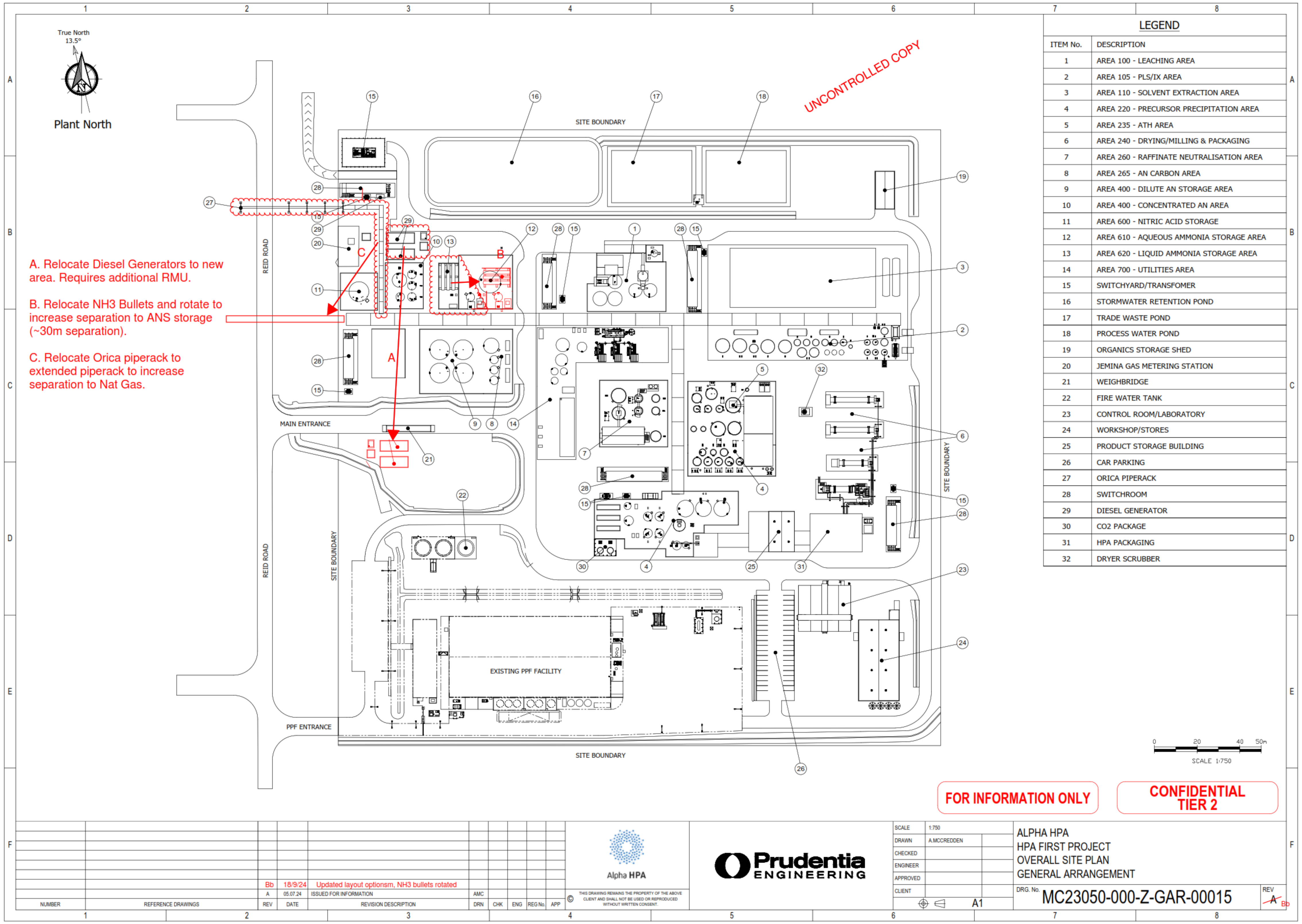


Figure 2.2: Layout



3. RESPONSES

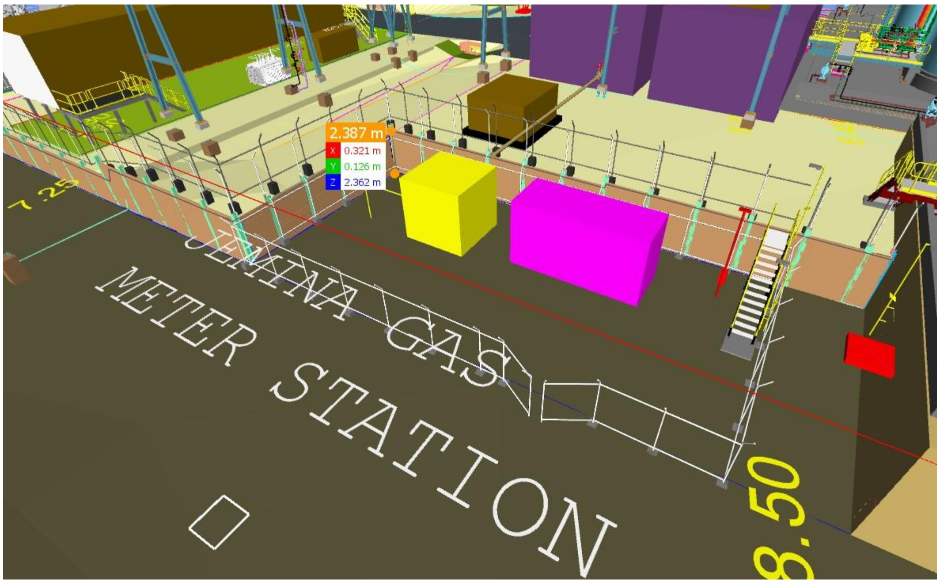
3.1. Natural gas

Natural gas is supplied to the site by underground pipe, pressure let down via a valve station and then distributed to users within the site. Consequence modelling has been undertaken for following scenarios using Gexcon EFFECTS v12.3. Inputs and results are provided in APPENDIX A:

- **Foreseeable scenario:** ignited leak / jet fire from natural gas valve station, eg 15mm diameter flange / valve leak, operating pressure 500 kPag

  Note that the design is as follows:

  - Separation distance to ANS storage tanks (tanks insulated for heat conservation) is approximately 25m
  - Natural gas valve station is at a lower elevation than ANS storage area, ~2m high pit wall acts as a barrier for any horizontal jet fires as shown below



  - Distance to $8kW/m^2$ is less than 5m from a vertical jet fire. (NOTE: $8kW/m^2$ is not an escalation threshold for insulated tanks, it is for unprotected steel tanks).

- **Other scenarios:** ignited leak / jet fire from fully welded piping,
  - Natural gas piping from valve station is fully welded to point of use (minimises any leak points).
  - Piping to run underground from valve station to elevated piperack south of ANS storage, minimising the length of piping passing ANS storage, ie vertical leg from underground section to pipe rack .

- No exposure of piping to impact scenarios (eg vehicles) in vicinity of ANS storage
- Isolation can be achieved at the valve station, isolatable inventory in the piping will be consumed in a matter of minutes. A short duration fire will not lead to ASN storage escalation.

- **Worst case scenario**: full bore rupture (150mm) of fully welded above ground piping and ignited leak / jet fire.
  - Natural gas piping from valve station is fully welded to point of use (minimises any leak points).
  - Isolation can be achieved at the valve station, isolatable inventory in the piping will be consumed in a matter of minutes. A short duration fire will not lead to escalation.
  - Distance to $8kW/m^2$ is approximately 25m from a vertical jet fire at valve station. (NOTE: $8kW/m^2$ is not an escalation threshold for insulated tanks, it is for unprotected steel tanks).

Conclusion:

- No escalation effect on ANS storage for foreseeable scenario at valve station
- Residual risk of an extended duration fire caused by leak in fully welded gas piping that cannot be isolated is extremely low.
- No additional measures necessary

3.2. Diesel generators

The diesel generators are compression engines, not fired appliances (ie choice of diesel not gas as fuel). Explosion is not a credible scenario for this type of appliance, potential for a pool or spray fire involving diesel only. Diesel inventory has been minimised (total 8000L in 2 generators) and is internally bunded with drainage / containment provided for spills during fuel top up

The layout has been changed to achieve greater separation (more than 50m) to ANS storage as per Figure 2.2 to eliminate any escalation potential.

Conclusion:

- There are no escalation effects from diesel generators to ANS storage.
- No additional measures necessary.

3.3. Separation distance between ANS and ammonia storage

ANS has a potential decomposition risk if contaminated or heated to above decomposition temperature (ie above approximately 180 degC). Overpressures could result in damage to the ammonia storage vessels and an escalated event.

Consequence modelling has been undertaken for overpressures from ANS explosion scenarios with the results presented in APPENDIX A.

Ammonia storages are designed as thick-walled horizontal pressure vessels. As per the original QRA the impact of overpressure on a horizontal pressure vessel results in the following damage, in a range of 35kPa to 70kPa as per Table 3.1. Therefore, overpressures capable of overturning or damaging horizontal pressure vessels and connected piping are significantly higher than the State Code 21'dangerous dose to built environment' of 14 kPa.

Debris/projectile impact is not assessed quantitively however the probability of direct impact with sufficient velocity to damage an ammonia vessel or associated piping/fittings is much lower than the event probability due to directional effects.

Table 3.1: Overpressure damage levels

Level (kPa)	Typical effect - buildings	Typical effect - process equipment	Reference
70	Complete demolition of houses	**Equipment (columns, utilities etc) uplifted**	HIPAP 4, Ref [4] OGP, Ref [5]
35	House uninhabitable	Wagons and plants items overturned **Pipe support frame collapses and piping breaks** **Horizontal pressure vessel frame deformed**	HIPAP 4, Ref [4] Gexcon, Ref [6] OGP, Ref [5]
21		Reinforced structures distort Storage tanks fail Cooling tower frame collapse	HIPAP 4, Ref [4] Gexcon, Ref [6] OGP, Ref [5]
14	House uninhabitable and badly cracked	Cooling tower inner parts damaged Gauges and instruments damaged	HIPAP 4, Ref [4] Gexcon, Ref [6] OGP, Ref [5]
7	Damage to internal partitions and joinery but can be repaired	Cone roof tank roof collapse	HIPAP 4, Ref [4]

- **Foreseeable scenario:** ANS decomposition in a pump. This has occurred in industry.

  Note that the design to minimise the likelihood of this event is as follows:

  - Industry standard ANS pumps with special seal design to prevent friction and overheating
  - pump heating to prevent blockages with maximum temperature limited to below ANS decomposition temperature
  - free draining piping design to prevent blockages in a no flow condition

  - instrumented high temperature and minimum flow lines to protect against pump deadheading

  Overpressure effects from an ANS pump explosion event extend 12 m to 35kPa. The separation distance to ammonia storage is greater than this.

  Conclusion:

  - There are no escalation effects from ANS pump decomposition events to ammonia storage.
  - No additional measures necessary.

- **Worst case scenario:** ANS decomposition in largest ANS storage inventory. This is extremely unlikely and very few incidents can be found in inventory of ANS storage tanks exploding. There are some examples of ANS explosion events in neutralisers (the reactor used to produce concentrated ANS in some AN facilities, noting that this is not present at AlphaHPA) and in ANS road tankers involved in road accidents.

  Note that the design to minimise the likelihood of this event is as follows:

  - ANS is produced in dilute form (~20%) as byproduct of the process (ie not in a neutraliser or pipe reactor in concentrated form).
  - Hazardous contaminants eliminated at feed stage / raw materials. Potential metal or chloride contaminants are removed via the process and will tend to ‘follow the metal/solvent’ not the ANS (raffinate).
  - QA of dilute solution before it is concentrated
  - pH adjustment (multiple locations before and after concentrating) with aqueous ammonia
  - High temperature trips (multiple locations)
  - Heating coil, steam temperature limited by PSV setting to below ANS decomposition temperature
  - Concentrated ANS storage inventory minimised to operationally practicable quantity (ie sufficient time to QA before transfer to Orica, 24 hours production in largest tank)
  - Dilution water on concentrated ANS tanks to respond to abnormal conditions
  - A bowtie summarising the controls above linked to a layer of protection analysis (LOPA) predicts an ANS storage decomposition event frequency of ~1.5 $x10^{-6}$ per year (see APPENDIX C). This is lower than statistical large leaks from pressure vessels which are around 12 $x10^{-6}$ per vessel for rupture and large holes ie does not materially affect the frequencies used in the QRA for ammonia events.

It should also be noted that ANS decomposition is a ‘with- warning’ event providing time for evacuation minimising the likelihood of effects of overpressure or any subsequent ammonia exposures on people.

Also note that the maximum inventory of each ammonia storage vessel has been reduced such that the distance to the 1% toxic dose fatality threshold for an ammonia tank rupture during daytime meteorological conditions is less than 400m, compared to 414 m to 14 kPa fatality threshold for ANS explosion (see APPENDIX A).

The layout has also been modified as follows to further minimise the risk of escalation:

- Ammonia vessel rotated such that heads rather than longitudinal vessel side faces ANS storage to minimise exposure surface to overpressures .
- Ammonia vessels swapped location with aqueous ammonia tank, ie non-hazardous inventory located closest to ANS storage providing a barrier to ammonia vessels.

An additional control of providing an explosion barrier wall between the ANS storage and the ammonia storage was assessed. As per the SFARP register in APPENDIX B this was assessed as ‘not reasonably practicable’ for the following reasons:

- To provide any benefit the design of the barrier would need to achieve something better than the likely response of the pressure vessel itself, this implies that the design basis would need to be in excess of the 35 – 70kPa damage thresholds and would need to be a relatively large structure to protect the vessels or block effects from a storage tank explosion. An effective design basis for the wall is difficult to establish and may not be technically feasible for the likely size of structure.
- The residual frequency of multiple fatalities accounting for failure of evacuation is likely to be an order of magnitude less than the event frequency, ie of the order of $1x10^{-7}$ per year. A screening level cost benefit analysis based on UK HSE approach and assumptions given in APPENDIX B for fatalities of up to 150 people (ie approximately Orica and AlphaHPA population) indicates a spend of more than $23,000 is ‘grossly disproportionate’. Even if a design basis could be established design and construction of a blast wall would be well in excess of this value.

Conclusion:

- As per the risk reduction hierarchy design focus should be on preventative controls to minimise the likelihood of any ANS decomposition event.
- There are no identified ‘reasonably practicable’ measures associated with layout change or mitigation via blast barriers to further reduce the risk of escalation from the ANS storage explosion to ammonia storage.

3.4. ANS piping road crossing

The ANS piping runs in above the road to Orica instead of underground for the following reasons:

- Good practice design for ANS piping: free draining, heated ANS piping. This cannot be achieved with an underground pipeline which will have a low point.
- There is a risk of ANS blockage in low points resulting in increased decomposition risk due to pump deadhead and explosion.
- Risks to personnel when clearing blockages are introduced (steam out etc, decomposition risk). Known incidents in industry associated with this activity.

The risk of vehicle impact results in:

- Loss of containment of ANS. This is an environmental issue or a potential fire if ANS contacts combustibles, both are less severe scenarios than blocked underground pipeline containing ANS.
- ANS is not shock sensitive, explosion due to vehicle impact not credible.

Controls implemented to reduce the risk of vehicle impact are:

- Height of pipeline road crossing - 12m to ensure high point in both directions.
- 12m covers allowable load height. Any oversize load would be escorted.
- Pipeline support structure is very robust - needed to support height and span
- Physical impact protection of uprights
- Warning systems for overheight (eg jingle bars)
- Remote shutoff valves at both AlphaHPA and Orica ends of pipeline

Conclusion:

- An underground pipeline for ANS is not ‘reasonably practicable’ on the basis that the process safety risk is greater than the process safety risks of the pipeline road crossing.

3.5. Comparison against State Code 21 v3.0 PO11

Table 3.2 provides the PO11 requirement.

Table 3.2: State code 21 v3.0 PO11

ID	Applicability	Performance outcome
PO11	All development	Development is designed and sited to mitigate the risks from hazard scenarios occurring at existing hazardous chemical facilities.

As per the original QRA, AN explosions on the Orica site could damage the ammonia storage at the Alpha HPA resulting in a toxic release. As previously noted the ammonia storage location on the Alpha HPA site has been selected to minimise complexity and length of the ammonia import line route between Orica and Alpha HPA.

Safeguards included in the Alpha HPA design to reduce the likelihood or consequence of damage and leak from ammonia storage due to an offsite AN explosion are summarised in Table 3.3. (Note that this does not cover any control measures at the Orica site).

- The outcome of this type of event would be potential dislodgement/movement of the vessel and connected piping shearing, with the worst case being the liquid outlet piping.
- As per original QRA report, the frequency of exceedance of 35 kPa (overpressure causing damage as per Table 3.1) at the location of the Alpha HPA ammonia storage is approximately 33 x 10^{-6} per year (from Orica's QRA). Shearing of a pipe would result in a very high flow closing the vessel internal excess flow valve. The resulting un-isolated leak frequency is 3.9 x 10^{-7} per year.

Table 3.3: Potential knock on scenarios

Scenario	Consequence	Alpha HPA safeguards
AN explosion at Orica	Overpressure damage and loss of containment from Alpha HPA ammonia storage/piping.	**Effects on AlphaHPA personnel** Control room / admin building located to maximise the separation distance from Orica **Escalation effects:** Ammonia storage located outside the Orica 50 x 10^{-6} per year risk contour. Storage vessels oriented with heads (i.e. smallest exposure area) rather than longitudinal side facing Orica Fail safe actuated shut off valve on liquid in and out (may be damaged/ineffective in this scenario) Vessel internal excess flow valves liquid outlets – self closing on high outflow. (unlikely to be damaged in this scenario). Emergency response plan coordinated with Orica.

4. REFERENCES

[1] Sherpa Consulting Pty Ltd, "Qualitative Risk Assessment - Proposed High Purity Alumina Project," 2020.

[2] S. C. P. Ltd, "TECHNICAL NOTE QRA ADDENDUM PRECURSOR PRODUCTION FACILITY (PPF) doc ref 21438-TN-003," Rev B Nov 2021.

[3] Sherpa Consulting Pty Ltd, "TECHNICAL NOTE QRA HPA Plant ADDENDUM UPDATED INVENTORIES doc ref 21874-TN-002 Rev 1," 23 Aug 2024.

[4] NSW Department of Planning, "Hazardous Industry Planning Advisory Paper No.4 - Risk Criteria for Land Use Safety Planning," 2011.

[5] OGP, "Risk Assessment Data Directory Report No. 434 – 15, Vulnerability of Plant/Structures," 2010.

[6] Dag Bjerketvedt, Jan Roar Bakke and Kees van Wingerden, "Gas Explosion Handbook Chapter 8.3 Table 8.1," 24 December 2012. [Online]. Available: http://www.gexcon.com/article/handbook-chapter-8. [Accessed April 2016].

[7] Stephens, M, "Minimising damage to refineries from nuclear attack, natural or other disasters (taken from OGP 434-15 Vulnerability of Plant Structure 2010)," Office of Oil and Gas, US Department of the Interior , 1970.

[8] Dag Bjerketvedt, Jan Roar Bakke and Kees van Wingerden. Gexcon, Gas Explosion Handbook Chapter 8.3 Table 8.1 [Online], http://www.gexcon.com/article/handbook-chapter-8, 24 December 2012..

APPENDIX A. CONSEQUENCE RESULTS

A1. Natural gas jet fires

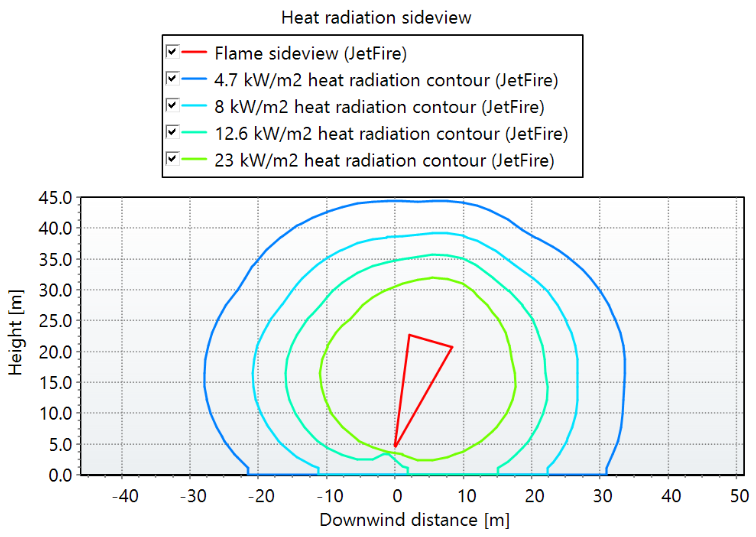
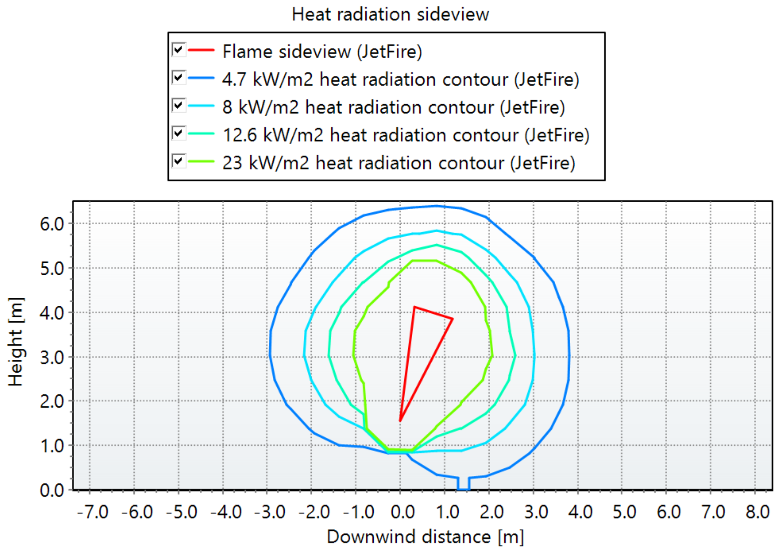
Model: Gexcon EFFECTS v12.3

15 mm/45 deg

Model: Gas LOC Scenario Continuous Leak

version: v2024.09.9943f73 (12/09/2024)
Reference: EFFECTS User manual "Combined models"

Parameters	
Process Conditions	
Chemical name	METHANE (DIPPR)
Initial temperature in vessel (°C)	25
Initial (absolute) pressure in vessel (bar)	6
Calculation Method	
Hole diameter (mm)	15
Hole rounding	Sharp edges
Outflow angle in XZ plane (0°=horizontal; 90°=vertical) (deg)	45
Height of release (Z-coordinate) (m)	1
Pasquill stability class	D (Neutral)
Wind speed at 10 m height (m/s)	5
Predefined wind direction	W

150 mm full bore rupture vertical	15mm hole vertical
	

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A2. ANS explosion overpressures

QRA Scenario										Distance to Overpressure (kPa) (m)					
									fatality inside	100%		50%	20.0%	1	
									fatality outside	100%		15%	1%	0.1%	Injury
														Distance *m)	
Scenario ID	Area	Scenario Description	Material	Max storage quantity (te)	proportion AN	Theoretical Mass Avail for Explosion (te)	Equivalence	Efficiency	NEQ (kg)	70	50	35	21	14 kPa	7kPa
AN1-02	AN Storage and concentration	240m3 tank ANS explosion	ANS	328.8	0.885	291	0.353	0.6	61631	152	182	224	311	414	710
AN1-03	AN Storage and concentration	100m3 tank ANS explosion	ANS	40	0.885	35	0.353	0.6	7498	75	90	111	154	205	352
AN1-04	AN Storage and concentration	ANS pump explosion	ANS	0.05	0.885	0.04	0.353	0.6	9	8	10	12	17	22	38

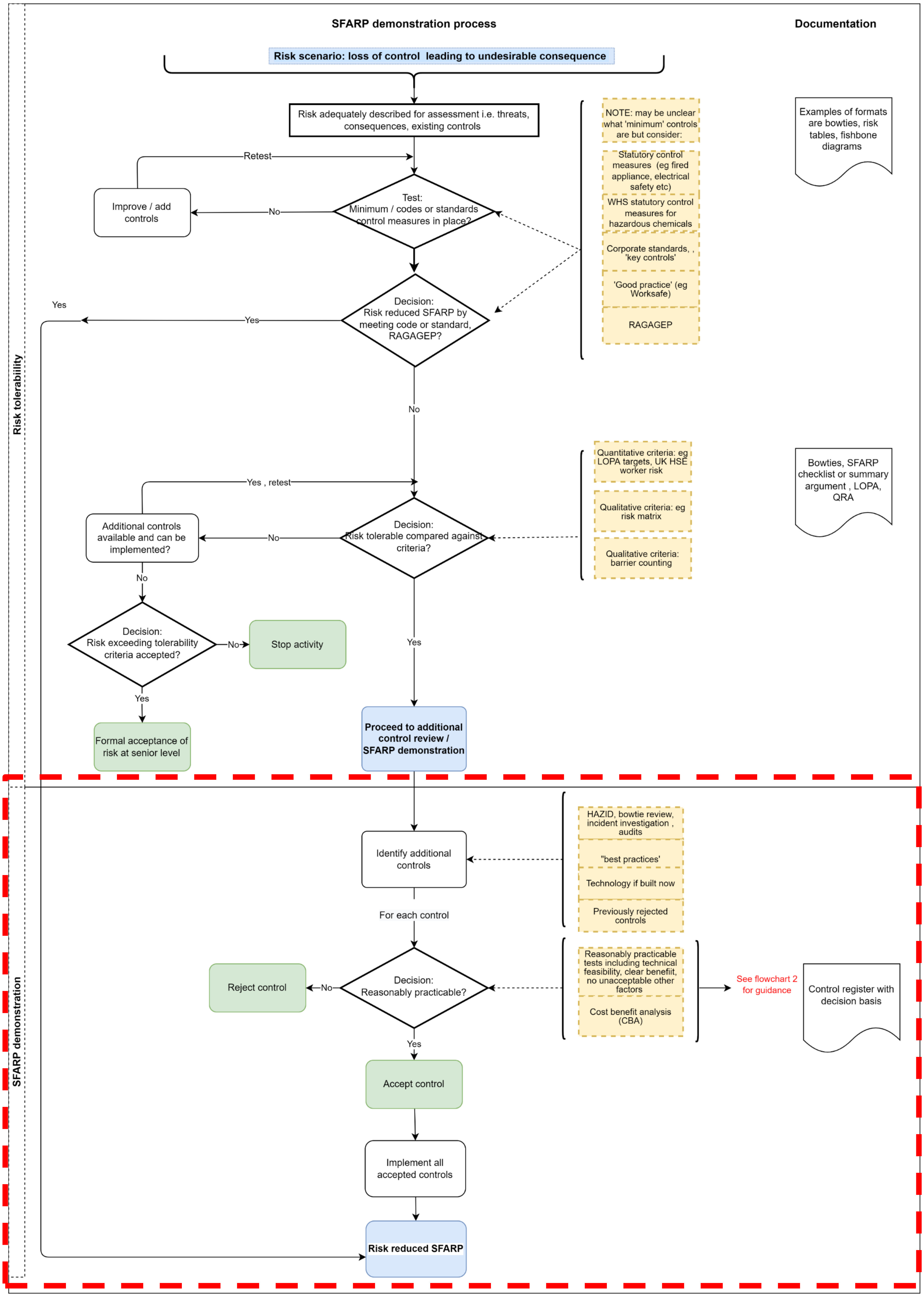
A3. Ammonia 51m^3 vessel rupture

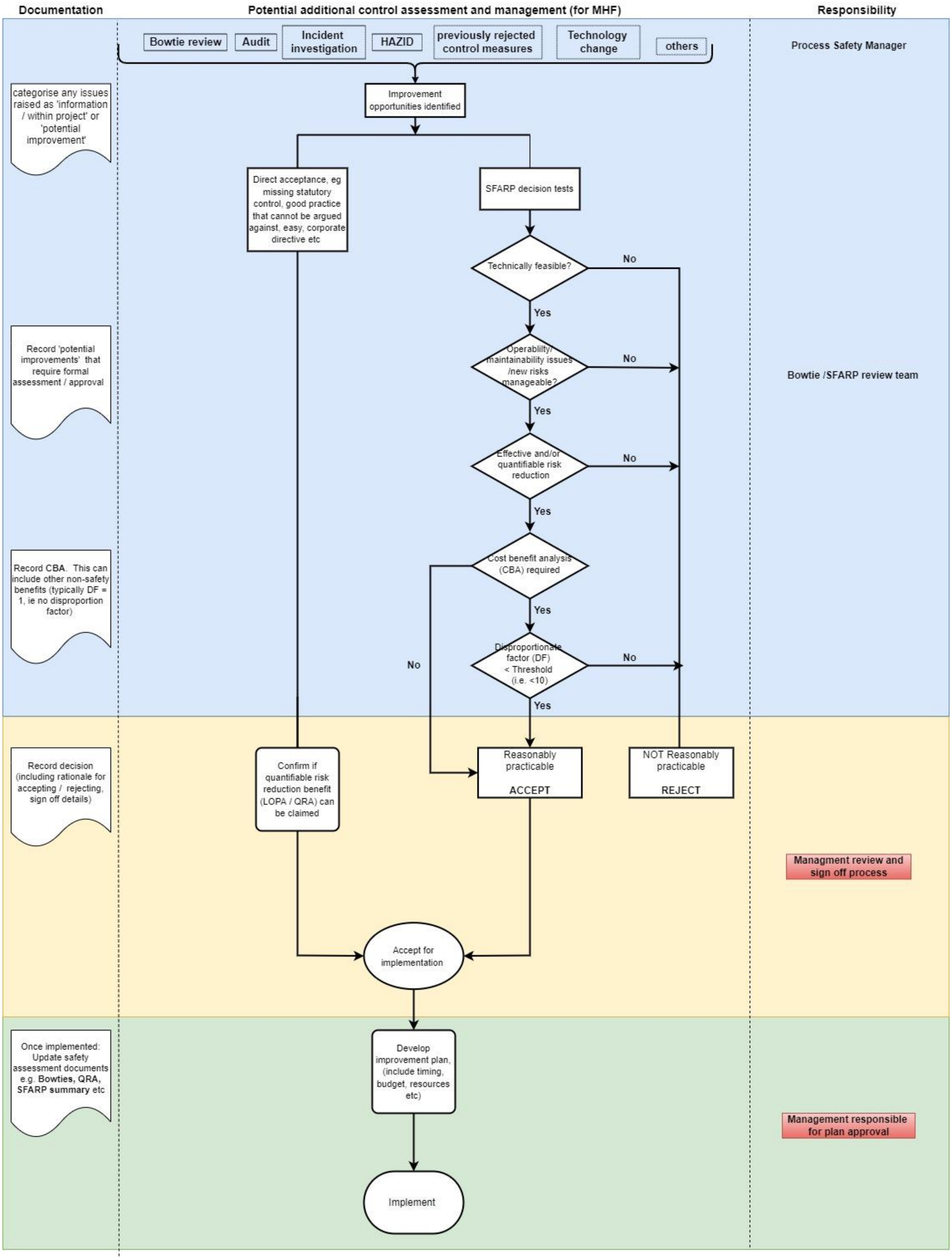
Modelset: Instaneous Ammonia rupture Set							
Model: Liquefied Gas LOC Scenario Instantaneous Release							
version: v2024.08.9943f73 (12/08/2024)							
Reference: EFFECTS User manual "Combined models"							
Parameters							
Inputs	**A2.5 Day**	**B2.7 Day**	**C2.4 Day**	**D1.9 Day**	**D1.9 Night**	**E1.9 Night**	**F2 Night**
Process Conditions							
Chemical name	AMMONIA (DIP	AMMONIA (DIPI	AMMONIA (	AMMONIA (DI	AMMONIA (I	AMMONIA (I	AMMONIA (DIPPR)
Initial temperature in vessel (°C)	23	23	23	23	23	23	23
Pressure inside vessel determination	Use vapour pres	Use vapour pres	Use vapour	Use vapour pre	Use vapour p	Use vapour p	Use vapour pressure
Burst pressure vessel (bar)	25	25	25	25	25	25	25
Calculation Method							
Outcome / phenomena	Toxic cloud	Toxic cloud	Toxic cloud	Toxic cloud	Toxic cloud	Toxic cloud	Toxic cloud
Vessel volume (m3)	51	51	51	51	51	51	51
Filling degree (%)	100	100	100	100	100	100	100
Reporting							
Contour maximum distances							
Lethality contours distance [m]	**A2.5 Day**	**B2.7 Day**	**C2.4 Day**	**D1.9 Day**	**D1.9 Night**	**E1.9 Night**	**F2 Night**
1 % lethality contour (Combine Toxic cloud	**162**	**254**	**338**	**358**	**356**	**437**	**778**
Concentration contours distance [m]	**A2.5 Day**	**B2.7 Day**	**C2.4 Day**	**D1.9 Day**	**D1.9 Night**	**E1.9 Night**	**F2 Night**
AEGL-2 [3600] at 1.5m (Toxic Cloud Instant	**1485**	**2360**	**3302**	**3604**	**3612**	**6763**	**10742**
Other information							
Main program	RISKCURVES 12.3.0.24041						

Results outside model validity range. Can be regarded as indicative and are provided for completeness only. In reality the wind and environmental conditions would change over the area which would tend to result in a wider and shorter effect area than predicted by this type of modelling

APPENDIX B. SFARP ASSESSMENT REGISTER

B1. Methodology




Documentation
Potential additional control assessment and management (for MHF)
Responsibility
Bowtie review
Audit
Incident investigation
HAZID
previously rejected control measures
Technology change
others
Process Safety Manager
categorise any issues raised as 'information / within project' or 'potential improvement'
Improvement opportunities identified
Direct acceptance, eg missing statutory control, good practice that cannot be argued against, easy, corporate directive etc
SFARP decision tests
Technically feasible?
No
Yes
Record 'potential improvements' that require formal assessment / approval
Operablity/ maintainability issues /new risks manageable?
No
Yes
Bowtie /SFARP review team
Effective and/or quantifiable risk reduction
No
Yes
Record CBA. This can include other non-safety benefits (typically DF = 1, ie no disproportion factor)
Cost benefit analysis (CBA) required
Yes
No
Disproportionate factor (DF) < Threshold (i.e. <10)
No
Yes
Record decision (including rationale for accepting / rejecting, sign off details)
Confirm if quantifiable risk reduction benefit (LOPA / QRA) can be claimed
Reasonably practicable
ACCEPT
NOT Reasonably practicable
REJECT
Managment review and sign off process
Accept for implementation
Once implemented: Update safety assessment documents e.g. Bowties, QRA, SFARP summary etc
Develop improvement plan, (include timing, budget, resources etc)
Management responsible for plan approval
Implement

B2. SFARP register extract

Relevant review workshop:

Date: 7 Sept 2024

Attendees:

Name	Company	Role
Jason Hepburn	Prudentia	Process
David O'Connor	Prudentia	Mechanical
Matthew Callanan	AlphaHPA	General Manager
Lisa Roobottom	AlphaHPA	General Manager Manufacturing Support
Nicola Curtis	AlphaHPA	HSEQ manager site
Jenny Polich	Sherpa	Facilitator

Key

red text — driver for decision

Incident	Risk Reduction Option	Function	Hierarchy of Control	Direct Acceptance (Y/N)?	Existing risk level - qualitative comments	Technically feasible? (Y/N)?	Effectiveness comments	Any new ops / maintenance issues can be adequately managed (Y/N)?	Any new risks can be adequately managed (Y/N)?	Applicable for other MIs?	Risk Reduction Benefits quantifiable (LOPA or QRA)	Carried forward to Cost Benefit Analysis?	SFARP Summary	Reasonably Practicable (Y/N)?	Status
ANS storage decomposition resulting in escalation / damage to ammonia storage	Blast wall between ANS storage and ammonia storage	Reduce likelihood of overpressure damage to ammonia storage and escalated event of toxic gas release	Isolate / Separate	No	A bowtie summarising the controls above linked to a layer of protection analysis (LOPA) predicts an ANS storage decomposition event frequency of ~1.5 x10-6 per year.	Probably not. Design of the barrier would need to achieve something better than the likely response of the pressure vessel itself, this implies that the design basis would need to be in excess of the 35 – 70kPa damage thresholds and would need to be a relatively large structure to protect the vessels or block effects from a storage tank explosion. An effective design basis for the wall is difficult to establish and may not be technically feasible for the likely size of structure. The TNT equivalent is also very large compared to Class 1 explosives inventories in magazines where blast walls / mounds typically used. Blast protection design is usually about minimising size of structures	Very difficult to establish design basis/ effectiveness. Events beyond design still could occur	Not a determining factor Though this would be a significant obstruction and structural integrity would need to be monitored)	Events beyond wall design still could occur - additional debris risk of wall failing	No	Yes But minimal benefit as the base frequency for NH3 tank rupture / large leaks is higher by at least 1 order of magnitude ANS storage decomposition event frequency of ~1.5 x10-6 per year. This is lower than statistical large leaks from pressure vessels ~ 12 x10-6 per vessel for rupture and large holes, ie does not materially affect the frequencies used in the QRA for ammonia events	Screening only. Including effect of evacuation as ANS decomp is a with warning event frequency is of the order of 1e-7 per year. Max spend is <$30,000 for fatalities up to 150 people. Blast wall design and installation cost far higher	Rejected primarily on the basis that a design basis that can clearly demonstrate a benefit is very difficult to establish. Even if this could be done the risk reduction benefit is very small because of the low frequency of the event. Effects on people likely to be minimal as it is 'with warning' event and evacuation can be achieved	No	Rejected
ANS storage decomposition resulting in escalation / damage to ammonia storage	Rearrange ammonia area to position process water tank to west and ammonia storage on east side of pad	Non hazardous inventory closest to ANS storage, provides	Isolate / Separate	Yes	A bowtie summarising the controls above linked to a layer of protection analysis (LOPA) predicts an ANS storage decomposition event frequency of ~1.5 x10-6 per year.	Yes	Difficult to establish effectiveness	Not applicable	Not applicable	No	No	No cost implications as this stage of design	Direct acceptance	Yes	Accepted
ANS storage decomposition resulting in escalation / damage to ammonia storage	Orient ammonia storage vessel with heads rather n=than longitudinal axis facing ANS storage area	Minimise surface area of ammonia pressure vessel exposed to overpressure	Minimise/reduce	Yes	A bowtie summarising the controls above linked to a layer of protection analysis (LOPA) predicts an ANS storage decomposition event frequency of ~1.5 x10-6 per year.	Yes	Difficult to establish effectiveness	Not applicable	Not applicable	No	No	No cost implications as this stage of design	Direct acceptance	Yes	Accepted
Collision of vehicle with ANS pipeline over Reid Rd	Underground pipeline	Eliminate risk of vehicle impact on pipeline	Eliminate	No	Impact risk judged to be low given height of pipeline crossing and uprights well separated from road edges	Yes Would need to be in a culvert with heating and access	Effective	Significant operability issues arise as follows: - any trip would need to flush / dilute pipeline to Orica to avoid blockage in static condition (even with heating).	Pump trips would protect the pump however may be a high demand on trip, significant risks associated with unblocking the pipe. Compared with: Loss of containment of ANS from	No	Risk would be higher - increases frequency of ANS pump dead head scenario / decomposition frequency.	No	U/g pipeline introduces new risks, risk is higher than road crossing pipeline (which can be managed by design choices of height, structure protection, overheight warning). No risk reduction benefit, new risks / operation issues not manageable. Not reasonably practicable	No	Rejected

B3. Cost benefit screening approach

UK HSE guidance (https://www.hse.gov.uk/risk/theory/alarpcheck.htm#) in relation to major hazards facility provides the following approach to assist with demonstrating SFARP. Something is 'reasonably practicable' unless its costs are grossly disproportionate to the benefits.

Put simply if:

$$\frac{\text{Costs}}{\text{Benefits}} > 1 \times DF$$

where DF is the 'disproportion factor', then the measure is not worth doing for the risk reduction achieved.
A DF of not more than 10 is suggested for multiple fatality events.

To assess the maximum spend which can assist with decision making:

- Maximum spend ('cost') = DF x benefit
- Safety benefit = (fatality risk initial – fatality risk after per year) x number of fatalities x life of facility x value of statistical life.

Basis data

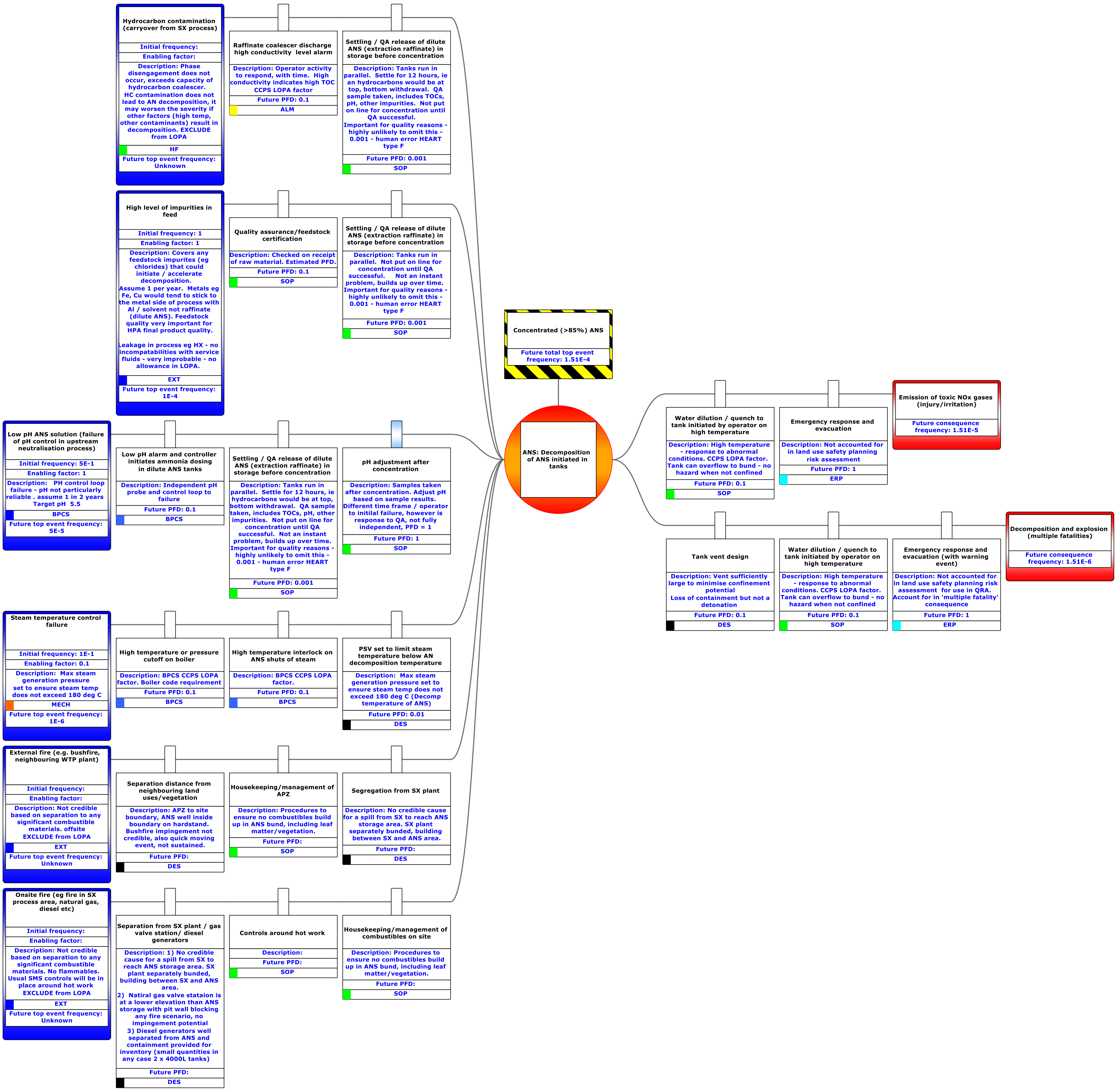
	Safety	Asset	
Parameter	**Value**		**Source**
Value of statistical life (AUD/year)	$5,015,020	estimate loss / damage	https://www.pmc.gov.au/sites/default/files/publications/Value_of_Statistical_Life_guidance_note.pdf
Life of plant (year)	30	30	Typical
Disproportion Factor (-)	10	1	DF=> 10 'grossly disproportionate' - for safety UK HSE guidance (https://www.hse.gov.uk/risk/theory/alarpcheck.htm#)

Safety Sample Calculation

This sheet covers sample DF calculation which is included in *21468-TN-004 SA using BowtieXP*

Change in Risk		Other			Safety		
		MAXIMUM SPEND (no DF)			MAXIMUM SPEND (with DF)		
Initial Risk including existing controls (per year)	Reduced Risk (per year)				No of Fatalities		
		1	10	150	1	10	150
1.00E-02	1.00E-03	$1,354,055	$13,540,554	$203,108,310	$13,540,554	$135,405,540	$2,031,083,100
1.00E-02	1.00E-04	$1,489,461	$14,894,609	$223,419,141	$14,894,609	$148,946,094	$2,234,191,410
1.00E-02	0	$1,504,506	$15,045,060	$225,675,900	$15,045,060	$150,450,600	$2,256,759,000
1.00E-03	1.00E-04	$135,406	$1,354,055	$20,310,831	$1,354,055	$13,540,554	$203,108,310
1.00E-03	1.00E-05	$148,946	$1,489,461	$22,341,914	$1,489,461	$14,894,609	$223,419,141
1.00E-03	0	$150,451	$1,504,506	$22,567,590	$1,504,506	$15,045,060	$225,675,900
1.00E-04	1.00E-05	$13,541	$135,406	$2,031,083	$135,406	$1,354,055	$20,310,831
1.00E-04	1.00E-06	$14,895	$148,946	$2,234,191	$148,946	$1,489,461	$22,341,914
1.00E-04	0	$15,045	$150,451	$2,256,759	$150,451	$1,504,506	$22,567,590
1.00E-05	1.00E-06	$1,354	$13,541	$203,108	$13,541	$135,406	$2,031,083
1.00E-05	1.00E-07	$1,489	$14,895	$223,419	$14,895	$148,946	$2,234,191
1.00E-05	0	$1,505	$15,045	$225,676	$15,045	$150,451	$2,256,759
1.00E-06	1.00E-07	$135	$1,354	$20,311	$1,354	$13,541	$203,108
1.00E-06	1.00E-08	$149	$1,489	$22,342	$1,489	$14,895	$223,419
1.00E-06	0	$150	$1,505	$22,568	$1,505	$15,045	$225,676
1.00E-07	0	$15	$150	$2,257	$150	$1,505	$22,568

APPENDIX C. ANS STORAGE DECOMPOSITION FREQUENCY ESTIMATE



Attachment C: Stage 2 list and quantities of hazardous chemicals and Stage 1 site manifest

Stage 2 List and Quantities of Hazardous Chemicals

Alpha HPA Process Hazardous Chemical Inventory

Document Number: MC23050-000-P-MEM-00004

Rev	Date	Description	By	Checked	Approved
A	25/07/24	For Use	C. Harris	J Hepburn	
B	30/08/24	Updated Chemical List	C. Harris	J Hepburn	J Hepburn

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Contents

1 Purpose

The purpose of this memorandum is to respond to Alpha HPA's email sent on 24/07/24 regarding the update of hazardous chemicals affecting the quantitative risk assessment (QRA).

Revision B expanded to include other chemicals used in the plant.

2 Response

The table below contains the current process inventory for SX Organic, Anhydrous Ammonia, 22% Ammonium Nitrate solution, 88.5% Ammonium Nitrate solution, Nitric Acid, Diesel, Natural Gas, and Cooling Tower Dosing Chemicals. The process inventory is obtained from MC23050-000-P-CAL-00010 Rev C using the current process and reagent storage tank inventory. An allowance for piping inventories is included, this assumes that process tanks are operating at their maximum fill position.

Table 1 Hazardous Chemical Inventory

Material	Process Inventory (tonnes) Dry basis – note 1	Operating Conditions	Revision
SX Organic	1200	Contained in 11 mixer and settler tanks including reagent supply and storage tanks Total Organic: 1200t Shellsol D80: 700t Extract 1: 380t Extract 2: 120t Organic has a flash point of ~73°C and is combustible	A
Anhydrous Ammonia	120	Stored in 3 x 51m^3 isotainers Design Pressure: 22 barg Design Temperature -40°C to 55°C	A
<50% Ammonium Nitrate Solution (Dilute ANS)	1400	Storage at ~5-25% ANS in processing tanks Quality Assurance tank largest storage at 4 off tanks x 750 m^3 ea Stored at atmospheric pressure and ~60°C	A
88.5% Ammonium Nitrate Solution (Concentrated ANS)	750	100% AN basis 4 x 88m^3 tanks and 1 x 237m^3 tank Stored at atmospheric pressure and 120°C	A
60% Hydrogen Peroxide	30	Storage in 40 m3 tank @ 60% Hydrogen Peroxide	A
Nitric Acid (60% w/w)	700	Storage in 600 m3 tank (stored at 60% w/w)	B

Material	Process Inventory (tonnes) Dry basis – note 1	Operating Conditions	Revision
Diesel	15	Stored across diesel generators tanks and diesel storage on site.	B
Natural Gas Piping	0.1 (100 kg)	Operating Pressure: 500kPag Operating Temperature: 25°C	B
Cooling Tower Dosing Chemicals	Approx 5	Consists of the following: Caustic (1000L) Anti Scalant (1000L) Biocide (1000L)	B

Note 1 – Inventory is based on dry basis (i.e. 100% reagent)

Stage 1 Site Manifest

Dangerous Good Manifest

Authorised by: Vicki Wright, HSE Specialist, 25/08/2023

WORKPLACE INFORMATION

Business name	Solindo Pty Ltd
Trading name	Alpha HPA Limited
Address	53 Reid Road, Yarwun, Gladstone QLD, 4694
Date of preparation/ revision	14/09/2023

EMERGENCY CONTACTS

Name	Position	Telephone
Matthew Callinan	Site Manager	+61 459 647 173
Geoffrey Sheppard	Site Superintendent	+61 409 761 798
Vicki Wright	HSE Specialist	+61 439 434 953

HAZARDOUS CHEMICALS STORED IN BULLETS OR TANKS

Tank ID	Dangerous goods					Tanks		
	Shipping Name	UN No.	Class	Sub Risk	PG	Type	Capacity	Diameter
A	Ammonia, Anhydrous	1005	2.3	8	N/A	a/g	21,000 L	N/A
B	Ammonia, Anhydrous	1005	2.3	8	N/A	a/g	21,000 L	N/A

Tank ID	Dangerous goods					Tanks		
	Shipping Name	UN No.	Class	Sub Risk	PG	Type	Capacity	Diameter
C	Dilute Ammonium Nitrate 25%	N/A	N/A	N/A	N/A	a/g	30,000 L	3.4 M
D	Dilute Ammonium Nitrate 25%	N/A	N/A	N/A	N/A	a/g	30,000 L	3.4 M
E	Nitric Acid (65%, other than red fuming)	2031	8	1A	II	a/g	30,000 L	3.8 M
F	Ammonia, Aqueous (25%)	2672	8	N/A	III	a/g	2,000 L	1.4 M
G	Petroleum Gases, Liquified	1075	2.1	N/A	N/A	a/g	4,000 L	N/A
H	Sodium Hydroxide Solution	1824	8	N/A	II	a/g	1,000 L	N/A
I	Carbon Dioxide, Compressed	1013	2	2.2	N/A	a/g	12,000 L	2.5 M

MANUFACTURING AREAS

Area ID	Hazardous chemicals					Quantities	
	Shopping Name	UN No.	Class	Sub risk/s	PG	Average	Maximum
J	Carbon Dioxide, Compressed (Manpack 12 x 50 litre cylinders)	1066	2.2	N/A	N/A	600 L	1,200 L
K	Hydrogen Peroxide (20-60%)	2984	5.1	8	II	840 L	1,680 L
L	Argon, Compressed (Manpack 12 x 50 litre cylinders)	1006	2.2	N/A	N/A	600 L	1,200 L
M	Nitrogen, Compressed (Manpack 12 x 50 litre cylinders)	1066	2.2	N/A	N/A	600 L	1,200 L

CHEMICAL STORAGE AREAS - IBC / BULK BAG STORAGE

Due to operating as a production facility, the arrangement of hazardous chemical storage is subject to multiple changes throughout the course of a working day, driven by the need for materials in support of production activities.

HAZARDOUS CHEMICALS – IBC STORAGE AREA 1

Area	Hazardous chemicals					Quantities	
	Shipping name	UN NO.	Class	Sub risk/s	PG	Average	Maximum
1	Shellsol (Vivasol) D80	n/a	C1 Combustible Liquid	N/A	N/A	2,500 L	5,000 L
1	Nitric Acid (<65%, other than red fuming)	2031	8	N/A	II	1,000 L	2,000 L
1	Aluminium Nitrate (Crystal)	1438	5.1	N/A	III	10,000 KG	20,000 KG

HAZARDOUS CHEMICALS – IBC STORAGE AREA 2

Area	Hazardous chemicals					Quantities	
	Shipping name	UN NO.	Class	Sub risk/s	PG	Average	Maximum
2	Hydrogen Peroxide (35%)	2984	5.1	8	II	821 L	1,650 L
2	Sodium Hydroxide	1824	8	N/A	II	1,500 L	3,000 L

ADJOINING SITES/PREMISES

ORICA YARWUN

The adjacent facility situated across the thoroughfare from our plant entry is Orica. This establishment is an industrial plant involved in the controlled manufacture and handling of Sodium Cyanide and Ammonium Nitrate operations. The land situated on Alpha side of the road, not within their site, serves as an area for Orica employees' staff parking.

YARWUN WATER TREATMENT PLANT

The facility on the northern side of our plant is Yarwun Water treatment plant.

Alpha HPA

Alpha HPA Yarwun

53 Reid Road, Yarwun Qld 4694

23°50'8"S 151°9'58"E 23°50'8"S 151°10'26"E

23°50'33"S 151°9'58"E 23°50'33"S 151°10'26"E

A product of Queensland Globe

Legend located on next page

N

0 100 metres

Scale: 1:4345

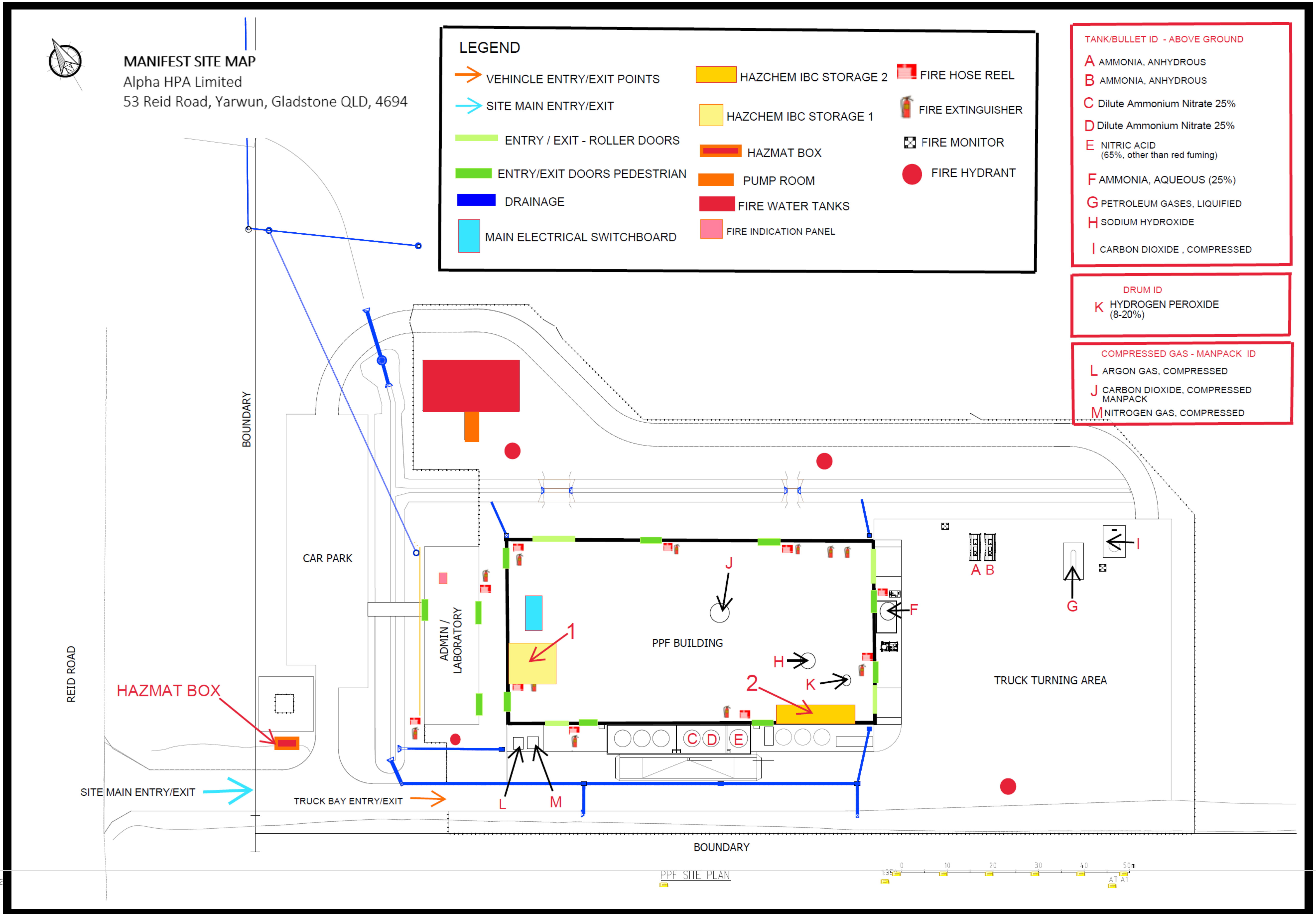
Printed at: A4

Print date: 2/8/2022

Projection: Web Mercator EPSG 102100 (3857)

For more information, visit https://qldglobe.information.qld.gov.au/help-info/Contact-us.html

Queensland Government
Department of Resources


MANIFEST SITE MAP
Alpha HPA Limited
53 Reid Road, Yarwun, Gladstone QLD, 4694
LEGEND
VEHINCLE ENTRY/EXIT POINTS
SITE MAIN ENTRY/EXIT
ENTRY / EXIT - ROLLER DOORS
ENTRY/EXIT DOORS PEDESTRIAN
DRAINAGE
MAIN ELECTRICAL SWITCHBOARD
HAZCHEM IBC STORAGE 2
HAZCHEM IBC STORAGE 1
HAZMAT BOX
PUMP ROOM
FIRE WATER TANKS
FIRE INDICATION PANEL
FIRE HOSE REEL
FIRE EXTINGUISHER
FIRE MONITOR
FIRE HYDRANT
TANK/BULLET ID - ABOVE GROUND
A AMMONIA, ANHYDROUS
B AMMONIA, ANHYDROUS
C Dilute Ammonium Nitrate 25%
D Dilute Ammonium Nitrate 25%
E NITRIC ACID (65%, other than red fuming)
F AMMONIA, AQUEOUS (25%)
G PETROLEUM GASES, LIQUIFIED
H SODIUM HYDROXIDE
I CARBON DIOXIDE , COMPRESSED
DRUM ID
K HYDROGEN PEROXIDE (8-20%)
COMPRESSED GAS - MANPACK ID
L ARGON GAS, COMPRESSED
J CARBON DIOXIDE, COMPRESSED MANPACK
M NITROGEN GAS, COMPRESSED
BOUNDARY
CAR PARK
ADMIN / LABORATORY
PPF BUILDING
TRUCK TURNING AREA
REID ROAD
HAZMAT BOX
SITE MAIN ENTRY/EXIT
TRUCK BAY ENTRY/EXIT
BOUNDARY
PPF SITE PLAN
0 10 20 30 40 50m

Attachment D: Updated State Code 21 response

State code 21: Hazardous chemical facilities

Planning guideline – State code 21: Hazardous chemical facilities provides direction on how to address this code.

Table 21.1: Material change of use

Performance outcomes	Response
Off-site impacts—vulnerable land use or land zoned for a vulnerable land use	
PO1 The **hazardous chemical facility** does not create a **dangerous dose to human health**.	**Complies** A Quantitative Risk Assessment (QRA) was prepared and submitted as part of the originating Development Application Material. The QRA has not been updated as part of the changes proposed. The report assessed the Projects risk to the sensitivity of the surrounding land uses and concluded compliance.
Off-site impacts—sensitive land use or land zoned for a sensitive land use	
PO2 The **hazardous chemical facility** does not create a **dangerous dose to human health**.	**Complies** A QRA was prepared and submitted as part of the originating Development Application Material. The QRA has not been updated as part of the changes proposed. The report assessed the Projects risk to the sensitivity of the surrounding land uses and concluded compliance.
Off-site impacts—commercial or community activity land use or land zoned for a commercial or community activity land use	
PO3 The **hazardous chemical facility** does not create a **dangerous dose to human health**.	**Complies** A Quantitative Risk Assessment (QRA) was prepared and submitted as part of the originating Development Application Material. The QRA has not been updated as part of the changes proposed. The report assessed the Projects risk to the sensitivity of the surrounding land uses and concluded compliance.

Off-site impacts—open space land use or land zoned for an open space land use	
PO4 The **hazardous chemical facility**, does not create: a. a **dangerous dose to human health**; or b. where (a) cannot be achieved, an **individual fatality risk level** of 10 x 10^{-6}/year and the societal risk criteria in figure 21.1.	**Complies** A Quantitative Risk Assessment (QRA) was prepared and submitted as part of the originating Development Application Material. The QRA has not been updated as part of the changes proposed. The report assessed the Projects risk to the sensitivity of the surrounding land uses and concluded compliance.
Off-site impacts—industrial land use or land zoned for an industrial land use	
PO5 The **hazardous chemical facility**, does not create either of the following: a. a **dangerous dose to the built environment**; and b. an **individual fatality risk level** of 50 x 10^{-6}/year.	**Complies** A Quantitative Risk Assessment (QRA) was prepared and submitted as part of the originating Development Application Material. The QRA has not been updated as part of the changes proposed. The report assessed the Project's risk to the sensitivity of the surrounding land uses and concluded compliance.
Storage and handling areas	
PO6 Storage and handling areas for **fire risk hazardous chemicals** are provided with a 24-hour monitored fire detection system that has the ability to detect a fire in its early stages and notify an **emergency responder** at all times.	**Complies** As per the Project's Fire Services Design Criteria, fire detection and alarm systems will be in accordance with AS 1670. The system will include: • Point type smoke detectors • Point type heat detectors • Heat detector probes in the SX plant • Linear heat detection in the SX pipe rack • Aspirated Smoke Detectors in switchrooms • Flame detectors in the SX plant • Manual call points • Visual and audible warning devices The proposed fire panel will include Automatic Signalling Equipment (ASE) to allow direct monitoring by QFES (as currently in place for the Stage 1 facility).
PO7 Storage and handling areas for **packages** of liquid or solid **fire risk hazardous chemicals** are provided with a spill containment system with a working volume capable of containing a minimum of 100 percent of all **packages** (**prescribed hazardous chemicals** and/or non-hazardous	**Not applicable** PO7 requirements are for storage of packages of fire hazardous chemicals. Based on definitions in *AS 1940 The storage and handling of flammable and*

chemicals) within the area plus the output of any **fixed firefighting system** provided for the area over a minimum of 90 minutes.	*combustible liquids*, "package" is a container with a capacity less than 500 L. The proposed Stage 2 chemicals will be stored in tanks with a capacity greater than 500 L and are therefore addressed in PO8.
PO8 Storage and handling areas for liquid or solid **fire risk hazardous chemicals** in **tanks** are provided with a spill containment system with a working volume capable of containing a minimum of: a. 110 percent of the largest **tank** within a spill compound or 25 percent of the aggregate where multiple **tanks** are located within a spill compound, whichever is the greater; and b. the output of any **fixed firefighting system** provided for any bulk **tank** within a spill compound over a minimum of 90 minutes.	**Complies** Bunds are provided for all hazardous chemical tanks with a minimum bund capacity of 110% of the largest tank or 25% of all tanks in the compound, whichever is larger. Additionally, the Solvent Extraction Bund 110 has an additional bund wall height of 600 mm to account for fire-fighting foam coverage.
PO9 Storage and handling areas for **prescribed hazardous chemicals** that, if in contact with each other, may react to produce a fire, explosion or other harmful reaction, or a flammable, toxic or corrosive vapour are designed to prevent contact between the **prescribed hazardous chemicals**.	**Complies** The Project's Basis of Design states that the net capacity of a bunded compound in a tank storage facility must be at least 110% of the net capacity of the largest tank or 25% of the total tank capacity in the compound, whichever is larger, and in accordance with AS 1940 or AS 3780 as appropriate. An additional allowance for rainwater shall be made, i.e. sufficient capacity to cope with a 1 in 10 year, 24-hour storm. In addition, the Basis of Design states that incompatible chemicals shall not be stored within the same bunded areas. A review of each process area and the chemicals stored within those areas has been carried out and confirms that incompatible chemicals are adequately separated and that the Project complies with the requirements of PO9 . 1. <u>Area 100 Leach</u> a) Chemicals are nitric acid, very dilute AN, alumina, hydrogen peroxide, peroxide, aqueous ammonia (no storage tank). b) Peroxide is in its own bund. c) This area has its own bund. None of these chemicals would be regarded as reacting dangerously if mixed from storage tanks. 2. <u>Area 110-150 SX</u> a. Chemicals are nitric acid, dilute AN, organic, aqueous NH3 (not storage tank). b. All of SX is a single bund. None of the chemicals can react dangerously if mixed from storage tanks.

	3. <u>Area 200 Crystalliser</u> a. Chemicals are nitric acid, dilute AN, aqueous NH3 (not storage tank). b. This area has its own bund, none of the chemicals can react dangerously if mixed from storage tanks. 4. <u>Area 220-235 Precursor and ATH</u> a. Chemicals are CO2, NH3, Dilute AN, Nitric Acid (no storage), peroxide (piping only for scrubber). b. This area has its own bund, none of the chemicals can react dangerously if mixed from storage tanks. 5. <u>Area 260</u> a. Chemicals are CO2, Dilute AN, Nitric Acid (no storage). b. This area has its own bund, none of the chemicals can react dangerously if mixed from storage tanks. 6. <u>Area 265/400 (dilute AN)</u> a. Chemicals are Dilute AN, aqueous NH3, Nitric Acid (no storage). b. This area has its own bund, none of the chemicals can react dangerously if mixed from storage tanks. 7. <u>Area 400 Concentrated AN</u> a. Chemicals are Concentrated AN, Aqueous NH3. b. This area has its own bund, none of the chemicals can react dangerously if mixed from storage tanks. 8. <u>Area 600 (nitric acid)</u> a. This tank has its own bund. 9. <u>Area 610 Aqueous NH3</u> a. Chemicals are dilute AN, Aqueous NH3. b. This area has its own bund, none of the chemicals can react dangerously if mixed from storage tanks.
PO10 Development is designed and sited to mitigate impacts on **storage and handling areas** from **natural hazard** including, but not limited to: a. flood; b. bushfire; c. erosion;	**Complies** The Project complies with PO10 though the following considerations: • Flooding - reference is made to the planning report which demonstrates flood mitigation measures to ensure compliance is achieved.

d. storm tide inundation; e. landslide; f. earthquake; g. **wind action**.	• Bushfire Prone Area - reference is made to the previously submitted Site Based Management Plan which demonstrates mitigation measures to ensure compliance is achieved. • Erosion Prone Area/Storm Tide Inundation Area - the Project area is not impacted by erosion prone area or storm tide inundation mapping. • Landslide Hazard Area – the Project area is not mapped as a landslide hazard area.
All development	
PO11 Development is designed and sited to mitigate the risks from **hazard scenarios** occurring at existing **hazardous chemical facilities**.	**Complies** As per the Quantitative Risk Assessment (QRA) submitted, AN explosions on the Orica site could damage the ammonia storage at the Alpha HPA resulting in a toxic release. As detailed in the *Sherpa Technical Note – Response to QIR Queries* (dated 23/09/24), the ammonia storage location on the Alpha HPA site has been selected to minimise complexity and length of the ammonia import line route between Orica and Alpha HPA. Safeguards included in the Alpha HPA design to reduce the likelihood or consequence of damage and leak from ammonia storage due to an offsite AN explosion are summarised in the table below (note that this does not cover any control measures at the Orica site). • The outcome of this type of event would be potential dislodgement/movement of the vessel and connected piping shearing, with the worst case being the liquid outlet piping. • As per QRA report, the frequency of exceedance of 35 kPa (overpressure causing damage as per table below) at the location of the Alpha HPA ammonia storage is approximately 33 x 10-6 per year (from Orica's QRA). Shearing of a pipe would result in a very high flow closing the vessel internal excess flow valve. The resulting un-isolated leak frequency is 3.9 x 10-7 per year.

Scenario	Consequence	Alpha HPA safeguards
AN explosion at Orica	Overpressure damage and loss of containment from Alpha HPA ammonia storage/piping.	**Effects on AlphaHPA personnel** Control room / admin building located to maximise the separation distance from Orica **Escalation effects:** Ammonia storage located outside the Orica 50 x 10^{-6} per year risk contour. Storage vessels oriented with heads (i.e. smallest exposure area) rather than longitudinal side facing Orica Fail safe actuated shut off valve on liquid in and out (may be damaged/ineffective in this scenario) Vessel internal excess flow valves liquid outlets – self closing on high outflow. (unlikely to be damaged in this scenario). Emergency response plan coordinated with Orica.