Table B.1: Assessment against the strategic visions for the GSDA

Strategic vision	Statement of compliance
1. The vision for the GSDA is to: a) be Central Queensland's economic powerhouse, with an efficient concentration of large-scale industry of national, State and regional significance that benefit from the SDA's strategic location near the Port of Gladstone and major road and rail networks	Complies The Proposal is for a special industry (chemical manufacturing facility, as defined in Schedule 1 Part 2 of the GSDA Development Scheme) and RaL to establish a chlor-alkali facility to mitigate sovereign risk associated with essential chemicals including chlorine (single domestic producer with aging infrastructure) and caustic soda (reliance on foreign supply), which are vital for Australia's industrial, economic, and public health sectors. Siting of Project Halogen within the GSDA represents an efficient concentration of strategic heavy industry uses, which benefits from the existing infrastructure availability for production and delivery to market, including to customers already located within the GSDA.
b) support development that aligns with the Queensland Government's strategic priorities for the region, particularly related to the hydrogen industry.	Complies The Proposal supports strategic priorities for the region by providing a modern chlor-alkali facility, that will produce chemicals vital for Australia's industrial, economic and public health sectors. The criticality of the Proposal to the Queensland Government, and alignment with the Queensland Government's strategic priorities for the region, is evidenced through the QIC investment and the formation of the PHWG; including representatives from the DSDIP, OCG, OIR and EDQ. Hydrogen is produced in the chor-alkali production process and the Prroposal will be capturing the hydrogen for use in steam generation rather than venting to the atmosphere.
c) maintain environmental, cultural heritage and community values where possible to support wider ecological processes and provide community benefits.	Complies The GSDA location was selected to minimise impact on the community from heavy industry. The Proposal will provide general community benefit through the supply of essential chemicals, including chlorine required for disinfecting drinking water (refer also to response to 1(a)). The Proposal cannot avoid clearing vegetation present on the Site, described as regrowth vegetation with scattered remnant trees. A significant impact assessment undertaken on matters considered likely or known to occur on the Site based on desktop reviews and site-specific ecological surveys indicated that no significant residual impact to MNES species or MSES species habitat was considered likely, provided appropriate mitigation measures are implemented as outlined in the ecological assessment (refer to Appendix E) and the EMP (refer to Appendix L). OPW for the clearing of regulated regrowth vegetation can be undertaken as a SDA self-assessable

Strategic vision	Statement of compliance
	development, where associated with a MCU and / or RaL authorised by an SDA approval. The FNBGGGTB People, as Traditional Owners of the Site, have been involved throughout the initial site assessment process. No cultural heritage values have been registered on the Site (refer to Appendix N), however, a cultural heritage assessment will be undertaken prior to commencement of any ground disturbing activities in accordance with the Aboriginal Cultural Heritage Act 2003: Duty of Care Guidelines.
2. The strategic vision is supported by the overall objectives for development and preferred development intents of development precincts within the GSDA.	Complies Refer to responses to overall objectives for development in the GSDA provided in Table B.2 and for the preferred development intents within the MTSC Precinct of the GSDA in Table B.3.

Table B.2: Assessment against the overall objectives of the GSDA

Overall Objectives	Statement of Compliance
1. Development within the GSDA will: a) capitalise on Gladstone SDA's strategic location and support the role and function of the Port of Gladstone	Complies The Proposal will capitalise on the existing infrastructure and customers located within and adjacent to the GSDA. The Proposal will support the function of the Port of Gladstone through the import of chemical process modules for construction, and where required export of commercial products by sea (noting the hierarchy of preference for supply is Central Queensland, Queensland and Australia).
b) identify and implement opportunities for synergies and co-location between other uses, services and infrastructure to minimise waste and inefficiencies	Complies The Proposal will benefit from the existing infrastructure (refer to response to 1(c)) and customers located within the GSDA (including RTAY).
c) use land and infrastructure efficiently and be adequately serviced by infrastructure	Complies The Site will be adequately serviced by infrastructure available within close proximity (including water, power, roads and telecommunications). The design approach is focused on ensuring the Proposal uses both land and infrastructure as efficiently as possible to minimise environmental impacts, as well as operational costs. The conceptual layout (refer to Appendix C) will be further refined to this end as the Proposal proceeds to detailed design.

Overall Objectives	Statement of Compliance
d) ensure the integrity and functionality of the Gladstone SDA, including infrastructure corridors and future development opportunities, is maintained and protected from incompatible land uses	Complies The Site is located within the MTSC Precinct of the GSDA, which is intended for providing linear and other infrastructure. The Proposal is classified as a MHF, requiring licensing under the WHS Reg. The GSDA has been specifically set aside to buffer the community from such uses. Refer to Section 4.2.1 of the Planning Report, responses to State Code 21: Hazardous chemical facilities (refer to Appendix B.3) and responses at Table B.3, for details on how the proposal has been designed to ensure the integrity and functionality of infrastructure corridors and future development opportunities.
e) ensure new lots are appropriately sized to accommodate preferred development	Complies The Proposal lease area is appropriately sized to accommodate the Proposal (refer to the conceptual layout at Appendix C).
f) be designed, constructed, and operated to a high quality consistent with best practice	Complies The Proposal is being designed by appropriately qualified engineers i.e., TKN for the chemical process and Prudentia for the balance of the plan and integration. The construction will be undertaken by qualified and experienced tradespeople to relevant standards under supervision of the Delivery Manager. All works will be signed off by a Registered Professional Engineer of Queensland (RPEQ) prior to handover. Construction will be undertaken in accordance with approval requirements (including the SDA approval) and a series of managed plans including but not limited to a Construction Management Plan and subsidiary EMP, Work Health and Safety Management Plan (WHSMP) and Emergency Response Plan (ERP). The operation will be managed directly by Grenof using competent personnel, supported by consulting technical specialists, where required. Operations will be undertaken in accordance with approval requirements (including the SDA approval, MHF licence and EA) and a series of management plans including but not limited to an Operations Management Plan and subsidiary EMP (to be ISO 14001 certified), WHSMP (to be ISO 45001 certified) and ERP.
g) avoid impacts on environmental, cultural heritage, and community values (including sensitive land uses), or minimise or mitigate impacts where they cannot be	Complies The GSDA location was selected to minimise impact on the community from heavy industry. The Proposal will provide general community benefit through the supply of essential chemicals, including chlorine required for disinfecting drinking water.

Overall Objectives	Statement of Compliance
avoided and offset any residual impacts	The Proposal cannot avoid clearing vegetation present on the Site, described as regrowth vegetation with scattered remnant trees. A significant impact assessment undertaken on matters considered likely or known to occur on the Site based on desktop reviews and site-specific ecological surveys indicated that no significant residual impact to MNES species or MSES species habitat was considered likely, provided appropriate mitigation measures are implemented as outlined in the ecological assessment (refer to Appendix E) and the EMP (refer to Appendix L). OPW for the clearing of regulated regrowth vegetation can be undertaken as a SDA self-assessable development, where associated with a MCU and / or RaL authorised by an SDA approval. Therefore, no offsetting of residual impacts is required. The FNBGGGTB People, as Traditional Owners of the Site, have been involved throughout the initial site assessment process. No cultural heritage values have been registered on the Site (refer to Appendix N), however, a cultural heritage assessment will be undertaken prior to commencement of any ground disturbing activities in accordance with the Aboriginal Cultural Heritage Act 2003: Duty of Care Guidelines.
h) not adversely impact on the outstanding universal values of the Great Barrier Reef World Heritage Area (GBRWHA)	Complies The Proposal will not directly impact the GBRWHA. Appropriate erosion and sediment control measures will be implemented during construction to protect and maintain water quality values. During operations the Site surface will be stabilised, with appropriate stormwater and wastewater (no release operation) controls in place. Any wastewater generated that cannot be reused in the process will be transported offsite by an appropriately licensed contractor (refer to Appendix C and D of the EMP at Appendix L).
i) manage the risks associated with the projected impacts of climate change and natural hazards to protect people and property	Complies GWT is committed to ensuring that the Proposal contributes to the transition to a low emissions global economy, whilst manufacturing essential chemicals for the region. The Proposal will result in a 25% reduction in energy use compared to the existing domestic supplier and reductions in emissions from the alternate chemical import shipping. A greenhouse gas abatement plan has been prepared for the Proposal (refer to Appendix H). The Proposal will manage the projected impacts of climate change (e.g., increased rainfall, cyclone activity and bushfires) through the EMP, WHSMP and ERP.

Overall Objectives	Statement of Compliance
j) manage impacts of air quality on the capacity of the Gladstone airshed.	Complies The Proposal will result in minimal air emissions (refer to Appendix G), with those generated to be managed in accordance with the EMP (refer to Appendix L).

Table B.3: Assessment against the Material Transportation and Services Corridor Precinct – preferred development intent

Preferred Development Intent	Statement of Compliance
a) This precinct provides an efficient, effective, and safe route for linear infrastructure to link to development in the Gladstone SDA and the Port of Gladstone.	Complies Linear infrastructure is preferably constructed in straight alignments. The northern portion of the Site within the existing MTSC Precinct follows the lot boundaries adjacent to Fisherman's Road which are at right angles and considered generally unsuitable for supporting the construction of linear infrastructure. It is noted that an electrical substation is already located on the adjacent land parcel to the west of the Site (Lot 2 on SP200899) within the MTSC Precinct. The Proposal assumes a 60 m corridor within the MTSC Precinct (to the south-east of the Site) will be maintained during both construction and operation to allow connectivity for future linear infrastructure between the north-east and south-west of the Site. In relation to future linear infrastructure, typical right of way (ROW) widths for underground pipelines range from 6 m to 40 m. The use of the site for chlorine storage will not hinder the ability for the proposed 60 m MTSC Precinct adjacent to the GWT facility to be used for a range of linear infrastructure, without the need for further buffers from the site footprint (refer to Appendix D).
b) Development in the precinct is to: i. minimise construction and operation footprints and follow a logical sequence of development to maximise opportunities for future linear infrastructure	Complies The design approach is focused on ensuring the Proposal uses both land and infrastructure as efficiently as possible to minimise environmental impacts, as well as operational costs. The conceptual layout (refer to Appendix C) will be further refined to this end as the Proposal proceeds to detailed design. The Proposal assumes a 60 m corridor within the MTSC Precinct (to the south-east of the Site) will be maintained during both construction and operation to allow connectivity for future linear infrastructure between the north-east and south-west of the Site. In relation to future linear infrastructure, typical ROW widths for underground pipelines range from 6 m to 40 m.

Preferred Development Intent	Statement of Compliance
ii. avoid adverse impacts on existing infrastructure	Complies There is no existing infrastructure traversing through the MTSC Precinct at this location based on Before You Dig Australia (BYDA), with the exception of Telstra underground communication cables which traverse across Lot 1 on MPH32292. An underground cable locator will be engaged to validate the mapped service location prior to earth disturbing activities being undertaken.
iii. provide and maintain access to the corridor for the construction, operation, and maintenance of existing and future linear infrastructure	Complies The proposed layout (refer to Figure 1.1 and Appendix C) maintains access to the corridor for construction, operation and maintenance of future linear infrastructure (refer to response a) and b)i.). Existing Telstra infrastructure as described in the response to b)ii. does not need to be restricted to the MTSC Precinct.
iv. co-exist with other linear infrastructure internal and external to the Gladstone SDA	Complies The proposed layout (refer to Figure 1.1 and Appendix C) and process design will allow for other linear infrastructure to co-exist within the proposed 60 m MTSC Precinct (refer to response a) and b)i.). Impacts to the Telstra underground communication cables will be mitigated as described in the response to b)ii.
v. recognises and manages adverse impacts to sensitive land uses adjacent to the Gladstone SDA.	Complies The nearest sensitive land uses adjacent to the Site are residents located approximately 3.7 km to the west, the Yarwun township approximately 4 km to the south-west and potential recreational uses of Port Curtis a minimum of 500 m away (noting this is also the busy Gladstone Port waterway). Within the GSDA approximately 500 m to the north-west of the Site is the home of the Gladstone Model Aero Club. The Proposal will require a MHF licence as it will exceed the threshold for chlorine storage in Schedule 15 of the WHS Reg. As a MHF, the Proposal will be subject to a rigorous, legally enforced framework for identifying, controlling, and continuously improving safety measures to prevent catastrophic incidents (refer to Appendix B.3: Safety Solutions Hazard Assessment Report).

Table B.4: Assessment against SDA wide assessment criteria

SDA wide assessment criteria	Statement of compliance
2.5.1 Infrastructure and services	
(1) Development: (a) is designed to maximise efficiency and minimise the cost for infrastructure and services (b) plans for and manages its impacts on existing and planned infrastructure and services (c) is adequately serviced by the infrastructure and services necessary to meet the demand generated by the development (d) integrates with existing and planned infrastructure and services where possible. *Note: infrastructure and services include telecommunications, transport (including corridors and operations), water, wastewater, recycled water and energy networks, and state or local government infrastructure and services.*	Complies (a) The Proposal will be designed to maximise efficiency and minimise infrastructure costs, as far as practicable. (b) Refer to responses provided at Table B.3. (c) The Proposal will be serviced by reticulated water, power, and suitable access to meet the demand generated by construction and operation. (d) Refer to responses provided at Table B.3.
2.5.2 Transport	
(1) Increased traffic arising from the development is either able to be accommodated within existing road networks, or works are undertaken to minimise adverse impacts on existing and future uses and road networks.	Complies The TIA prepared for the Proposal (refer to Appendix K) identified that turn treatments are required for the proposed Fisherman's / Landing Road intersection. Options include acquisition of land on the south-east corner of the intersection or relocating the proposed development access directly onto Landing Road, as presented in the Planning Report. All other roads and intersection in the impact assessment area are currently approved for use by B-doubles up to 26m in length (which is the maximum size anticipated by the Proposal). Risk assessment of existing road safety issues concluded that the proposed development will not increase the risk score of any existing risk items above their "without development" level and no action is required to mitigate existing road safety issues. Refer also to responses to State code 6: Protection of State transport networks provided in Appendix B.2.

SDA wide assessment criteria	Statement of compliance
(2) Road networks in the Gladstone SDA are designed to accommodate the proposed vehicle type and predicted traffic volumes associated with the development and the precinct/s.	Complies Refer to response to 1.5.2(1). Any changes to the road environment within the GSDA will be subject to a road safety audit by an accredited road safety auditor at the detailed design stage.
(3) Development is designed to facilitate safe and efficient vehicular ingress and egress and does not unduly impact on the safe and efficient operation of transport infrastructure, including corridors.	Complies Safe and efficient vehicle ingress and egress will be accommodated in accordance with the recommendations of the TIA (refer to Appendix K). Refer also to response to 1.5.2(1) and (2).
(4) Adequate onsite parking for the number and nature of vehicles expected is provided.	Complies Adequate onsite parking for the number and nature of vehicles will be provided (refer to Appendix C).
2.5.3 Environmental nuisance	
(1) Development is located, designed, and operated to avoid, minimise or manage: (a) adverse impacts from air, noise and other emissions that will affect the environment and/or health and safety, wellbeing, and amenity of communities and individuals (b) conflicts with sensitive uses arising from (but not limited to) spray drift, odour, noise, light spill, dust, smoke, or ash emissions.	Complies Due to the Site location and surrounding land uses, negligible nuisance impacts from the Proposal are expected. Environmental nuisance risks will be managed in accordance with the strategies outlined in the EMP (refer to Appendix L). Refer also to response to 2.5.3(2).
(2) The location, design and operation of development achieves the relevant acoustic objectives of the *Environmental Protection (Noise) Policy 2019* and achieves the relevant air quality objectives of the *Environmental Protection (Air) Policy 2019.*	Complies Noise from the operation is expected to readily comply with the noise level goals and acoustic quality objectives at sensitive receptors, with a "no response" response from shorebirds in the intertidal area (refer to Appendix I). The impact of dust emissions on sensitive receptors during the construction phase were identified as negligible. The key operational emission sources will be the waste gas dechlorination stack (Cl_2 emissions) and HCl vent burner stack (Cl_2 and HCl emissions). Both emissions complied with the relevant assessment criteria, with the highest concentration of either pollutant anywhere in the model domain predicted to be less than 0.3 % of the relevant air quality assessment criteria (refer to Appendix G).

SDA wide assessment criteria	Statement of compliance
(3) Development: (a) avoids adverse impacts on the cumulative air quality of the Gladstone airshed or (b) where impacts cannot be avoided, conducts air shed modelling in accordance with current best practice to demonstrate compliance with air quality standards.	Complies There is no representative ambient air quality monitoring data for the air pollutants that are associated with the Proposal (Cl_2 and HCl. Therefore, the assessment of the potential impact of the Proposal has been conducted for the Proposal in isolation (refer to Appendix G). Based on this assessment, recognised techniques for dispersion modelling and emission estimation identified negligible emission impacts to sensitive receptors and the surrounding environment (refer to response to 2.5.3(2)).
2.5.4 Contaminated land	
(1) Development on land likely to be contaminated or recorded on the Environmental Management Register or Contaminated Land Register does not adversely impact on human health or the environment by exposure, management, or movement of contaminants. *Note: Refer to Department of Environment and Science (DES) if a site is subject to a per-and poly-fluoroalkyl substances site investigation.*	Complies The Site is not on the DETSI EMR or CLR, and preliminary assessments do not indicate that the Site is contaminated (refer to Appendix A and Appendix J).
(2) Where required, develop a strategy to manage any existing contamination and the potential for additional contamination, so that human health and the environment are not adversely affected.	Complies The Site is not on the DETSI EMR or CLR, and preliminary assessments do not indicate that the Site is contaminated (refer to Appendix A and Appendix J). Appropriate measures will be put in place during construction and operation to avoid the Site becoming contaminated due to the Proposal (refer to Appendix L).
2.5.5 Natural hazards	
(1) Development, in accordance with current best practice: (a) identifies relevant natural hazards that may impact upon the project (b) appropriately manages risk associated with identified hazards (c) avoids increasing the severity of natural hazards (d) avoids adverse impacts from natural hazards to protect people and property and enhances the community's resilience to natural hazards, or where adverse impacts cannot be avoided, impacts are minimised, mitigated, or offset	Complies The Site is identified as of Medium Potential Bushfire Intensity under the SPP's Bushfire Prone Area mapping and the GRC Planning Scheme Bushfire Hazard Overlay. This risk of bushfire will be mitigated through clearing of vegetation as part of self-assessable OPW. The eastern portion of the Site is mapped as within the Level 1 Flood Hazard Area under the SPP's Queensland Floodplain Assessment Overlay. This mapping is not intended to predict riverine flooding for specific land parcels, rather serves as an interim assessment to help local government authorities identify areas that may need

SDA wide assessment criteria	Statement of compliance
(e) avoids directly or indirectly increasing the severity of coastal erosion either on or off the site.	further refinement.[1] The Site is not identified as within the Flood Hazard or Coastal Hazard Overlays under the GRC Planning Scheme, although the latter is associated with Boat Creek to the south of the Site. The Proposal will manage the projected impacts of climate change (e.g., increased rainfall, cyclone activity and bushfires) through the operational EMP (to be ISO 14001 certified), WHSMP (to be ISO 45001 certified) and ERP. The ERP will include a Bushfire Emergency Management and Evacuation Plan prepared in accordance with the requirements of Australian Standard *AS3745-2010 Planning for Emergencies in facilities.*
(2) Development, in accordance with current best practice, achieves an appropriate level of flood immunity and: (a) does not adversely affect existing flow rates, flood heights, or cause or contribute to other flooding impacts on upstream, downstream, and adjacent properties, or the state transport network (including potential impacts from changes to stormwater flows and local flooding).	Complies The Site is not located in a flood affected area (refer to response to 2.5.5(1). The Site stormwater system is being designed by Prudentia and construction will be signed by an RPEQ. Downstream impacts will be managed by capturing stormwater in the proposed stormwater detention basin as depicted in ESCP and SWMP drawings (refer to Appendix C and D of the EMP at Appendix L).
2.5.6 Climate change	
(1) Development: (a) Avoids or, if avoidance cannot be achieved, minimises net increases in the emission of greenhouse gases (b) Can adapt to current and future impacts of a changing climate. *Note: projected climate change conditions include potential impacts from sea level rises, increased maximum cyclone intensity, increased rainfall intensity or increased likelihood and intensity of bushfires.*	Complies GWT is committed to ensuring that the Proposal contributes to the transition to a low emissions global economy, whilst manufacturing essential chemicals for the region. The Proposal will result in a 25% reduction in energy use (Scope 2 emissions) compared to the existing domestic supplier (base case) through design and procurement of best practice and highest efficiency production technology. Reductions in emissions will also be realised through the provision of a local alternative to chemical import shipping. A greenhouse gas abatement plan has been prepared for the Proposal (refer to Appendix H). The Proposal will manage the projected impacts of climate change (e.g., increased rainfall, cyclone activity and bushfires) through the EMP, WHSMP and ERP.

[1] Queensland Government (2024) Queensland Floodplain Assessment Overlay. Available at: https://www.qld.gov.au/emergency/dealing-disasters/disaster-types/flood/for-councils-and-flood-practitioners/flood-data-and-resources/queensland-floodplain-assessment-overlay

SDA wide assessment criteria	Statement of compliance
2.5.7 Acid sulfate soils	
(1) Development, in accordance with current best practice, is to: (a) avoid the disturbance of acid sulfate soils (ASS) or (b) ensure that the disturbance of ASS avoids or minimises the mobilisation and release of contaminants.	Complies The Proposal is located within the ASS 5 to 20 mAHD overlay of the GRC Planning Scheme. A preliminary ASS assessment was undertaken on the Site, with results from samples collected from three boreholes to five metres not supporting the presence of ASS in concentrations that would necessitate any further assessment (refer to Appendix J). Appropriate measures will be put in place during construction should ASS be encountered due to the Proposal (refer to Appendix L).
2.5.8 Water quality	
(1) Consistent with the Environmental Protection (Water and Wetland Biodiversity) Policy 2019, development avoids or, if avoidance cannot be achieved, minimises, mitigates or offsets adverse impacts on the environmental values and water quality objectives of receiving waters and wetlands arising from: (a) altered stormwater quality and/or flow (b) wastewater (other than contaminated stormwater and sewage) (c) the creation or expansion of regulated structures or non-tidal artificial waterways (d) the release and mobilisation of nutrients and sediments.	Complies Appropriate erosion and sediment control measures will be implemented during construction to protect and maintain water quality values (refer to Appendix C of the EMP at Appendix L). During operations the Site surface will be stabilised, with appropriate stormwater controls in place (refer to Appendix D of the EMP at Appendix L). Comprehensive bunding, collection and treatment systems will be designed to prevent contamination during spill scenarios. No contaminated wastewater will be discharged to the environment, where not able to be reused in the process wastewater will be transported offsite by an appropriately licensed contractor (refer to Appendix L).
(2) Development encourages a precinct-wide stormwater management approach that achieves an improved water quality outcome.	Complies The construction erosion and sediment control and operational stormwater management measures proposed take into account the catchment context, with potential impacts to be managed in accordance with the EMP (refer to Appendix C and D of Appendix L). Stabilisation of the Site post-construction will minimise ongoing risks during operation.

SDA wide assessment criteria	Statement of compliance
(3) Development protects the ecological and hydraulic function of waterway corridors in and adjacent to the Gladstone SDA, with particular regard to the Great Barrier Reef World Heritage Area, fish passage and marine plants.	Complies The Proposal will not directly impact the GBRWHA, fish passage or marine plants. The Proposal is setback from Boat Creek (mapped watercourses under the *Water Act 2000 (Qld)*) which is located approximately 250 m to the south portion of the Site. Refer to response to 2.5.8(1) and (2).
2.5.9 Risk management – activities	
(1) Development is located, designed, and operated to: (a) minimise the health and safety risks to communities and individuals (b) avoid any potential adverse impacts from emissions and hazardous activities, or where adverse impacts cannot be avoided, impacts are minimised or mitigated (c) protect high pressure gas pipelines from encroachment that would compromise the ability of the pipelines to function safely and effectively.	Complies The Proposal will require a MHF licence as it will exceed the threshold for chlorine storage in Schedule 15 of the WHS Reg. As a MHF, the Proposal will be subject to a rigorous, legally enforced framework for identifying, controlling, and continuously improving safety measures to prevent catastrophic incidents. These measures will require the facility's operations to identify and control major incident hazards (through comprehensive safety management systems and detailed safety cases), collaborate with emergency services and engage with local communities (refer to Appendix B.3: Safety Solutions Hazard Assessment Report). The use of the site for chlorine storage will not hinder the ability for the proposed 60 m MTSC Precinct adjacent to the GWT facility to be used for a range of linear infrastructure, without the need for further buffers from the site footprint (refer to Appendix D).
(2) Activities involving the use, storage, and disposal of hazardous materials and prescribed hazardous chemicals, dangerous goods, and flammable or combustible substances are located and managed to minimise the health and safety risks to communities and individuals.	Complies Refer to response to 2.5.9(1) and (3).
(3) Development provides adequate protection from the harmful effects of noxious and hazardous materials and chemicals manufactured or stored in bulk during natural hazard events.	Complies The Proposal design aims to (in order of preference in accordance with the waste and safety management system hierarchy) eliminate, substitute, isolate or apply engineering controls to manage the risk of harmful effects of noxious and hazardous materials during their manufacture and storage under routine and emergency situations. Where personnel involvement is required in relation to these controls, and for lower level controls (administrative and personal protective equipment)

SDA wide assessment criteria	Statement of compliance
	requirements will be communicated through the EMP, WHSMP and ERP. Refer also to response to 2.5.9(1).
2.5.10 Cultural heritage and community	
(1) Indigenous and non-Indigenous cultural heritage values, and community values of the premises on which the development is undertaken, and immediate surrounds, are identified and managed, consistent with current best practice. *Note: Duty of Care under Section 23 of the Aboriginal Cultural Heritage Act 2003 should be considered a minimum requirement of all development.*	Complies The GSDA location was selected to minimise impact on the community from heavy industry. The nearest sensitive land uses adjacent to the Site are residents located approximately 3.7 km to the west, the Yarwun township approximately 4 km to the south-west and potential recreational uses of Port Curtis a minimum of 500 m away (noting this is also the busy Gladstone Port waterway). The FNBGGGTB People, as Traditional Owners of the Site, have been involved throughout the initial site assessment process. No cultural heritage values have been registered on the Site (refer to Appendix N), however, a cultural heritage assessment will be undertaken prior to commencement of any ground disturbing activities in accordance with the Aboriginal Cultural Heritage Act 2003: Duty of Care Guidelines.
(2) Development is located, designed and operated to avoid adverse impacts on cultural heritage and community values, or where adverse impacts cannot be avoided, impacts are minimised, mitigated, or offset.	Complies Refer to response to 2.5.10(1). Potential impacts will be managed in accordance with the EMP (refer to Appendix L).
(3) Development recognises and protects the cultural heritage values associated with: (a) the Euroa Homestead on Lot 200 on SP239672 (b) the Mount Larcombe Station Original Homestead Site on Lot 73 on SP272417 and Lot 20 on SP272417 (c) the Targinnie Cemetery on Lot 95 on DS287.	Not applicable The Proposal does not impact upon the listed sites, being approximately 3.5 km away from the nearest (Targinnie Cemetery).
(4) Where development requires a buffer to mitigate the adverse amenity impacts of the development, including, but not limited to, visual and acoustic impacts, that buffer is accommodated within the development site.	Not applicable A buffer is not required to mitigate visual or acoustic impacts (refer to responses to 2.5.3 and 2.5.15).

SDA wide assessment criteria	Statement of compliance
2.5.11 Environment	
(1) Environmental values of the premises on which the development is undertaken, and immediate surrounds are identified and managed, consistent with current best practice.	Complies Environmental values have been identified and measures to mitigate impacts recommended through various technical reports attached to the Planning Report. The Proposal will be managed in accordance with the EMP (refer to Appendix L) which has been prepared in consideration of the recommended mitigation measures.
(2) Development is located, designed, and operated to: (a) avoid adverse impacts on environmental values including matters of local, state, and national environmental significance or where adverse impacts cannot be avoided, impacts are minimised, mitigated, or offset (b) maintain ecological connectivity and processes (c) maintain the outstanding universal value (OUV) of the Great Barrier Reef World Heritage Area including the local attributes of the OUV identified in the Master plan for the Priority Port of Gladstone and Port overlay (d) retain, to the greatest extent possible, tidal fish habitat and marine plants.	Complies A significant impact assessment undertaken on matters considered likely or known to occur on the Site based on desktop reviews and site-specific ecological surveys indicated that no significant residual impact to MNES species or MSES species habitat was considered likely, provided appropriate mitigation measures are implemented as outlined in the ecological assessment (refer to Appendix E) and the EMP (refer to Appendix L). The Proposal will not directly impact the GBRWHA OUV, tidal fish habitat passage or marine plants. The Proposal is setback from Boat Creek (mapped watercourses under the Water Act 2000) which is located approximately 250 m to the south portion of the Site. Appropriate erosion and sediment control measures will be implemented during construction to protect and maintain water quality values (refer to Appendix C of the EMP at Appendix L). During operations the Site surface will be stabilised, with appropriate stormwater controls in place (refer to Appendix D of the EMP at Appendix L). Comprehensive bunding, collection and treatment systems will be designed to prevent contamination during spill scenarios. No contaminated wastewater will be discharged to the environment, where not able to be reused in the process wastewater will be transported offsite by an appropriately licensed contractor (refer to Appendix L).
(3) Any residual significant adverse impacts are offset in accordance with the relevant Commonwealth or Queensland environmental offset framework.	Not applicable A significant impact assessment undertaken on matters considered likely or known to occur on the Site based on desktop reviews and site-specific ecological surveys indicated that no significant residual impact to MNES species or MSES species habitat was considered likely, provided appropriate mitigation measures are

SDA wide assessment criteria	Statement of compliance
	implemented as outlined in the ecological assessment (refer to Appendix E) and the EMP (refer to Appendix L). OPW for the clearing of regulated regrowth vegetation can be undertaken as a SDA self-assessable development, where associated with a MCU and / or RaL authorised by an SDA approval. Therefore, no offsetting of residual impacts is required.
(4) Lighting associated with the construction and operation of development is designed to limit the impacts on aquatic wildlife, including turtles and migratory species.	Not applicable Due to the Site's location approximately 1.5 km from the intertidal zone, impacts to aquatic wildlife are not anticipated. In any case, outdoor lighting will be designed, installed and maintained in accordance with Australian Standard 4282: Control of the obtrusive effects of outdoor lighting (refer to Appendix L).
(5) Where development requires a buffer to mitigate the impacts of the development, that buffer must be accommodated within the development site.	Not applicable No buffers are identified as required (refer to responses to 2.5.9 and 2.5.10(4)).
(6) Development avoids native vegetation clearing, or where avoidance is not reasonably possible, minimises clearing to: (a) conserve vegetation (b) avoid land degradation (c) avoid fragmentation and conserve connectivity.	Complies The Proposal cannot avoid clearing vegetation present on the Site, described as regrowth vegetation with scattered remnant trees. A significant impact assessment undertaken on matters considered likely or known to occur on the Site based on desktop reviews and site-specific ecological surveys indicated that no significant residual impact to MNES species or MSES species habitat was considered likely, provided appropriate mitigation measures are implemented as outlined in the ecological assessment (refer to Appendix E) and EMP (refer to Appendix L). OPW for the clearing of regulated regrowth vegetation can be undertaken as a SDA self-assessable development, where associated with a MCU and / or RaL authorised by an SDA approval. Land degradation and indirect ecological impacts will be avoided through implementation of measures outlined in the EMP (refer to Appendix L).
2.5.12 Engineering and Design Standards	
(1) Development is to be designed and constructed in accordance with the relevant engineering and design standards (and any subsequent revisions to the relevant standards) stated in Table 7	Complies

SDA wide assessment criteria	Statement of compliance
below. Alternative and innovative solutions that demonstrate compliance with the relevant standards are encouraged	Relevant engineering and design standards as listed under section 2.5.12 Table 7 of the Development Scheme will be applied during Proposal design and construction. The Proposal is being designed by appropriately qualified engineers i.e., TKN for the chemical process and Prudentia for the balance of the plan and integration. All design works and as constructed drawings will be signed off by an RPEQ prior to handover. Construction will be undertaken in accordance with approval requirements (including the SDA approval) and a series of managed plans including but not limited to a Construction Management Plan and subsidiary EMP, WHSMP and ERP.
2.5.13 Other government matters	
(1) Development is to demonstrate consistency with any other relevant legislative requirements that may be necessary for the development to proceed and to the extent practicable, be consistent with regional plans, the State Planning Policy, the Port Overlay for the priority Port of Gladstone, and the State Development Assessment Provisions, where the State interests articulated by these instruments are likely to be affected by the development.	Complies Refer to the Planning Report for statements concerning the SPP and Central Queensland Regional Plan. Refer to a response to State code 6: Protection of State transport networks and State code 21: Hazardous chemical facilities provided in Appendix B.2 and Appendix B.3 respectively. Refer to a response to GRC Planning Scheme Bushfire Hazard Overlay code in Appendix F. These responses indicate general consistency with these requirements, with any departures considered reasonable and appropriately managed to facilitate this critical infrastructure addressing a sovereign risk to be located within the GSDA designated for such facilities.
(2) Development recognises and protects the long-term availability of the extractive resource and access related to the Targinnie Key Resource Area (Number 119).	Not applicable The Proposal does not impact on key resource area 119.
(3) Development does not compromise existing or future port facilities and operation on Strategic Port Land.	Complies The Proposal will have no impact upon future port facilities or current operations over Strategic Port Land.
2.5.14 Energy and water efficiency	
(1) Building, site design, and layout maximises energy efficiency having regard to:	Complies The Proposal will result in a 25% reduction in energy use compared to the existing domestic supplier through design

SDA wide assessment criteria	Statement of compliance
(a) building orientation and passive solar design (b) maximising opportunities for cross ventilation (c) appropriate shade treatments (d) landscaping treatments to the western side of the building.	and procurement of best practice and highest efficiency production technology. Energy use will be monitored and reported on an ongoing basis (refer to Appendix H).
(2) Water efficiency is optimised with alternative water supply sources, including: (a) Rainwater harvesting systems (b) Recycled water source.	Complies The Proposal will be designed to be as water efficient as possible. The design is for a fully contained water management system, with wastewaters generated to be collected and treated for reuse in the process, where possible.
(2) Where practicable, development should be consistent with the Queensland government's renewable energy policies.	Complies The Proposal greenhouse gas abatement plan includes the key result area (KRAs) "Reduce Scope 2 emissions with investment in renewable energy technology where feasible and cost-effective". Performance against this, and other greenhouse gas abatement KRAs, are to be routinely monitored and reported on (refer to Appendix H and Appendix L).
2.5.15 Visual impacts	
(1) Visual impacts of buildings, retaining structures, or other development are minimised through building design, landscaping, and use of appropriate materials when viewed from a publicly accessible viewpoint such as major roads and the Mount Larcom landform.	Complies The Site is located on Fisherman's Road, setback from Landing Road (both local roads), and is not in proximity to a publicly accessible viewpoint. Visual impacts are not considered to be a significant issue, given this is a modest sized Proposal in an area of large industrial developments, with existing vegetation outside the Site (asset protection zone required for bushfire mitigation, refer to Section 2.5.5(1)) providing vegetative screening.
(2) Development maintains and enhances significant vegetation where possible and provides landscaping that: (a) minimises the visual impacts of the development (b) incorporates at least 50 per cent local species (c) is low maintenance.	Complies The Proposal cannot avoid clearing vegetation present on the Site, described as regrowth vegetation with scattered remnant trees. A significant impact assessment undertaken on matters considered likely or known to occur on the Site based on desktop reviews and site-specific ecological surveys indicated that no significant residual impact to MNES species or MSES species habitat was considered likely, provided appropriate mitigation

SDA wide assessment criteria	Statement of compliance
	measures are implemented as outlined in the ecological assessment (refer to Appendix E) and EMP (refer to Appendix L). Landscaping measures, consistent with bushfire hazard mitigation measures, will be implemented as outlined in the EMP (refer to Appendix L).
2.5.16 Reconfiguring a lot	
(1) Development provides lawful, safe and practical access.	Complies The Proposal will gain access from either Landing Road directly as the preferred access location, or via Fisherman's Road. The access will be designed and constructed to relevant standards. All design works and as constructed drawings will be signed off by an RPEQ prior to handover.
(2) Lot sizes are adequate to accommodate a development footprint consistent with the preferred development in each precinct. A range of lot sizes is preferred to accommodate development in each precinct. Minimum lot sizes for development precincts are generally consistent with the following: (a) Port Related Industry Precinct – 2 hectares (ha) (b) High Impact Industry Precinct – 10 ha (c) Medium Impact Industry Precinct - 2 ha (d) Industry Investigation Precinct – 2 ha	Complies The proposed lease boundary (lot size) of approximately 7.65 ha is adequate to accommodate the Proposal.

Table B.4 Assessment against the SDA wide requirements for SDA self-assessable development – operational works for the clearing of native vegetation

Number	SDA wide requirements	Requirements	Statement of compliance
1	Vegetation type	(1) Clearing is for the following vegetation: (a) regulated regrowth vegetation (b) an of concern regional ecosystem in a category B area (c) a least concern regional ecosystem in a category B area	Complies Clearing of regulated regrowth vegetation on the Site is required to facilitate the Proposal (refer to Appendix E for further details, including mapping).
2	Land use	(1) Clearing is associated with reconfiguring a lot that is authorised by an SDA approval or (2) clearing is associated with a material change of use that is authorised by an SDA approval and is for development listed in Schedule 1 Part 2 but (3) does not include development associated with animal husbandry, animal keeping or cropping.	(1) and (2) Complies The proposed clearing is associated with a RaL and MCU for a special industry (as defined in Schedule 1 Part 2 of the GSDA Development Scheme). Clearing activities may only be carried out following receipt of an SDA approval and in accordance with relevant conditions of the approval as a requirement of meeting the provisions of accepted development. (3) Not applicable The Proposal is for a chlor-alkali facility (special industry).

State code 6: Protection of state transport networks

Table 6.2 Development in general

Performance outcomes	Acceptable outcomes	Response
Network impacts		
PO1 Development does not compromise the safety of users of the **state-controlled road** network.	No acceptable outcome is prescribed.	**PO1 Complies** The TIA prepared for the Proposal (refer **Appendix K**) indicates that the proposed development will not increase the risk score of any existing risk items above their "without development" level and no action is required to mitigate existing road safety issues.
PO2 Development does not adversely impact the structural integrity or physical condition of a **state-controlled road** or **road transport infrastructure**.	No acceptable outcome is prescribed.	**PO2 Complies** The TIA prepared for the Proposal (refer to **Appendix K**) indicates that development will not significantly increase traffic volumes crossing any road transport infrastructure (i.e. bridges, culverts or railway lines). Development traffic vehicle types generated by the Proposal are approved on all routes used by the Proposal.
PO3 Development ensures **no net worsening** of the operating performance the **state-controlled road** network.	No acceptable outcome is prescribed.	**PO3 Complies** The TIA prepared for the Proposal (refer to **Appendix K**) compared development generated traffic to an opening year "without development" traffic during four identified peak periods. It was concluded that development may significantly increase turning movements between Gladstone – Mt Larcom Road and the Bruce Highway south of Gladstone – Mt Larcom Road It is noted that the above estimation of peak hour development traffic particularly HV traffic, is based on a number of conservative assumptions. In the case of turning movements between Gladstone – Mount Larcom Road and the Bruce Highway south of Gladstone – Mount Larcom Road these conservative

Performance outcomes	Acceptable outcomes	Response
		assumptions may have overestimated development traffic by more than 50%. Traffic on Gladstone – Mt Larcom Road westbound from Landing Road may have a significant impact in the short term if the development commences operation prior to 2028. Beyond this period, development impacts on State-controlled roads will not be significant. This is reflected in the pavement contributions calculations (refer **Appendix K**). Impacts to other sections of the state-controlled road network are <5% and do not warrant further assessment.
PO4 Traffic movements are not directed onto a **state-controlled road** where they can be accommodated on the **local road** network.	No acceptable outcome is prescribed.	**PO4 Complies** Development traffic uses a combination of local and State-controlled roads. Given the location of the Site, the use of State-controlled roads during both construction and operations cannot be avoided.
PO5 Development involving haulage exceeding 10,000 tonnes per year does not damage the pavement of a **state-controlled road**.	No acceptable outcome is prescribed.	**PO5 Complies** Haulage exceeding 10,000 tonnes per year will be relevant to the Proposal. The TIA prepared for the Proposal (refer to **Appendix K**) identified that if operations commence prior to 2028, a one-off pavement contribution would mitigate significant impact from the development (>5% of modelled "no development" traffic volumes). If operations do not commence until 2028 or later, the development impact on State-controlled road pavement will not be significant (<5%). Further, heavy vehicle movements involving B-doubles as proposed, are consistent with existing use of State-controlled roads. In accordance with the TIA prepared for the Proposal (refer **Appendix K**) GWT advise that construction activities are not expected to generate over-size-

Performance outcomes	Acceptable outcomes	Response
		over-mass (OSOM) vehicle movements or move vehicle movements than peak operations traffic. Therefore, construction traffic is expected to be no worse than operation traffic and only operations traffic has been assessed to mitigate both operations and construction impacts.
PO6 Development does not require a new **railway** level crossing.	No acceptable outcome is prescribed.	**PO6-PO13 Complies** In accordance with the TIA prepared for the Proposal (refer **Appendix K**) the Proposal will not significantly increase traffic volumes crossing any railway lines or result in safety concerns.
PO7 Development does not adversely impact the operating performance of an existing **railway crossing**.	No acceptable outcome is prescribed.	
PO8 Development does not adversely impact on the safety of an existing **railway crossing**.	No acceptable outcome is prescribed.	
PO9 Development is designed and constructed to allow for on-site circulation to ensure vehicles do not queue in a **railway crossing**.	No acceptable outcome is prescribed.	
PO10 Development does not create a safety hazard within the **railway corridor**.	No acceptable outcome is prescribed.	
PO11 Development does not adversely impact the operating performance of the **railway corridor**.	No acceptable outcome is prescribed.	
PO12 Development does not interfere with or obstruct the **railway transport infrastructure** or **other rail infrastructure**.	No acceptable outcome is prescribed.	
PO13 Development does not adversely impact the structural integrity or physical condition of a **railway corridor** or **rail transport infrastructure**.	No acceptable outcome is prescribed.	
Stormwater and overland flow		
PO14 Stormwater run-off or overland flow from the development site does not create or exacerbate a safety hazard for users of a **state transport corridor** or **state transport infrastructure**.	No acceptable outcome is prescribed.	**PO14-PO17 Not applicable** The Site is not located near a State transport corridor. The only impact to State transport corridors is via transport required during the construction and operational phases. As such there will be no stormwater run-off or overland
PO15 Stormwater run-off or overland flow from the development site does not result in a	No acceptable outcome is prescribed.	

Performance outcomes	Acceptable outcomes	Response
material worsening of operating performance of a **state transport corridor** or **state transport infrastructure**.		flow impacts from the Proposal on State transport infrastructure.
PO16 Stormwater run-off or overland flow from the development site does not interfere with the structural integrity or physical condition of the **state transport corridor** or **state transport infrastructure**.	No acceptable outcome is prescribed.	
PO17 Development associated with a **state-controlled road** or **road transport infrastructure** ensures that stormwater is lawfully discharged.	**AO17.1** Development does not create any new points of discharge to a **state transport corridor** or **state transport infrastructure**. AND **AO17.2** Development does not concentrate flows to a **state transport corridor**. AND **AO17.3** Stormwater run-off is discharged to a **lawful point of discharge**. AND **AO17.4** Development does not worsen the condition of an existing **lawful point of discharge** to a **state transport corridor** or **state transport infrastructure**.	
Flooding		
PO18 Development does not result in a material worsening of flooding impacts within a **state transport corridor** or **state transport infrastructure**	*For a **state-controlled road** or **road transport infrastructure**, all of the following apply:* **AO18.1** For all flood events up to 1% **annual exceedance probability**, development ensures there are negligible impacts (within +/- 10mm) to existing flood levels within a **state transport corridor**.	**PO18 Not applicable** The Site is not located near a State transport corridor. The only impact to State transport corridors is via transport required during the construction and operational phases. As such there will be no material worsening of flooding impacts on State transport infrastructure.

Performance outcomes	Acceptable outcomes	Response
	AND **AO18.2** For all flood events up to 1% **annual exceedance probability**, development ensures there are negligible impacts (up to a 10% increase) to existing peak velocities within a **state transport corridor**. AND **AO18.3** For all flood events up to 1% annual exceedance probability, development ensures there are negligible impacts (up to a 10% increase) to existing time of submergence of a **state transport corridor**. *No acceptable outcome is prescribed for a **railway corridor** or **rail transport infrastructure**.*	
Drainage infrastructure		
PO19 Drainage infrastructure does not create a safety hazard in a **state transport corridor**.	*For a **state-controlled road** environment, both of the following apply:* **AO19.1** Drainage infrastructure associated with, or in a **state-controlled road** is wholly contained within the development site, except at the **lawful point of discharge**. AND **AO19.2** Drainage infrastructure can be maintained without requiring access to a **state transport corridor**. *For a **railway** environment both of the following apply:*	**PO19-PO20 Not applicable**. The Site is not located near a State transport corridor. The only impact to State transport corridors is via transport required during the construction and operational phases. As such drainage infrastructure related to the Proposal will have no impact on a State transport corridor.

Performance outcomes	Acceptable outcomes	Response
	AO19.3 Drainage infrastructure associated with a **railway corridor** or **rail transport infrastructure** is wholly contained within the development site. AND **AO19.4** Drainage infrastructure can be maintained without requiring access to a **state transport corridor**.	
PO20 Drainage infrastructure associated with, or in a **state-controlled road** or **road transport infrastructure** is constructed and designed to ensure the structural integrity and physical condition of existing drainage infrastructure and the surrounding drainage network is maintained.	No acceptable outcome is prescribed.	
Planned upgrades		
PO21 Development does not impede delivery of **planned upgrades** of **state transport infrastructure**.	No acceptable outcome is prescribed.	**PO21 Not applicable** The Site is not located near a State transport corridor. The only impact to State transport corridors is via transport required during the construction and operational phases. As such the Proposal will not impede delivery of planned upgrades for State transport infrastructure.

Table 6.3 Public passenger transport infrastructure and active transport

Performance outcomes	Acceptable outcomes	Response
PO22 Development does not damage or interfere with **public passenger transport infrastructure**, **active transport infrastructure** or **public passenger services**.	No acceptable outcome is prescribed.	**PO22-PO25 Not applicable** There is no public passenger transport infrastructure, active transport infrastructure or public passenger services in the vicinity of the Site.
PO23 Development does not compromise the safety of **public passenger transport infrastructure**, **public passenger services** and **active transport infrastructure**.	No acceptable outcome is prescribed.	
PO24 Development does not adversely impact the operating performance of **public passenger transport infrastructure, public passenger services** and **active transport infrastructure**.	No acceptable outcome is prescribed.	
PO25 Development does not adversely impact the structural integrity or physical condition of **public passenger transport infrastructure** and **active transport infrastructure**.	No acceptable outcome is prescribed.	
PO26 Upgraded or new **public passenger transport infrastructure** and **active transport infrastructure** is provided to accommodate the demand for **public passenger transport** and **active transport** generated by the development.	No acceptable outcome is prescribed.	**PO26-PO28 Not applicable** There will be no demand for public passenger transport or active transport generated by the Proposal. As such, upgrades for public passenger or active transport infrastructure is not required.
PO27 Development is designed to ensure the location of **public passenger transport infrastructure** prioritises and enables efficient **public passenger services**.	No acceptable outcome is prescribed.	
PO28 Development enables the provision or extension of **public passenger services**, **public passenger transport infrastructure** and **active transport infrastructure** to the development and avoids creating indirect or inefficient routes for **public passenger services**.	No acceptable outcome is prescribed.	

Performance outcomes	Acceptable outcomes	Response
PO29 New or modified road networks are designed to enable development to be serviced by **public passenger services**.	**AO29.1** Roads catering for buses are arterial or **sub-arterial roads**, collector or their equivalent. AND **AO29.2** Roads intended to accommodate buses are designed and constructed in accordance with: 1. Road Planning and Design Manual, 2nd Edition, Volume 3 – Guide to Road Design; Department of Transport and Main Roads; 2. Supplement to Austroads Guide to Road Design (Parts 3, 4-4C and 6), Department of Transport and Main Roads; 3. Austroads Guide to Road Design (Parts 3, 4-4C and 6); 4. Austroads Design Vehicles and Turning Path Templates; 5. Queensland Manual of Uniform Traffic Control Devices, Part 13: Local Area Traffic Management and AS 1742.13-2009 Manual of Uniform Traffic Control Devices – Local Area Traffic Management; AND **AO29.3** Traffic calming devices are not installed on roads used for buses in accordance with section 2.3.2 Bus Route Infrastructure, Public Transport Infrastructure Manual, Department of Transport and Main Roads, 2015.	**PO29 Not applicable** There are no new or modified road networks required by the Proposal.
PO30 Development provides safe, direct and convenient access to existing and future **public passenger transport infrastructure** and **active transport infrastructure**.	No acceptable outcome is prescribed.	**PO30 Not applicable** Refer to response to PO22 to PO28.
PO31 On-site vehicular circulation ensures the safety of both **public passenger transport services** and pedestrians.	No acceptable outcome is prescribed.	**PO33 Not applicable** The Proposal will not generate any demand for public passenger transport services (refer to

Performance outcomes	Acceptable outcomes	Response
		response to PO32 and PO33). Dedicated pedestrian access will be provided and clearly identified on the Site in accordance with the WHSMP.
PO32 Taxi facilities are provided to accommodate the demand generated by the development.	No acceptable outcome is prescribed.	**PO32 Not applicable** The Proposal will not generate any demand for taxi facilities. The on-site visitor carpark would provide adequate facilities for taxis, if ever required.
PO33 Facilities are provided to accommodate the demand generated by the development for community transport services, courtesy transport services, and **booked hire services** other than taxis.	No acceptable outcome is prescribed.	**PO33 Not applicable** The Proposal will not generate any demand for booked hire services. The on-site visitor carpark would provide adequate facilities for booked hire services, if ever required.
PO34 Taxi facilities are located and designed to provide convenient, safe and equitable access for passengers.	**AO34.1** A **taxi facility** is provided parallel to the kerb and adjacent to the main entrance. AND **AO34.2 Taxi facilities** are designed in accordance with: 1. AS2890.5–1993 Parking facilities – on-street parking and AS1428.1–2009 Design for access and mobility – general requirements for access – new building work; 2. AS1742.11–1999 Parking controls – manual of uniform traffic control devices 3. AS/NZS 2890.6–2009 Parking facilities –off street parking for people with disabilities; 4. Disability standards for accessible public 5. transport 2002 made under section 31(1) of the Disability Discrimination Act 1992; 6. AS/NZS 1158.3.1 – Lighting for roads and public spaces, Part 3.1: Pedestrian area (category P) lighting – Performance and design requirements;	**PO34 Not applicable** Refer to response to PO32.

Performance outcomes	Acceptable outcomes	Response
	7. Chapter 7 Taxi Facilities, Public Transport Infrastructure Manual, Department of Transport and Main Roads, 2015.	
PO35 Educational establishments are designed to ensure the safe and efficient operation of **public passenger services**, pedestrian and cyclist access and **active transport infrastructure**.	**AO35.1** Educational establishments are designed in accordance with the provisions of the Planning for Safe Transport Infrastructure at Schools, Department of Transport and Main Roads, 2011.	**PO35 Not applicable** The Proposal is not for an educational establishment.

Hazard Assessment Report

GRENOF PROJECT HALOGEN FACILITY

Revision 1

A0335-REP-001

GRENOF

SAFETY SOLUTIONS

Revision Status

Rev	Date	Revision Description	Author	Reviewer	Approver
1	10/11/2025	Issued for use	G Platt	M Mitchell	J Brooks

Change Record

Rev	Description of Change
1	Minor changes following stakeholder review

Contents

Figures

Tables

Abbreviation	Definition
ACH	Air Changes per Hour (building air exchange rate)
ADG Code	Australian Dangerous Goods Code for the Transport of Dangerous Goods by Road and Rail
AEGL	Acute Exposure Guideline Levels
Barg	Bar (gauge)
EDQ	Economic Development Queensland
GHS	Globally Harmonized System
GSDA	Gladstone State Development Area
kg	kilogram
km	kilometres
kPa	Kilo pascals
m	metre
m/s	metres per second
MHF	Major Hazard Facility
mm	Millimetre
NCC	National Construction Code
ºC	Celsius
ppm	Parts per million
SDAP	State Development Assessment Provisions
SFARP	So Far As Reasonably Practicable
SIS	Safety Instrumented System
tpd	Tonnes per day
WHSQ	Workplace Health and Safety Queensland

1. Summary

This Hazard Assessment Report has been prepared in accordance with the requirements of Queensland State Code 21: Hazardous Chemical Facilities, as outlined in the State Planning Policy. The purpose of this report is to identify, evaluate, and mitigate potential risks associated with the proposed development of Grenof Project Halogen facility to be located at Yarwun in the Gladstone Region, Queensland.

This assessment addresses:

- Potential hazards arising from the facility's operations, including processing, storage and handling risks
- Risk control measures to reduce the likelihood and consequences of hazardous events
- Land use compatibility with surrounding sensitive receptors and infrastructure

The findings and recommendations contained within this report are intended to inform the development application process and support decision-making by the relevant assessment authorities.

It should be noted that the hazard assessment in this report is based on worst case unmitigated scenarios (i.e., with no controls in place) as required by State Code 21. This 'worst-case' methodology is adopted to ensure all potential hazards and impacts are comprehensively identified and not overlooked. This process is fundamental to implementing and validating the necessary preventative and mitigative controls, ensuring that risks in both design and operation are reduced to a level that is as low as far reasonably practicable (SFARP).

The proposed Grenof Project Halogen facility will utilise Thyssenkrupp Nucera's advanced Chlor-Alkali Electrolysis membrane-based technologies to produce chlorine, sodium hydroxide, sodium hypochlorite and hydrochloric Acid.

The hazard that the facility poses to the surrounding land uses is the potential release of chlorine from the processing and storage on site. Chlorine is a dense, toxic gas with physical and chemical properties that make it prone to wide dispersion if released. As chlorine is a heavier than air gas, dispersion clouds tend to sink and spread along low-lying areas. Under calm and stable conditions, without good lateral mixing in the air, concentrations dangerous to human health can extend significant distances. Consequence modelling for worst-case release scenarios under the least favourable weather conditions conducted as part of this hazard assessment confirmed this, and the relevant performance outcome requirements may not be met under these weather conditions.

A balanced assessment of the proposed Grenof Project Halogen development confirms its strong alignment with the overarching purpose statement of State Code 21. The project's design and siting are strategically focused on achieving the code's primary intent: ensuring that human

health, safety, and the built environment are protected from off-site risks from the chlor-alkali operations. This successful alignment with the code's purpose is considered the key finding of the report.

The key aspects in meeting the intent of the requirements of the code, can be summarised as follows:

- The proposed location for the Grenof Project Halogen facility is within the Gladstone State Development Area (GSDA), a designated industrial zone suitable for a facility such as this. It is compatible with other existing hazardous industries within area, and suitable separation from vulnerable and residential areas. This is an appropriate location for a facility such as Grenof's Project Halogen.
- The proposed Grenof Project Halogen facility will utilize Thyssenkrupp Nucera's advanced technology, recognized globally for high safety performance, energy efficiency, and environmental compatibility. The design utilises advanced engineering, automated controls, and operational discipline to significantly reduce the likelihood and impact of major incidents.
- The proposed Grenof Project Halogen facility will be licenced Major Hazard Facility (MHF), being subject to strict regulatory requirements including implementation of comprehensive safety management systems, and detailed safety cases. These measures will require the facility's operations to identify and control major incident hazards, collaborate with emergency services, and engage with local communities.

Through a comprehensive and systematic approach, this report demonstrates the proponent's commitment to safe and responsible industrial development in GSDA at Yarwun.

2. Site Location

2.1. Project Halogen Facility

Grenof Project Halogen facility is to be located on land managed by Economic Development Queensland (EDQ) in Yarwun, north of Gladstone in Queensland. The Project area is approximately 6.9ha which includes plant and ancillary facilities

The location is within the Gladstone State Development Area (GSDA) located on land at 56 Fisherman's Road, Yarwun, and 26 Landing Road, Yarwun.

The GSDA is a large, strategically designated industrial zone approximately 10km north of Gladstone. It was established by the Queensland Government to support and attract large-scale, complex industrial projects that are critical to the state's economic development.

The location of the Grenof Project Halogen facility in relation to other industrial facilities within the GSDA and localities is shown in Figure 1.

Figure 1 Project Halogen Facility Location

2.2. Surrounding Land Use

The purpose of State Code 21 is to ensure that hazardous chemical facilities in Queensland are planned, located, and designed in a way that protects public health, safety, and the environment from potential offsite impacts. Central to assessing compliance with the performance outcomes of the code is identifying land use or land zoned for the following land us types:

- vulnerable land use or land zoned for a vulnerable land use
- sensitive land use or land zoned for a sensitive land use
- commercial or community activity land use or land zoned for a commercial or community activity land use
- open space land use or land zoned for an open space land use
- industrial land use or land zoned for an industrial land use

The location of the Grenof Project Halogen facility in relation to surrounding land use is shown in Figure 2.

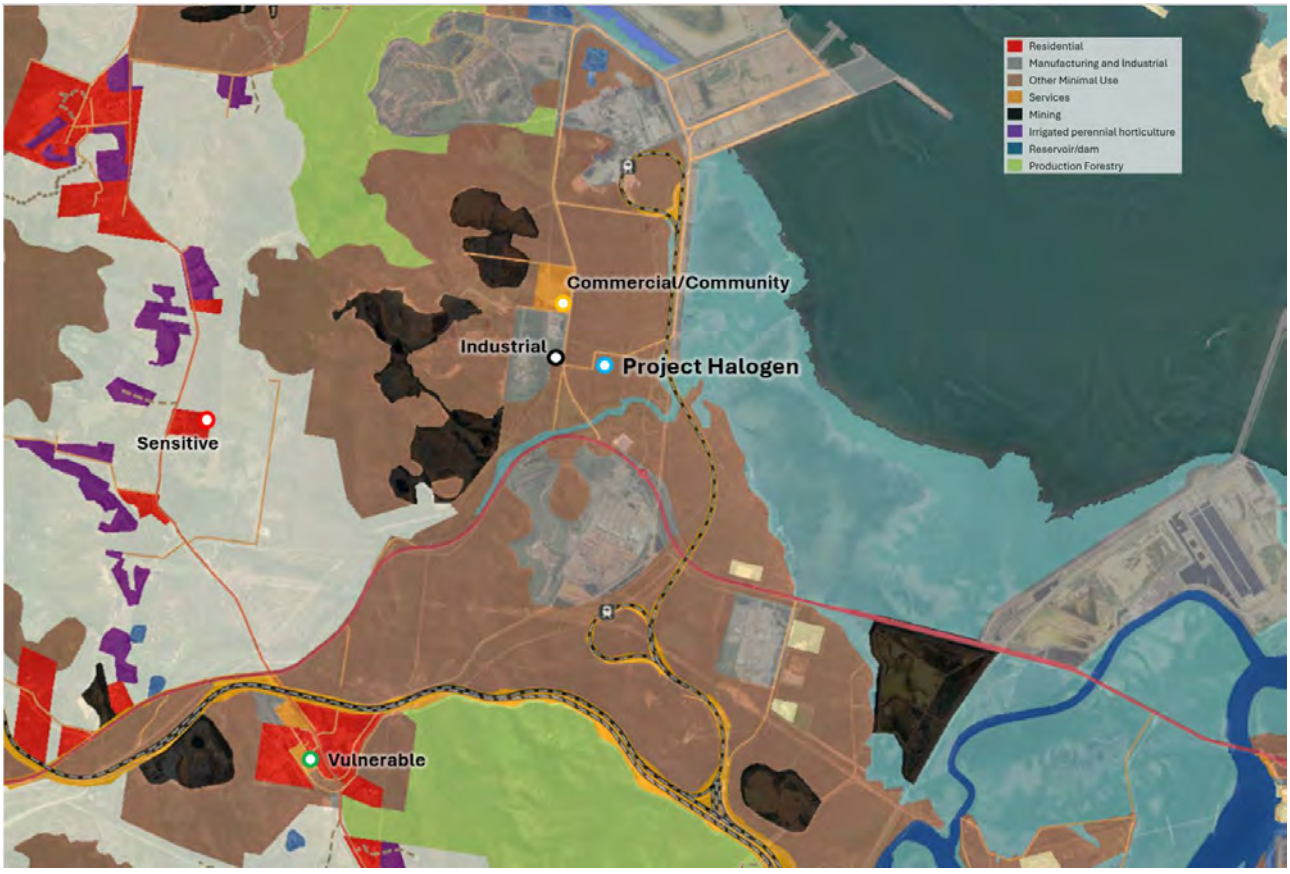


Figure 2 Surrounding Land Use Zones

The nearest land use locations to the proposed Grenof Project Halogen site as shown in Figure 2 are identified in Table 1 with approximate distances and direction from site.

Table 1 Surrounding Land Use

Land Use Zone	Identification	Distance	Direction
Vulnerable	Yarwun State School	4600 m	SW
Sensitive	Targinnie Rd residences	3600 m	W
Commercial / Community	Gladstone Model Aero Club	600 m	NW
Industrial	Northern Oil Refinery Cleanaway Industrial Waste Services	400 m	W

3. Hazardous Chemicals

3.1. Chemicals Stored and Handled

The Grenof Project Halogen facility is a chlor-alkali facility which will produce three primary chemicals—chlorine (Cl_2), hydrogen (H_2), and sodium hydroxide (NaOH) through the electrolysis of brine (saltwater).

In addition to these primary chemicals, the facility will also produce sodium hypochlorite (NaOCl) solution, and hydrochloric acid (HCl). Hydrogen peroxide (H_2O_2) solution and sulphuric acid (H_2SO_4) will also be used as an in-process chemical.

A summary of the hazards associated with each of these chemicals is provided in Appendix B.

3.2. Chlorine

Of particular interest in assessing the potential for offsite consequences is chlorine. Chlorine is classified as a hazardous substance under the criteria of Safe Work Australia's Globally Harmonized System (GHS) and classified as a Dangerous Good by the criteria of the Australian Dangerous Goods Code for the Transport of Dangerous Goods by Road and Rail (ADG Code).

Chlorine is a greenish-yellow gas at room temperature and has a pungent, irritating odour detectable at concentrations as low as 0.2 ppm. Chlorine is a highly toxic, corrosive gas that poses serious health risks upon inhalation, skin contact, or eye exposure. Inhalation is the most dangerous route. Chlorine gas reacts with moisture in the respiratory tract to form hydrochloric and hypochlorous acids, causing chemical burns.

The health effects of chlorine are as follows:

- Low concentrations (1–3 ppm): Can cause throat irritation, coughing, and chest tightness.
- Moderate concentrations (5–15 ppm): Lead to difficulty breathing, eye irritation, and pulmonary inflammation.
- High concentrations (>30 ppm): May cause acute respiratory distress, pulmonary edema, and potentially fatal outcomes.
- Chronic exposure: Can result in long-term respiratory damage and increased sensitivity to airborne irritants.

Chlorine gas is non-flammable but can cause fire or explosion when in contact with organic substances. It is heavier than air gas and can accumulate in low-lying areas or flow downhill, particularly in still air. Chlorine is highly corrosive to metals, particularly when moisture is present. Chlorine readily absorbs water from the atmosphere.

4. Process Description

The Grenof Project Halogen facility will utilise Thyssenkrupp Nucera's advanced Chlor-Alkali Electrolysis membrane-based technologies to produce chlorine, hydrogen and sodium hydroxide from brine (a solution of sodium chloride). The process is based on electrochemical decomposition of brine using membrane cell technology, which separates the anode and cathode compartments with an ion-selective membrane.

Pure brine solution prepared on site is fed into the electrolysis cells, consisting of an anode compartment and a cathode compartment separated by a cation-exchange membrane. In the anode compartment, chloride ions (Cl^-) are oxidized to form chlorine gas. In the cathode compartment, water molecules are reduced to produce hydrogen gas (H_2) and hydroxide ions (OH^-). The membrane selectively allows sodium ions (Na^+) to pass from the anode side to the cathode side, where they combine with hydroxide ions to form sodium hydroxide.

Following electrolysis, the products are separated and processed. Chlorine gas is cooled, dried, and compressed for liquefaction, storage and filling into 920kg drums and 70kg cylinders. Hydrogen gas is collected and used as a feedstock for hydrogen chloride (HCl) synthesis. The excess hydrogen gas is vented safely to atmosphere. Sodium hydroxide solution is concentrated and stored for distribution or further use at the facility. Additionally, the facility will also produce sodium hypochlorite solution.

The process is designed to minimise environmental impact through closed-loop systems, efficient gas handling, and low emissions. Safety systems are integrated to manage risks associated with chlorine and hydrogen production, including leak detection, emergency shutdown and an emergency waste gas dechlorination systems.

The Grenof Project Halogen facility will operate 24 hours per day, 365 days a year and is proposed to produce the following products:

- **Chlorine gas** - 90 tpd
- **Sodium Hydroxide 50% solution** - 100 tpd
- **Sodium Hypochlorite 12% solution** - 189 tpd
- **Hydrochloric Acid 33% solution** - 93 tpd

5. Hazard Identification Methods and Hazard Analysis

5.1. Methodology

The hazard assessment methodology with the performance outcomes and acceptable solutions outlined in *State Code 21: Hazardous Chemical Facilities*, part of the State Development Assessment Provisions (SDAP) under the Planning Regulation 2017 (Qld). The purpose is to identify, evaluate, and manage the risks associated with the hazardous chemicals stored, handled, and used at the proposed Grenof Project Halogen Facility.

This approach focused on identifying hazardous scenarios during the operation of the facility, and screening for the potential for offsite impacts. The extent of the impacts, with the particular focus on human health and safety at offsite locations, was assessed against the performance outcomes of State Code 21 and / or complies with the purpose statement of the code.

It should be noted that this screening and the subsequent consequence modelling are first conducted on an unmitigated basis (i.e., with no controls in place). This conservative 'worst-case' methodology ensures that all potential hazards are identified and not overlooked, forming the basis for implementing controls to minimise risks so far as reasonably practical as part of the project and operations.

5.2. Hazard Assessment

5.2.1. Hazard Identification

The hazard identification process for the Grenof Project Halogen facility was conducted with the primary objective of identifying credible scenarios involving hazardous materials with particular consideration to scenarios that could result in offsite impacts. The emphasis was placed on consequence-based scenario development, particularly those involving the release of chlorine and its potential for effects beyond the facility boundary on surrounding industries and communities.

The methodology adopted was structured and scenario-driven, taking a systematic review of the facility's design, operational parameters, and processes to identify potential initiating events that could lead to a loss of containment. Information relevant to the facility; including process flow diagrams, proposed site layout, and process and control descriptions were reviewed. Particular attention was given to the physical and chemical properties of chlorine, its processing and storage conditions, and the mechanisms by which it could be released into the atmosphere.

The chlorine process within the proposed facility is illustrated in Figure 3.

The process description and technical drawings for the proposed facility [2] provided by Thyssenkrupp Nucera, detailed the Chlor-Alkali Electrolysis and chlorine processes proposed for the Grenof Project Halogen facility. This document not only outlined and described the various

process and the function of the process areas, but it also provided information on the safety measures and controls inherent with the design to minimise the risk of unlikely chlorine releases.

The risk control measures are discussed in greater detail in section 6 of this document.

A simplified block flow diagram providing a high-level graphical representation of the chlorine processes at the Grenof Project Halogen facility outlining the major process areas and how chlorine and chlorine waste streams flow between them is illustrated in Figure 4.

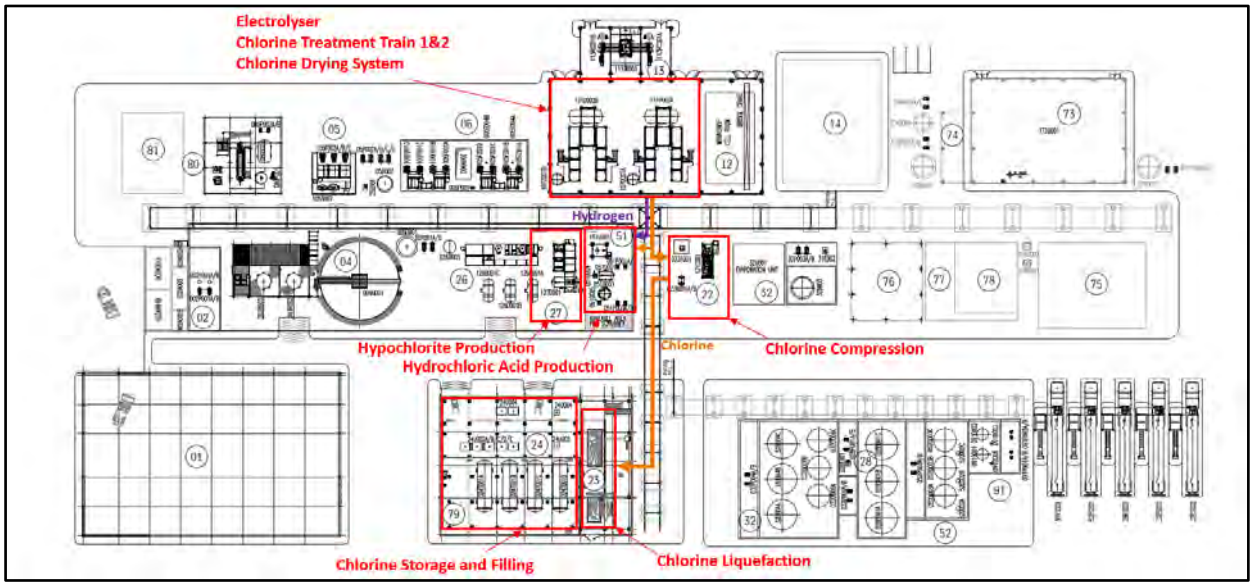


Figure 3 Facility Layout - Chlorine Process Overlay

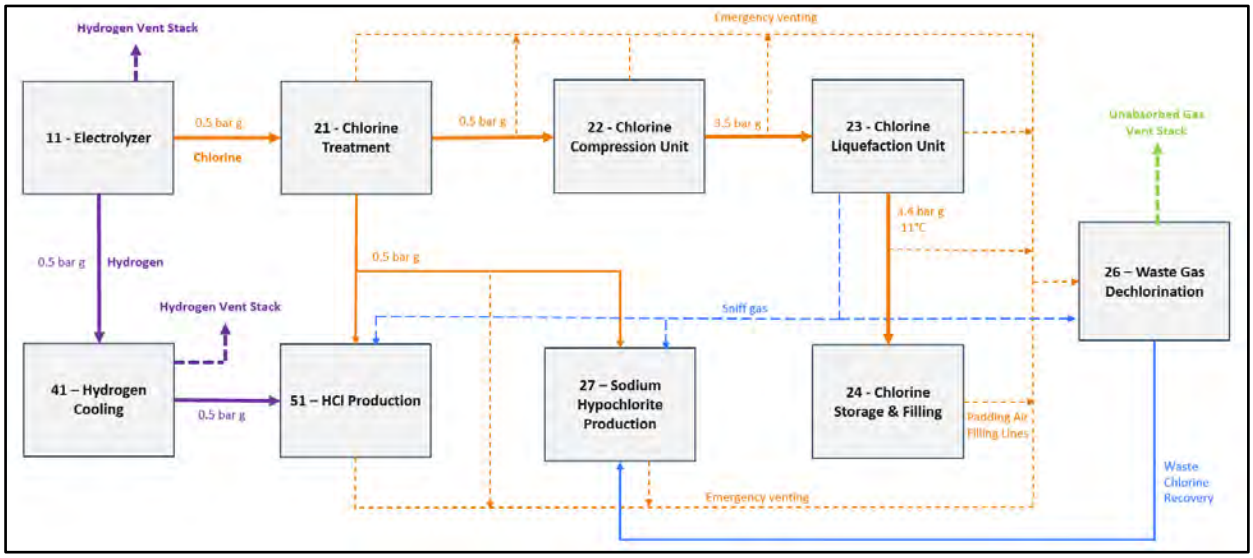


Figure 4 Simplified Chlorine Process Block Flow Diagram

5.2.2. Hazard Assessment Workshop

Hazard identification was conducted through a facilitated workshop with the session encouraging open discussion and brainstorming to explore plausible scenarios , without the proposed controls in place. Each scenario was developed based on the specific process areas, the materials and their process conditions, a defined initiating event and potential causes, such as equipment integrity failure, operational issues or external impact. The potential impacts of each risk scenario were identified, along with the planned preventative and mitigative control measures.

The Hazard Assessment Workshop was conducted virtually on 19th September 2025. involving experienced representatives from the Grenof team, with facilitation provided by Safety Solutions. The workshop provided a systematic and comprehensive identification of all possible scenarios that could lead to a hazardous incident at the facility, based on:

- Activities at the facility
- Natural events
- Malicious acts
- Hazardous events on neighbouring sites

And documented the following:

- Identified physical and chemical hazards
- Types of incidents that could result from each hazard and their causes
- Possible effects of each incident

The minutes of the workshop are provided in Appendix C.

5.2.3. Workshop Output

The preliminary hazard assessment identified a total of 30 hazardous material scenarios for further screening. These scenarios were derived from a range of potential initiating sources, including activities, potential interactions with neighbouring industrial facilities, exposure to natural hazards such as extreme weather or seismic events, and actions or influences from third parties.

Of the 30 scenarios, 15 specifically involved chlorine, with the potential to cause offsite impacts under certain release conditions.

These 15 scenarios were grouped into six top events. These six were selected for detailed consequence modelling to evaluate dispersion characteristics, impact zones, and risk to surrounding land uses in accordance with State Code 21 requirements.

The Top Events are provided in Table 2.

Table 2 Top Events for Consequence Modelling

Top Event	Event Description
A0335-MI-01	Release of Chlorine from Electrolyzer Building
A0335-MI-03	Release of Chlorine from HCl production unit
A0335-MI-04	Release of Chlorine from Hypochlorite production unit
A0335-MI-05	Release of Chlorine from Chlorine Compressor Building
A0335-MI-06	Release of Chlorine from transfer pipework between Chlorine Compressor Unit and Chlorine Liquefaction Unit
A0335-MI-07	Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)

5.3. Offsite Impact Scenarios

The Top Events identified for worst case scenario modelling for the identified scenarios are discussed in greater detail in the following tables.

Table 3 A0335-MI-01 - Release of Chlorine from Electrolyzer Building

Top Event	**A0335-MI-01 - Release of Chlorine from Electrolyzer Building**
Scenarios	**#1** Release of chlorine due to electrolyser leaks and/or piping flanges/connection leaks from anode**.** **#3** Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include !21E001 Chlorine Cooler 121E002 Chlorine Chiller, 121F001 Wet Chlorine Filter Mist Eliminator 121C001 Chlorine Drying Tower
Process Area(s)	**11 – Electrolyzer** **21 – Chlorine Treatment** Low pressure dry chlorine gas is produced in the Electrolyzer and is transferred to the Chlorine Treatment for dying at approximately 0.5 bar g. The Electrolyzer and Chlorine Treatment units are located within the 'sealed' *Electrolyzer Building* which is continually kept under slight negative by the Waste Gas Dechlorination System exhauster fans. The fans also provide the required suction on the chlorine lines, preventing chlorine to leak to the atmosphere from the plant.

Scenario Description	Potential for chlorine releases from the Electrolyzer and Chlorine Treatment units and/or from associated piping, flanges and connections. Causes may include corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, or improper component installation.
Discussion	The credible scenarios for releases from the Electrolyzer and Chlorine Treatment units are likely to be releases from piping, components and fittings
Assumptions	Various hole sizes to be evaluated in the 300mm piping. Isolatable inventory is assumed to be 250kg. (secondary processing stream – conservative assumption) The unit is within the 'sealed' *Electrolyzer Building*. Chlorine will be released from the building based on assumed building air exchange rate of ACH = 0.1 (Appendix D - sealed building assumptions); however consequence modelling not conducted as A0335-MI-03 and A0335-MI-04 will provide worst case results for this specific piping release scenario (i.e. open to the atmosphere)

Table 4 A0335-MI-03 Release of Chlorine from HCl production unit

Top Event	**A0335-MI-03 Release of Chlorine from HCl production unit**
Scenarios	**#4** Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include 151U001 HCl Synthesis Unit
Process Area	**51 – Hydrochloric Acid Production Unit** Low pressure dry chlorine gas from the Chlorine Drying Tower enters the HCl Synthesis Unit at approximately 0.5 bar g The HCl Synthesis Unit is located open to the atmosphere.
Scenario Description	Potential for chlorine releases from the HCl Synthesis Unit and/or from associated piping, flanges and connections. Causes may include corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, or improper component installation.
Discussion	The credible scenarios for releases from the Hydrochloric Acid Production Unit are likely to be releases from piping, components and fittings
Assumptions	Various hole sizes to be evaluated in the 300mm piping. Isolatable inventory is assumed to be 250kg. (secondary processing stream – conservative assumption)

Table 5 A0335-MI-04 Release of Chlorine from Hypochlorite Production Unit

Top Event	**A0335-MI-04 Release of Chlorine from Hypochlorite Production Unit**
Scenarios	**#5** Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include 127F001 Hypochlorite Ejector.
Process Area	**27 – Sodium Hypochlorite Production Unit** Low pressure dry chlorine gas from the Chlorine Drying Tower enters the Hypochlorite Production Unit at approximately 0.5 bar g The process unit is located open to the atmosphere.
Scenario Description	Potential for chlorine releases from the Hypochlorite Production Unit and/or from associated piping, flanges and connections. Causes may include corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, or improper component installation.
Discussion	The credible scenarios for releases from the Hypochlorite Production Unit are likely to be releases from piping, components and fittings
Assumptions	Various hole sizes to be evaluated in the 300mm piping. Isolatable inventory is assumed to be 250kg. (secondary processing stream – conservative assumption)

Table 6 A0335-MI-05 Release of Chlorine from Chlorine Compressor Building

Top Event	**A0335-MI-05 Release of Chlorine from Chlorine Compressor Building**
Scenarios	**#6** Release of chlorine due to equipment integrity Issues leading to process units and/or piping flanges/connection leaks. Process units include 122U001 Chlorine Compression Unit, 022F001 Dry Chlorine Filter Mist Eliminator **# 7** Release of chlorine due to operational issues leading to process units and/or piping flanges/connection leaks. Process units include 122U001 Chlorine Compression Unit, 022F001 Dry Chlorine Filter Mist Eliminator

Process Area	**22 - Chlorine Compression** Low pressure dry chlorine gas from the Chlorine Drying Tower enters the chlorine compression unit for pressurisation to 3.4 bar g (451 kPa a) in preparation for further processing in the Chlorine Liquefaction unit. The chlorine compression unit is located within the 'sealed' *Chlorine Compressor Building* which is continually kept under slight negative by the Waste Gas Dechlorination System exhauster fans. The fans also provide the required suction on the chlorine lines, preventing chlorine to leak to the atmosphere from the plant.
Scenario Discussion	Potential for chlorine releases from the compression units (Chlorine Compression Unit and Dry Chlorine Filter Mist Eliminator) and/or from associated piping, flanges and connections. Causes may include corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components, vibration, overheating, over pressurisation or improper component installation.
Assumptions	The unit is within the 'sealed' *Chlorine Compressor Building,* for the purposes of assessing worst case releases a release at production flow rate into the building (i.e. 90tpd chlorine rate), Chlorine releases from the building are based on assumed building air exchange rate of ACH = 0.1 (Appendix D - sealed building assumptions)

Table 7 A0335-MI-06 Release of Chlorine from transfer pipework

Top Event	**A0335-MI-06 Release of Chlorine from transfer pipework between Chlorine Compressor Unit and Chlorine Liquefaction Unit**
Scenarios	**#8** Release of chlorine due to pipe rupture (vehicle impact) on chlorine piping in pipe bridge between 22 - Chlorine Compression Unit and 23 - Chlorine Liquefaction Unit. Pipe bridge spans central roadway on site. **#9** Release of chlorine due to leak on chlorine piping in pipe bridge between 22 - Chlorine Compression Unit and 23 - Chlorine Liquefaction Unit.
Process Area	**Compressed Chlorine Piping between 22 - Chlorine Compression and 23 Chlorine Liquefaction process areas.** Compressed chlorine is piped from the chlorine compressor to the chlorine liquefaction unit across an internal facility roadway on an elevated pipe bridge. Chlorine gas within the piping is 3.4 bar g (451 kPa a).

Scenario Discussion	Potential releases from this chlorine piping will go directly to the surrounding atmosphere. Causes may include corrosion, stress corrosion cracking, flange and gasket failures, weld defects, improper installation, vibration and impact. The use of approved materials form the technology provider and limitation of flanges are used for elimination leaks, along with the operational software and failsafe control features. The pipe bridge is above an internal roadway, with the potential for uncontrolled vehicle movement to impact the pipe bridge structure or the chlorine piping directly. Vehicle movement on this section of the roadway is to be restricted / eliminated
Assumptions	Various hole sizes to be evaluated including 150mm full pipe diameter rupture. Isolatable inventory is assumed to be 1000kg. (15 minutes production)

Table 8 A0335-MI-07 Release of Chlorine from Liquid Chlorine Building

Top Event	**A0335-MI-07 Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)**
Scenarios	**#10** Release of chlorine due to equipment integrity Issues leading to process units and/or piping flanges/connection leaks. Process units include 123U001 Chlorine Liquefaction Unit **#11** Release of chlorine due to operational issues leading to process units and/or piping flanges/connection leaks. Process units include 123U001 Chlorine Liquefaction Unit **#12** Release of Chlorine from tank, drum and cylinder fill lines due to piping flanges and connections leaks **#13** Release of chlorine from chlorine tank leaks to due to corrosion, vessel integrity issue. **#14** Release of chlorine from chlorine tank leaks due to over-pressurisation or overfill. **#15** Release of chlorine from drum, cylinder leaks or associated piping due to equipment integrity issues. **#16** Release of chlorine from drum, cylinder leaks or associated piping due to operational issues.

Process Areas	**23 Chlorine Liquefaction** The dry and compressed chlorine gas enters the Chlorine Liquefaction Unit where it is liquefied. The chlorine liquefaction unit is located within the 'sealed' *Liquid Chlorine Building* which is continually kept under slight negative by the Waste Gas Dechlorination System exhauster fans. **24 - Chlorine Storage & Filling** Liquid chlorine (approximately at 3.4 bar g and -11°C) flows from the Chlorine Liquefaction Unit to the Liquid Chlorine Storage Tanks. These bulk storage tanks are located within the same 'sealed' *Liquid Chlorine Building,* There are three 20 t capacity bulk tanks in service, as well as an additional emergency 20 t capacity bulk tank which remains empty. Each tank is positioned within a bund to detain any accidental release of liquid chlorine from the storage tanks. Liquid chlorine is filled into 920kg drums or cylinders from the storage tanks. Chlorine gas from these filling stations is sent to Chlorine Absorption System via the liquid chlorine trap. The chlorine drum and cylinder filling operations are undertaken within the same 'sealed' *Liquid Chlorine Building,* which is continually kept under slight negative by the Waste Gas Dechlorination System exhauster fans.
Scenario Discussion	Potential for chlorine releases from the **Chlorine Liquefaction Unit** and/or from associated piping, flanges and connections. Causes may include corrosion, stress corrosion cracking, flange and gasket failures, compressor or pump seal leaks, heat exchanger leaks, valve failures, loose fittings or connections, worn components, ice formation, pressure imbalances, rapid cooling or heating cycles, or improper component installation. Potential for chlorine releases from the **bulk liquid chlorine storage tanks** and/or from associated piping, flanges and connections. Causes may include corrosion of tank walls, stress corrosion cracking, seal and gasket failure, weld defects, overfilling or over-pressuring, or improper component installation. Potential for chlorine releases from the **liquid chlorine storage drums, cylinders** and/or from associated piping, flanges and connections. Causes may include worn or improperly sealed valves, gaskets, or couplings, corroded pipework or fittings, faulty pressure relief valves, damaged containers or overfilling

Assumptions	The unit is within the 'sealed' *Liquid Chlorine Building,* for the purposes of assessing worst case releases from all sources will be a 20t chlorine tank instantaneous release into the building (i.e. 90tpd chlorine rate), Chlorine releases from the building are based on assumed building air exchange rate of ACH = 0.1 (Appendix D - sealed building assumptions)

5.4. Quantitative Assessment of Offsite Consequences

5.4.1. Consequence Modelling

Consequence modelling is the process of predicting and quantifying the physical impacts that might result from a hazardous release. Discharge models are created to estimate the rate of release of hazardous gases, liquids or a mix of both, and the amount released.

Dispersion models are then used to estimate concentration/time profiles of flammable or toxic gases at various distances downwind from the point of release.

Inputs required are the release characteristics, process conditions (pressure and temperature), weather, and site layout. Outputs provided will be impact distances, which can then be used in risk assessments and emergency response planning.

Vapour cloud behaviour is determined by a variety of factors including:

- the density of the gas relative to air,
- the rate of release over time,
- the amount of air entrainment at source,
- wind speed, and
- weather stability.

5.4.2. Weather Conditions

Yarwun, located on the central coast of Queensland, experiences a warm and humid subtropical climate characterized by hot, wet summers and mild, dry winters. The average annual temperature is approximately 22°C, with summer months (December to February) typically reaching highs of 30–32°C with lows around 21–23°C. In winter months (June to August) the day-time highs average around 22–24°C, with night-time lows of 12–14°C.

The area experiences predominantly easterly winds throughout the year, with average speeds ranging from 2.7 m/s to 5.6 m/s. Easterly winds dominate, especially from September to February, with winds shift slightly toward the southeast and south during winter months (June–August), winds shift slightly toward the southeast and south, though easterlies still prevail.

Rose of wind direction versus wind speed in km/h for the Gladstone area are provided in Appendix E.

5.4.3. Acute Exposure Guideline Levels

Acute Exposure Guideline Levels (AEGLs) are exposure guidelines designed to help responders deal with emergencies involving chemical spills or other catastrophic events where members of the general public are exposed to a hazardous airborne chemical.

AEGLs estimate the concentrations at which most people will begin to experience health effects if they are exposed to a hazardous chemical for a specific length of time (duration). For a given exposure duration, a chemical may have up to three AEGL values, each corresponding to a specific tier of health effects:

- AEGL-1: Notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.
- AEGL-2: Irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.
- AEGL-3: Life-threatening health effects or death.

AEGLs estimate how the general public would react to a release of this nature. For the purposes of addressing the State Code 21 requirements, the AEGL-2 value that is considered a *dangerous dose to human health*.

5.4.4. Consequence Modelling Results

Details of the consequence modelling conducted based on the potential off site impact scenarios identified in section 5.3, is provided in Appendix D.

Table 9 summarises the extent of the AEGL-2 distances for the worst-case scenario releases under the least favourable weather conditions, i.e. 1.5/F – light wind speed (1.5m/s) and stable atmospheric conditions (Stability Class F).

Table 9 Summary of Consequence Modelling Results

Ref.	Scenario Description	Material	Consequence Type	Weather Conditions	Extent [km]
MI-01 MI-03 MI-04	Release of Chlorine from HCl production unit/ Electrolyzer	Chlorine	Toxic (AEGL-2)	**1.5/F**	**3.6**
				4.6/C	1.8
MI-05	Release of Chlorine from Chlorine Compressor Building	Chlorine	Toxic (AEGL-2)	**1.5/F**	**3.0**
				4.6/C	0.4

Ref.	Scenario Description	Material	Consequence Type	Weather Conditions	Extent [km]
MI-06a MI-06b	Release of Chlorine from Transfer Pipework Between Chlorine Compressor Unit and Chlorine Liquefaction Unit	Chlorine	Toxic (AEGL-2)	**1.5/F**	**6.1**
				4.6/C	3.7
MI-07	Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)	Chlorine	Toxic (AEGL-2)	**1.5/F**	**9.3**
				4.6/C	0.9

As shown in these results chlorine gas releases can travel long distances because chlorine is heavier than air and capable of forming dense, ground-hugging plumes that spread rapidly under certain atmospheric conditions. Low wind speeds and stable atmospheric layers (e.g., during early morning or evening) can trap chlorine near the ground and promote horizontal spread.

By comparison, the results for the extent of the AEGL-2 distances for the worst-case scenario releases under other weather conditions, i.e. 4.6/C – a wind speed of 4.6m/s and atmospheric stability Class C. This combination represents a moderate dispersion scenario, often used for realistic or average-case modelling rather than worst-case. It reflects a balance between conservative and optimistic assumptions, providing a credible estimate of how a hazardous release might behave under typical daytime conditions.

The consequence modelling overlays provided in Appendix E, demonstrates the significant differences in the distance to the AEGL-2 extend between low wind speeds and stable atmospheric layers (1.5/F) and average wind speeds atmospheric layers (4.6/C)

5.5. Quantitative Assessment of Offsite Risk

In the initial phases of Grenof Project Halogen facility development, a number of critical design elements such as final process unit design and process configurations (e.g. Chlorine Compression and Liquefaction process units) plant layout, and equipment specifications are still under consideration and subject to change. Conducting a detailed Quantitative Risk Assessment (QRA) at this stage may lead to inaccurate or irrelevant results, as the assumptions used could quickly become obsolete. Deferment of the full QRA until the design is more stable can ensure that the assessment reflects realistic operating conditions and hazard scenarios.

Instead, a coarse risk assessment is more suitable for early assessment Appendix G provides an early approach to the quantitative likelihood of each of the Top Event release scenarios using Fault Tree Analysis.

6. Risk Control Measures

6.1. Identification of Risk Control Measures

Risk control measures have been identified through the hazard assessment process though identification of potential hazardous events associated with the facility's operations, chemical inventory, and external influences. Each scenario was evaluated with particular attention given to those that may result in offsite impacts. Through the analysis, proposed control measures were identified and documented on their ability to eliminate, reduce, or mitigate the identified risks with consideration to the control hierarchy (Figure 5).

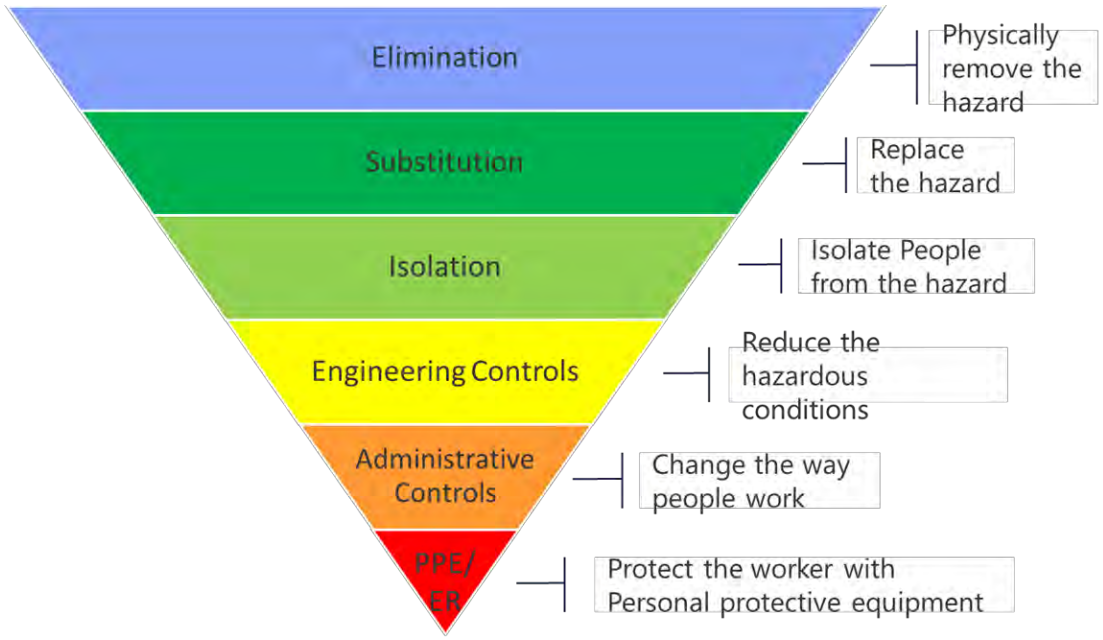


Figure 5 Control Hierarchy

The identified risk control measures include engineering solutions such as containment systems, automated shutdowns, and gas detection technologies and dichlorination systems; procedural safeguards such as standard operating procedures, maintenance protocols, and emergency response planning.

Key risk control measures of note include the following:

- Single Element Electrode Unit with integrated headers minimises leaks
- Electrode Unit leak detection continually monitoring pressure differentials and trigger emergency venting sequences (independent SIS)
- Process Leak detection system utilising dedicated pressure transmitters and interlocks to continuously monitor line pressure and trigger venting sequences (independent SIS)

- Enclosed 'sealed' buildings for chlorine processes maintained at slight negative pressure by the Waste Gas Dechlorination System extraction fans
- The Waste Gas Dechlorination System utilising sodium hydroxide scrubber unit with duty/standby fans providing continual suction on the chlorine lines and buildings
    - The dichlorination system is continuously operating – e.g. treating sniff gases, padding air etc.
    - Chlorine processes do not continue if the dichlorination system is not operating
- Ambient air Chlorine gas detectors to identify chlorine releases and initiate mitigation action – area/building extraction to Waste Gas Dechlorination System (independent SIS)
- Spare Emergency Chlorine Bulk Tank for chlorine transfer in the event of issues with an in-use storage tank
- Bulk chlorine storage tank over pressure and over fill protection, and bunding
- Process areas unoccupied during chlorine operations – control room monitoring and operations
- Exclusion of vehicles in proximity of pipe bridge (Chlorine Compressor to Chlorine Liquefaction) to eliminate vehicle impact
- No compressed Hydrogen storage on site. Use at low pressure and excess to requirements is vented safely to atmosphere

A more comprehensive list of proposed risk control measures is provided in greater detail in Appendix H. These risk control measures are consistent with those that have been successfully implement across over 600 Thyssenkrupp Nucera designed electrolysis projects worldwide, with no significant hazardous releases recorded.

The identified risk control measures and others to be further developed and refined during the Project Halogen implementation, will ensure that the risk of the hazardous release scenarios identified in this report are eliminated so far as reasonably practicable.

6.2. Scenario Bow Ties

The Bowtie method is a visual risk management tool that helps organizations understand and mitigate risks by mapping out causes, consequences, and risk controls measures around a central top event. Bow Ties have been developed to provide clarity around the role that the identified risk control measures have in minimising the risk so far reasonably practicable.

The Bow Ties are provided in Appendix I.

7. Code Compliance

7.1. Introduction

State Code 21 requires a compliance assessment against each of the performance outcomes (PO). Discussion on each of the performance outcomes compliance is discussed in this section.

In particular PO1- PO3, PO4 and PO5, an evaluation of foreseeable off-site impacts from the worst-case incident scenarios based on a quantitative assessment of the consequences is required. Worst case scenarios as identified in section 5.3 were evaluated (refer section 5.4) to determine the extent of the potential dangerous dose to human health levels (AEGL-2) from the potential source of release from the proposed facility.

In considering worst case scenarios as required by State Code 21, no credit is taken for the control measures at the facility to prevent such incidents from occurring or measures in place to mitigate the impacts. Additionally, the releases from these worst case scenarios are considered for all potential weather conditions (including wind conditions).

7.2. PO1 – PO3 Dangerous dose to human health, vulnerable, sensitive and commercial land use and land use zones

For the purposes of State Code 21 compliance, the dangerous dose to human health is defined as an effect that equals or exceeds AEGL-2 (60 minutes) for a toxic gas. Chlorine is a toxic gas and has an AEGL-2 (60 minutes) of 2 ppm.

Based on the consequence modelling conducted on the identified worst-case scenarios without the planned controls at the Grenof Project Halogen Facility in this hazard assessment it was determined that the dangerous dose to human health criteria could be exceeded at Vulnerable, Sensitive and Commercial land use locations as shown in Table 10 for the particular weather conditions indicated.

These weather conditions are 1.5/F – light wind speed (1.5m/s) and stable atmospheric conditions (Stability Class F). As indicated in the relevant rose of wind direction versus wind speed provided in Appendix E, that these conditions are experienced very infrequently in the direction of the Vulnerable (Yarwun State School) and the Sensitive (Residential) land use areas. i.e <0.5% of the time in the afternoon and approximately 2% of the time in the early morning.

Table 10 Dangerous dose to human health, vulnerable, sensitive and commercial land use and land use zones

Land Use Zone	Location	Top Event Reference	Weather Conditions
Vulnerable	Yarwun State School	A0335-MI-06	1.5/F
Vulnerable	Yarwun State School	A0335-MI-07	1.5/F
Sensitive	Targinnie Rd residence	A0335-MI-06	1.5/F
Sensitive	Targinnie Rd residence	A0335-MI-07	1.5/F
Commercial	Gladstone Model Aero Club	A0335-MI-01/03/04	All
Commercial	Gladstone Model Aero Club	A0335-MI-05	1.5/F
Commercial	Gladstone Model Aero Club	A0335-MI-06	All
Commercial	Gladstone Model Aero Club	A0335-MI-07	All

7.3. PO4 Dangerous dose to human health and individual fatality risk, open space land use and land use zones

For the purposes of State Code 21 compliance, the dangerous dose to human health is defined as an effect that equals or exceeds AEGL-2 (60 minutes) for a toxic gas. Chlorine is a toxic gas and has an AEGL-2 (60 minutes) of 2 ppm.

Based on the consequence modelling conducted on the identified worst-case scenarios at the Grenof Project Halogen Facility in this hazard assessment it was determined that the dangerous dose to human health criteria could be exceeded without relevant controls at open space zone locations as shown in Table 11.

Table 11 Dangerous dose to human health open space land use

Land Use	Location	Top Event Reference	Weather Conditions
Open Space	Gladstone Model Aero Club	A0335-MI-01/03/04	All
Open Space	Gladstone Model Aero Club	A0335-MI-05	1.5/F
Open Space	Gladstone Model Aero Club	A0335-MI-06	All
Open Space	Gladstone Model Aero Club	A0335-MI-07	All

The Gladstone Model Aero Club is identified as an open space zone as these zones are specifically allocated for recreational and community use.

7.4. PO5 Dangerous dose to the built environment and individual fatality risk, industrial land use and land use zones

For the purposes of State Code 21 compliance, the dangerous dose to human health is defined as an effect that equals or exceeds AEGL-2 (60 minutes) for a toxic gas. Chlorine is a toxic gas and has an AEGL-2 (60 minutes) of 2 ppm.

Based on the consequence modelling conducted on the identified worst-case scenarios at the Grenof Project Halogen Facility in this hazard assessment it was determined that the dangerous dose to human health criteria was exceeded at pen space zone locations as shown in Table 12.

Table 12 Dangerous dose to industrial land use

Land Use	Location	Top Event Reference	Exceeded?
Industrial	Northern Oil Refinery	A0335-MI-01/03/04	All
Industrial	Northern Oil Refinery	A0335-MI-05	1.5/F
Industrial	Northern Oil Refinery	A0335-MI-06	All
Industrial	Northern Oil Refinery	A0335-MI-07	All

7.5. PO6 Monitored fire detection

The Grenof Project Halogen Facility will potentially have quantities of the following *fire risk hazardous chemicals* as defined by *Work Health and Safety Regulation 2011*, Schedule 19:

7.5.1. Flammable Gas

Hydrogen, a flammable gas, will be produced in the electrolysis process and handled at low pressure (<0.5Bar g), with some used in downstream process (HCl synthesis) and the with excess vented to atmosphere. Hydrogen in air gas detection will be a consideration during the project as a preference over fire detection for hydrogen. Should other utility fuels such as LPG be considered as the project proceeds, appropriate controls such as fire or gas detection and notifications system will be considered as appropriate.

7.5.2. Oxidizer

Hydrogen Peroxide 50% is an oxidizer and will be used for brine dichlorination. The storage and use of hydrogen peroxide will be managed to avoid interaction with incompatible materials and decomposition. As the project proceeds, appropriate controls such as fire detection and notification systems will be considered as appropriate.

7.6. PO7-PO8 Spill containment of fire risk chemicals

It is proposed that no liquid or solid fire risk hazardous chemicals will be stored or handled at the Grenof Project Halogen facility.

7.7. PO9 Prevent mixing of reactive chemicals

The Grenof Project Halogen facility will store and handle incompatible bulk liquids such as sodium hypochlorite, hydrochloric acid, sulphuric acid and sodium hydroxide. The design of the bulk storage areas will be in accordance with AS 3780 *The storage and handling of corrosive substances*, and in particular materials will not share common piping, bunds or bund drains.

7.8. PO10: The facility is designed to mitigate the impacts of natural hazards

The Grenof Project Halogen facility is sited and designed to mitigate the impacts of natural hazards including

- Flood – the facility is sited outside identified flood zones,
- Bushfire – the facility is sited in a medium potential bushfire intensity area, and appropriate bush fire management plans will be developed and implemented. In line with the requirements of the National Construction Code (NCC) the design and construction of the facility will address the specific requirements for buildings and structures to resist natural hazard events such as bushfires.
- Erosion - the facility is sited outside identified erosion zones,
- Storm tide inundation - the facility is sited outside identified storm tide inundation zones,
- Landslide – the facility is sited on flat terrain with landslide impact being non credible,
- Earthquake - in line with the requirements of the National Construction Code (NCC) the design and construction of the facility will address the specific requirements for buildings and structures to resist earthquake hazards applicable to the area,
- Wind action - In line with the requirements of the National Construction Code (NCC) the design and construction of the facility will address the specific requirements for buildings and structures to resist natural hazard events such as cyclones and high winds.

7.9. PO11: Development is designed and sited to mitigate the risks from hazard scenarios occurring at existing hazardous chemical facilities

The Grenof Project Halogen facility has sufficient separation from existing hazardous chemical facilities in in the region of the facility.

The Northern Oil Refinery approximately 400m to the west, stores and processes combustible liquids (waste oil / reprocessed oil). Heat radiation from a combustible liquid fire at the Northern Oil Refinery would not directly impact the site; however, the smoke plume may impact or potentially cease operations.

Orica has operations to the south (Reid Road) of the Grenof Project Halogen facility producing nitric acid, ammonium nitrate and ammonium nitrate emulsion, as well as sodium cyanide; and

ammonia and caustic soda unloading and storage to the north at Fisherman's Landing. Major incidents at these facilities would not physically impact the Grenof Project Halogen facility processes and storages; however, toxic releases (ammonia) or incidents may impact or potentially cease operations.

As Project Halogen develops, the facility's operations will co-ordinate with all hazardous chemical facilities in the region on emergency response planning and actions, including joint responses and mutual aid as appropriate.

7.10. Purpose Statement Intent

7.10.1. Proposal Location

The proposed location for the Grenof Project Halogen facility is within the Gladstone State Development Area (GSDA). The GSDA is a 26,934-hectare area located approximately 10 km northwest of Gladstone, and is a designated industrial zone established to support large-scale, strategic industrial development.

The extent of the GSDA and the location of the proposed location of the Grenof Project Halogen facility within it is shown in Figure 6 [3].

The GSDA has several established large-scale industrial sites [4] including:

- Rio Tinto alumina refinery
- Orica chemical manufacturing complex
- Australia Pacific LNG
- Santos Gladstone LNG
- Queensland Curtis LNG
- Transpacific Industries waste management and recycling facility
- Southern Oil's Northern Oil Refinery
- Alpha HPA alumina production facility

As the area hosts major facilities such as the facilities mentioned above, there exists potential synergies with existing chemical operations, a shared emergency response and safety infrastructure, and appropriate separation from vulnerable and residential areas.

The GSDA would be an appropriate location for a facility such as Grenof's Project Halogen.

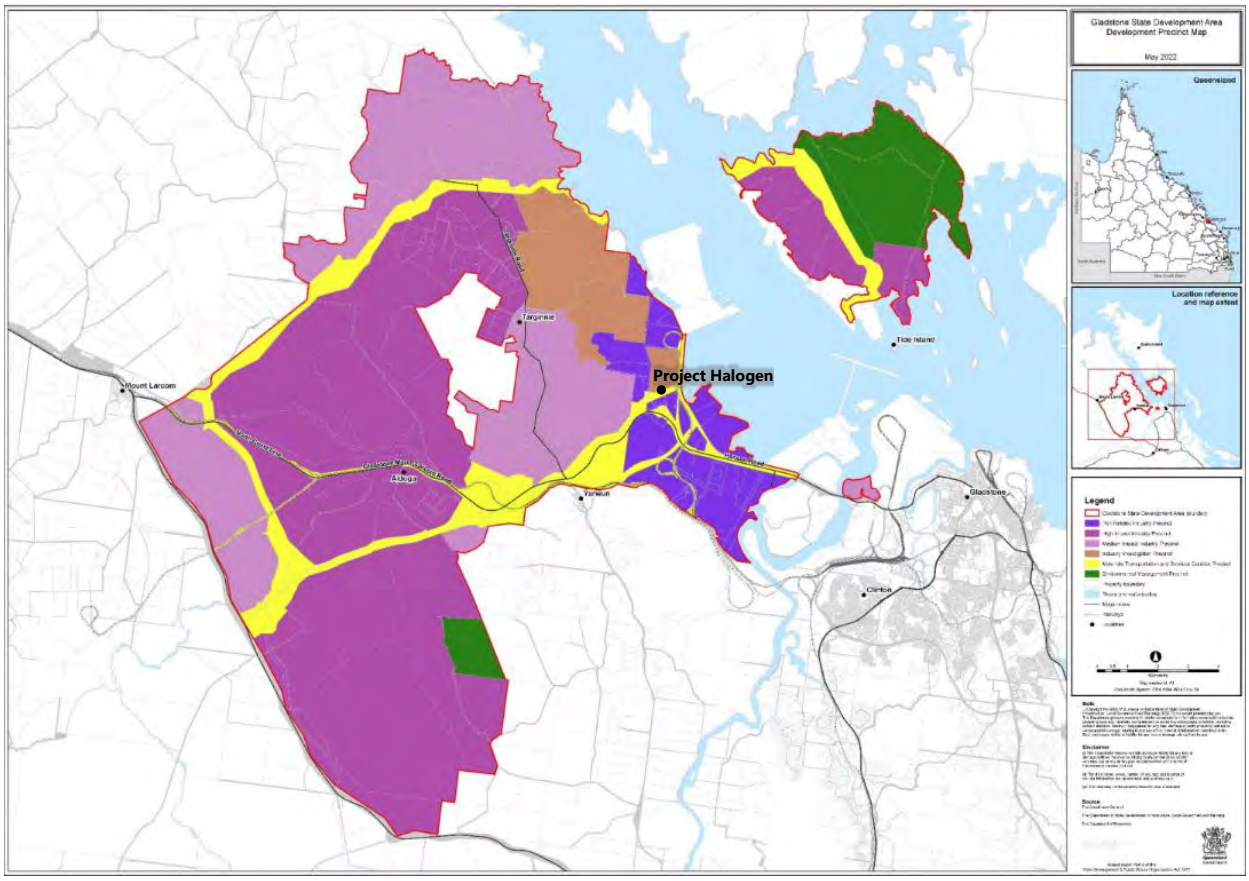


Figure 6 Gladstone State Development Area

7.10.2. Thyssenkrupp Nucera Technology

The proposed Grenof Project Halogen facility will utilize Thyssenkrupp Nucera's advanced membrane-based chlor-alkali electrolysis technology. These systems are globally recognized for their high safety performance, energy efficiency, and environmental compatibility. The electrolyzer is designed for low-pressure operation and modular cell construction, the technology offers robust containment, fault isolation, and operational flexibility.

Risks are mitigated through Thyssenkrupp Nucera's integrated safety features, including leak-proof seals, automated shutdown systems, hydrogen venting and dilution mechanisms, and real-time monitoring of membrane integrity and pressure differentials throughout the chlorine processes. The combination of advanced engineering, automated controls, and operational discipline significantly reduces the likelihood and impact of major incidents.

Thyssenkrupp Nucera, has been active in the chlor-alkali sector for more than 60 years. The company has successfully delivered over 600 electrolysis projects across the globe, ranging from small-scale installations to massive industrial complexes. Facilities using these systems are located in key industrial regions including:

- Europe (Germany, Italy)
- North America (USA)
- Asia-Pacific (Japan, India, China)
- Middle East (Saudi Arabia)

The proposed Grenof Project Halogen facility, utilizing Thyssenkrupp Nucera's technology, meets the intent with the combination of advanced engineering controls, robust safety systems, and strategic siting within the GSDA, risks to human health, safety, and the environment can be minimized and managed to an acceptable level.

7.10.3. MHF Licencing

In Queensland, the Major Hazard Facility (MHF) threshold quantity for chlorine is 25 tonnes as defined under Schedule 15 of the Work Health and Safety Regulation 2011 (Qld). The Grenof Project Halogen facility will exceed this threshold quantity and will be classified as an MHF. The classification and licencing as an MHF will ultimately be beneficial for the ongoing management of risks during the operational phase of the project, as it imposes a rigorous regulatory framework that enhances safety, accountability, and preparedness.

As an MHF, the Grenof Project Halogen facility is required to develop and maintain a comprehensive Safety Management System that:

- Identifies all major incident hazards
- Establishes control measures to eliminate or minimize risks
- Integrates emergency response, training, and monitoring procedures

This structured approach ensures that risks are systematically managed across all aspects of the facility's operations.

The facility will prepare a Safety Case, a detailed document that demonstrates how the facility controls major hazards. This includes:

- Scenario-based hazard identification
- Consequence analysis
- Justification of control measures
- Ongoing review and improvement mechanisms

The Safety Case promotes transparency and will require the facility to critically evaluate their risk control measures.

MHF status will bring the facility under the oversight of Workplace Health and Safety Queensland (WHSQ), part of the Queensland Office of Industrial Relations. Their role will be

- Review and approve the Safety Case
- Conduct regular audits and inspections
- Enforce compliance with safety standards

This external oversight ensures that risk management is actively maintained.

As an MHF the Grenof Project Halogen facility must develop and test emergency response plans that:

- Coordinate with local emergency services
- Address offsite impacts and community safety
- Include communication protocols for public notification

This will improve preparedness for any potential major incidents.

In summary, to comply with the MHF requirements the facility will operate with discipline, transparency, and integrity. The result is human health and safety, and the built environment in the Yarwun area are protected, so far as reasonably practicable, from off-site risks resulting from the chemical hazards at the proposed Grenof Project Halogen facility.

8. References

[1] Planning guideline State Code 21 - Hazardous chemical facilities, Ver 2, 4 March 2022
[2] Thyssenkrupp Nucera, Annex 05 Process Description and Technical Drawings, 240809 rev1
[3] Queensland Coordinator-General, Gladstone State Development Area, development Scheme, May 2022
[4] State development, Infrastructure and Planning, Gladstone State Development Area. https://www.statedevelopment.qld.gov.au/coordinator-general/state-development-areas/current/gladstone-state-development-area
[5] Water Corporation, Design Standard DS 70-01 Chlorine Buildings Standard Ver 2 Rev 0 February 2025
[6] Department of Climate Change, Energy, the Environment and Water, Australia's Guide to Environmentally Sustainable Homes. https://www.yourhome.gov.au/passive-design/passive-house
[7] UK HSE, Failure Rate and Event Data for use within Land Use Planning Risk Assessments

9. Appendices

Appendix A. State code 21: Hazardous chemical facilities

Table 13 Material change of use - State Development Assessment Provisions v3.3

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**.	**Only under worst case (calm) weather conditions which occur very infrequently Refer section 7.2**
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**.	**Only under worst case (calm) weather conditions which occur very infrequently Refer section 7.2**
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**.	**All of the worst case release scenarios may exceed the dangerous dose to human health criteria at commercial or community activity land use land use. Refer section 7.1**
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.	**All of the worst case release scenarios may exceed the dangerous dose to human health criteria at open space (community activity) land use land use. Refer section 7.3**
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.	**All of the worst case release scenarios may exceed the dangerous dose to human health criteria at industry land use land use. Refer section 7.4**
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, refer section 7.5**
PO7 Storage and handling areas for **packages** of liquid or solid **fire risk hazardous chemicals** are provided with a spill containment system with a	**Not Applicable, refer section 7.6**

working volume capable of containing a minimum of 100 percent of all **packages** (**prescribed hazardous chemicals** and/or non-hazardous chemicals) within the area plus the output of any **fixed firefighting system** provided for the area over a minimum of 90 minutes.	
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.	**Not Applicable, refer section 7.6**
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, refer section 7.7**
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; d. storm tide inundation; e. landslide; f. earthquake; g. **wind action**.	**Complies, refer section 7.8**
All development	
PO11 Development is designed and sited to mitigate the risks from **hazard scenarios** occurring at existing **hazardous chemical facilities**.	**Complies, refer section 7.9**

Appendix B. Hazardous Chemicals

Table 14: Hazardous Chemicals Stored

Chemical	UN number	GHS Classification	DG Classification	Sch. 15 threshold Qty (t)	Total Qty (t)	Largest container size (t)	Main Process Area
Chlorine	1017	Acute toxicity – category 3 Specific target organ toxicity (single exposure) – category 3 Skin irritation – category 2 Hazardous to the aquatic environment (acute) – category 1 Oxidising gas – category 1 Gases under pressure Eye irritation – category 2A	2.3 sub 5.1,8	25	90	20	24
Hydrochloric Acid 33%	1789	Skin corrosion – category 1B Specific target organ toxicity (single exposure) – category 3	8 PGII	N/A	30	10	52
Hydrogen Peroxide 50%	2014	Oxidising liquid – category 1 Acute toxicity – category 4 Acute toxicity – category 4 Skin corrosion – category 1A Specific target organ toxicity (single exposure) – category 3	5.1 sub 8 PG II	N/A	2	1	07
Sodium Hydroxide 32%	1824	Skin corrosion – category 1A Specific target organ toxicity (single exposure) – category 3	8 PG II	N/A	90	20	32

Chemical	UN number	GHS Classification	DG Classification	Sch. 15 threshold Qty (t)	Total Qty (t)	Largest container size (t)	Main Process Area
Sodium Hypochlorite 12.5 -15%	1791	Skin corrosion – category 1B Eye damage – category 1 Hazardous to the aquatic environment (acute) – category 1 Hazardous to the aquatic environment (chronic) – category 1 Specific target organ toxicity (single exposure) – category 3	8 PGIII	N/A	60	20	28
Sulphuric Acid 78%	1830	Skin corrosion – category 1A	8 PGII	N/A	15	5	91

Appendix C. Hazard Assessment Minutes

MEETING ATTENDANCE RECORD FORM

Date:	19/09/2025
Meeting Topic:	Grenof Project Halogen Hazard Assessment Workshop
Held By:	Safety Solutions Limited
Venue:	Virtual

Name	Signature	Position	Company	Email Address
Jason Brooks	JB	Director	Grenof	jason.brooks@grenof.com
Scott Barnes	SB	Managing Director	Grenof	scott.barnes@grenof.com
Luke Siri	LS	General Manager	Grenof	luke.sirl@grenof.com
Glenn Platt	GP	Principal Consultant / Facilitator	Safety Solutions Limited	glenn.platt@safetysolutions.com.au

Hazard Assessment

Scenario				Assessment				Top Event	Assessment
Ref #	Activities / locations	Chemical / Hazard	Risk Scenario	Immediate Impact	Causes	Offsite Impact Modelling ?	Planned Preventative Control Measures / Safeguards / Barriers		Planned Mitigative Control Measures / Safeguards / Barriers
1	**11 - Electrolyzer**	**Chlorine**	Release of chlorine due to electrolyser leaks and/or piping flanges/connection leaks from anode. Pipe diameter: 300mm Pressure: 0.5 Bar g (150 kPa a) Temp: ambient Equiv leak size: Small leak size from seals / flanges. Full piping diameter release not considered credible.	Release of chlorine to immediate process area within the Electrolyser building. Electrolyser building is a "sealed" building to contain potential releases. Air Exchange per Hour (ACH) for this building: 0.1	**Equipment Integrity Issues:** Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation	Yes	Single Element Electrode Unit Enclosed building Electrode Unit leak detection Waste Gas Dechlorination System Ambient air Chlorine gas detectors Basic Process Control Systems CCMS	**A0335-MI-01** Release of Chlorine from Electrolyzer Building	Process areas unoccupied during chlorine operations Emergency Response Plan
2	**11 - Electrolyzer**	**Hydrogen**	Release of hydrogen due to electrolyser leaks and/or piping flanges/connection leaks from cathode. Pipe diameter: 300mm Pressure: 0.5 Bar g (150 kPa a) Temp: ambient Equiv leak size: Small leak size from seals / flanges. Full piping diameter release not considered credible.	Release of hydrogen to immediate process area within the Electrolyser building. Electrolyser building is a "sealed" building to contain potential releases. Air Exchange per Hour (ACH) for this building: 0.1	**Equipment Integrity Issues:** Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation	No	Single Element Electrode Unit Enclosed building Electrode Unit leak detection Hydrogen Vent Stack Basic Process Control Systems CCMS	**A0335-MI-02** Release of Hydrogen from Electrolyzer Building	Process areas unoccupied during chlorine operations Emergency Response Plan
3	**21 - Chlorine Treatment**	**Chlorine**	Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include: 121E001 Chlorine Cooler 121E002 Chlorine Chiller 121F001 Wet Chlorine Filter Mist Eliminator 121C001 Chlorine Drying Tower Piping diameter: 300mm Pressure: 0.5 Bar g (150 kPa a) Temp: ambient Equiv leak size: Small leak size from seals / flanges. Full piping diameter release not	Release of chlorine to immediate process area Electrolyser building is a "sealed" building to contain potential releases. Air Exchange per Hour (ACH) for this building: 0.1	**Equipment Integrity Issues:** Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation	Yes	Enclosed building Electrode Unit leak detection Waste Gas Dechlorination System Ambient air Chlorine gas detectors Basic Process Control Systems CCMS	**A0335-MI-01** Release of Chlorine from Electrolyzer Building	Process areas unoccupied during chlorine operations Emergency Response Plan
4	**51 – HCl Production**	**Chlorine**	Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include: 151U001 HCl Synthesis Unit Piping diameter: 300mm Pressure: 0.5 Bar g (150 kPa a) Temp: ambient Equiv leak size: Small leak size from seals / flanges. Full piping diameter release not considered credible.	Release of chlorine to immediate process area within the HCl production area. This processing unit is not within an enclosed building.	**Equipment Integrity Issues:** Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation	Yes	Basic Process Control Systems CCMS	**A0335-MI-03** Release of Chlorine from HCl production unit	Process Leak detection Ambient air Chlorine gas detectors Waste Gas Dechlorination System Emergency Response Plan
5	**27 – Sodium Hypochlorite Production**	**Chlorine**	Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include: 127F001 Hypochlorite Ejector Piping diameter: 300mm Pressure: 0.5 Bar g (150 kPa a) Temp: ambient Equiv leak size: Small leak size from seals / flanges. Full piping diameter release not considered credible.	Release of chlorine to immediate process area within the Hypochlorite production area. This processing unit is not within an enclosed building.	**Equipment Integrity Issues:** Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation	Yes	Basic Process Control Systems CCMS	**A0335-MI-04** Release of Chlorine from hypochlorite production unit	Process Leak detection Ambient air Chlorine gas detectors Waste Gas Dechlorination System Emergency Response Plan

Hazard Assessment

Scenario					Assessment				Top Event	Assessment
6	22 - Chlorine Compression Unit	Chlorine	Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include: 122U001 Chlorine Compression Unit 022F001 Dry Chlorine Filter Mist Eliminator Piping diameter: 150mm & 80mm Pressure: 3.5 bar g Temp: Ambient Equiv leak size: Small leak size from seals / flanges and component connections. Full piping diameter release not considered credible.	Release of chlorine to immediate process area. Chlorine compression unit is within a "sealed" building to contain potential releases. Air Exchange per Hour (ACH) for this building: 0.1 Assume isolatable inventory with in the Chlorine Compressor Unit is 2000kg. Release at production flow rate. Potential for release of chlorine beyond site	**Equipment Integrity Issues:** Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation	Yes	Basic Process Control Systems Process Leak detection Ambient air Chlorine gas detectors Waste Gas Dechlorination System Enclosed building CCMS	**A0335-MI-05** Release of Chlorine from Chlorine Compressor Building	Process areas unoccupied during chlorine operations Emergency Response Plan
7	22 - Chlorine Compression Unit	Chlorine	Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include: 122U001 Chlorine Compression Unit 022F001 Dry Chlorine Filter Mist Eliminator Piping diameter: 150mm & 80mm Pressure: 3.5 bar g Temp: Ambient Equiv leak size: Small leak size from seals / flanges and component connections. Full piping diameter release not considered credible.	Release of chlorine to immediate process area. Chlorine compression unit is within a "sealed" building to contain potential releases. Air Exchange per Hour (ACH) for this building: 0.1 Assume isolatable inventory with in the Chlorine Compressor Unit is 2000kg. Release at production flow rate. Potential for release of chlorine beyond site	**Operational Issues:** Vibration, overheating or over pressurisation	Yes	Basic Process Control Systems Process Leak detection Ambient air Chlorine gas detectors Waste Gas Dechlorination System Enclosed building CCMS	**A0335-MI-05** Release of Chlorine from Chlorine Compressor Building	Process areas unoccupied during chlorine operations Emergency Response Plan
8	22 - Chlorine Compression Unit	Chlorine	Release of chlorine due to pipe rupture (vehicle impact) on chlorine piping in pipe bridge between 22 - Chlorine Compression Unit and 23 - Chlorine Liquefaction Unit. Pipe bridge spans central roadway on site. Pipe diameter:150mm Pressure: 3.5 bar g Temp: Ambient Equiv leak size: 150mm	Release of chlorine to surrounding atmosphere. Potential for release of chlorine beyond site This sceanrio is considered not credible with the operational controls in place (exclusion of vehicles in proximity of the pipe bridge)	**Vehicle Impact:** High vehicle impacts with pipework on pipebridge or vehicle impact with pipebridge structure, while travelling on internal roadway benith pipebridge.	Yes	Exclusion of Vehicles in proximity of pipe bridge	**A0335-MI-06** Release of Chlorine from transfer pipework between Chlorine Compressor Unit and Chlorine Liquefaction Unit	Process Leak detection Ambient air Chlorine gas detectors Waste Gas Dechlorination System Emergency Response Plan
9	22 - Chlorine Compression Unit	Chlorine	Release of chlorine due to leak on chlorine piping in pipe bridge between 22 - Chlorine Compression Unit and 23 - Chlorine Liquefaction Unit. Pipe bridge spans central roadway on site. Pipe diameter:150mm Pressure: 3.5 bar g Temp: Ambient Equiv leak size: Small leak size from seals / flanges and component connections. Full piping diameter release not considered credible.	Release of chlorine to surrounding atmosphere. Potential for release of chlorine beyond site	**Piping Integrity issues:** Corrosion, stress corrosion cracking, flange and gasket failures, weld defects or improper installation	Yes	Basic Process Control Systems CCMS	**A0335-MI-06** Release of Chlorine from transfer pipework between Chlorine Compressor Unit and Chlorine Liquefaction Unit	Process Leak detection Ambient air Chlorine gas detectors Waste Gas Dechlorination System Emergency Response Plan
10	23 - Chlorine Liquefaction Unit	Chlorine	Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include: 123U001 Chlorine Liquefaction Unit Pipe diameter:150mm Pressure: 3.4 bar g / Liquid Chlorine Temp: - 11°C Equiv leak size: Small leak size from seals / flanges and component connections. Full piping diameter release not considered credible.	Release of chlorine to immediate process area. Chlorine liquefaction nit is within a "sealed" building (chlorine Storage building) to contain any potential releases. Air Exchange per Hour (ACH) for this building: 0.1 Release of chlorine beyond site	**Equipment Integrity Issues:** Corrosion, stress corrosion cracking, flange and gasket failures, compressor or pump seal leaks, heat exchanger leaks, valve failures, loose fittings or connections, worn components or improper component installation.	Yes	Basic Process Control Systems Process Leak detection Ambient air Chlorine gas detectors Enclosed building Waste Gas Dechlorination System CCMS	**A0335-MI-07** Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)	Process areas unoccupied during chlorine operations Emergency Response Plan

Hazard Assessment

Scenario				Assessment				Top Event	Assessment
11	23 - Chlorine Liquefaction Unit	Chlorine	Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include: 123U001 Chlorine Liquefaction Unit Pipe diameter:150mm Pressure: 3.4 bar g / Liquid Chlorine Temp: - 11°C Equiv leak size: Small leak size from seals / flanges and component connections. Full piping diameter release not considered credible.	Release of chlorine to immediate process area. Chlorine liquefaction nit is within a "sealed" building (chlorine Storage building) to contain any potential releases. Air Exchange per Hour (ACH) for this building: 0.1 Release of chlorine beyond site	**Operational Issues:** Ice formation, pressure imbalances, rapid cooling or heating cycles,	Yes	Basic Process Control Systems Process Leak detection Ambient air Chlorine gas detectors Enclosed building Waste Gas Dechlorination System	**A0335-MI-07** Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)	Process areas unoccupied during chlorine operations Emergency Response Plan
12	24 - Chlorine Storage & Filling	Chlorine	Release of Chlorine from tank, drum and cylinder fill lines due to piping flanges and connections leaks Pipe diameter: 50mm Pressure: 3.4 bar g / liquid chlorine Temp: Ambient	Release of chlorine to immediate storage and filling area. Chlorine storage and filling area is within a "sealed" building (chlorine Storage building) to contain any potential releases. Air Exchange per Hour (ACH) for this building: Release of chlorine beyond site	**Piping Integrity issues:** Corrosion, stress corrosion cracking, flange and gasket failures, weld defects or improper installation	Yes	Basic Process Control Systems CCMS Process Leak detection Ambient air Chlorine gas detectors Enclosed building Waste Gas Dechlorination System Rupture disks releasing to expansion vessels on liquid chlorine fill lines	**A0335-MI-07** Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)	Process areas unoccupied during chlorine operations Emergency Response Plan
13	24 - Chlorine Storage & Filling	Chlorine	Release of chlorine from chlorine tank leaks to due to corrosion, vessel integrity issue. Catastrophic failure not consider credible; however should be considered for worst case analysis. Pressure: 3.4 bar g / liquid chlorine Temp: Ambient Inventory: 20t Equiv leak diameter: 20mm (consider full inventory release to building)	Release of chlorine to immediate storage and filling area. Chlorine storage and filling area is within a "sealed" building (chlorine Storage building) to contain any potential releases. Air Exchange per Hour (ACH) for this building: 0.1 Release of chlorine beyond site	**Tank Integrity Issues:** Corrosion of tank walls, stress corrosion cracking, seal and gasket failure, weld defects,	Yes	Basic Process Control Systems CCMS Process Leak detection Ambient air Chlorine gas detectors Enclosed building Waste Gas Dechlorination System Chlorine Bulk tank bunding Spare Emergency Chlorine Bulk Tank	**A0335-MI-07** Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)	Process areas unoccupied during chlorine operations Emergency Response Plan
14	24 - Chlorine Storage & Filling	Chlorine	Release of chlorine from chlorine tank leaks to due to overpresurisation or overfill. Catastrophic failure not consider credible; however should be considered for worst case analysis. Pressure: 3.4 bar g / liquid chlorine Temp: Ambient Inventory: 20t Equiv leak diameter: 20mm (consider full inventory release to building)	Release of chlorine to immediate storage and filling area. Chlorine storage and filling area is within a "sealed" building (chlorine Storage building) to contain any potential releases. Air Exchange per Hour (ACH) for this building: 0.1 Release of chlorine beyond site	**Operational Issues:** Chlorine Storage Tank overpressurisation or overfill	Yes	Basic Process Control Systems Chlorine Bulk tank level control and over fill protection Chlorine Bulk tank over pressure protection Ambient air Chlorine gas detectors Enclosed building Waste Gas Dechlorination System Chlorine Bulk tank bunding Spare Emergency Chlorine Bulk Tank	**A0335-MI-07** Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)	Process areas unoccupied during chlorine operations Emergency Response Plan
15	24 - Chlorine Storage & Filling	Chlorine	Release of chlorine from drum, cylinder leaks or associated piping. Pressure: 3.4 bar g / liquid chlorine Temp: Ambient Inventory: 1t & 80kg Equiv leak diameter: 20mm fitting/valve size	Release of chlorine to immediate storage and filling area. Chlorine storage and filling area is within a "sealed" building (chlorine Storage building) to contain any potential releases. Air Exchange per Hour (ACH) for this building: 0.1 Release of chlorine beyond site	**Equipment Integrity Issues:** Worn or improperly sealed valves, gaskets, or couplings, corroded pipework or fittings, faulty pressure relief valves, damaged containers	Yes	Basic Process Control Systems CCMS Process Leak detection Ambient air Chlorine gas detectors Enclosed building Waste Gas Dechlorination System Displaced gas directed to Waste Gas Dechlorination System	**A0335-MI-07** Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)	Process areas unoccupied during chlorine operations Emergency Response Plan

Hazard Assessment

Scenario				Assessment					Top Event	Assessment
16	24 - Chlorine Storage & Filling	Chlorine	Release of chlorine from drum, cylinder leaks or associated piping. Pressure: 3.4 bar g / liquid chlorine Temp: Ambient Inventory: 1t & 80kg Equiv leak diameter: 20mm fitting/valve size	Release of chlorine to immediate storage and filling area. Chlorine storage and filling area is within a "sealed" building (chlorine Storage building) to contain any potential releases. Air Exchange per Hour (ACH) for this building: 0.1 Release of chlorine beyond site	**Operational Issues:** Chlorine drum or cylinder overpressurisation or overfill	Yes	Basic Process Control Systems Rupture disks releasing to expansion vessels on liquid chlorine Process Leak detection Ambient air Chlorine gas detectors Enclosed building Waste Gas Dechlorination System Displaced gas directed to Waste Gas Dechlorination System	**A0335-MI-07** Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)	Process areas unoccupied during chlorine operations Emergency Response Plan
16	28 – Sodium Hypochlorite Storage	Sodium Hypochlorite 12.5 - 15%	Release of Sodium Hypochlorite from bulk tank due to: - Overfilling of Sodium Hypochlorite bulk tank - Tank integrity / leak - Fitting pipe leak	Release of Sodium Hypochlorite to surrounding area. Potential stormwater contamination.	**Equipment and Operational issues:** Tank corrosion, seal and gasket deterioration, weld failures or structural fatigue, valve and flange malfunctions, tank overfilling or Improper transfer procedures.	No	Hydrochloric Acid Bulk Storage Design CCMS	**A0335-MI-08** Spill / Release of Sodium Hypochlorite at Storage and Load out Area	Emergency Response Plan
17	32 - Caustic Soda Storage	Sodium Hydroxide 32%	Release of Sodium Hydroxide from bulk tank due to: - Overfilling of Sodium Hydroxide bulk tank - Tank integrity / leak - Fitting pipe leak	Release of Sodium Hydroxide to surrounding area. Potential stormwater contamination.	**Equipment and Operational issues:** Tank corrosion, seal and gasket deterioration, weld failures or structural fatigue, valve and flange malfunctions, tank overfilling or Improper transfer procedures.	No	Caustic Bulk Storage Design CCMS	**A0335-MI-09** Spill / Release of Sodium Hydroxide at Storage and Load out Area	Emergency Response Plan
18	52 – HCl Storage	Hydrochloric Acid 33%	Release of Hydrochloric Acid from bulk tank due to: - Overfilling of Hydrochloric Acid bulk tank - Tank integrity / leak - Fitting pipe leak	Release of Hydrochloric Acid to surrounding area. Potential stormwater contamination.	**Equipment and Operational issues:** Tank corrosion, seal and gasket deterioration, weld failures or structural fatigue, valve and flange malfunctions, tank overfilling or Improper transfer procedures.	No	Hydrochloric Acid Bulk Storage Design CCMS	**A0335-MI-10** Spill / Release of Hydrochloric Acid at Storage and Load out Area	Emergency Response Plan
19	91 - Sulphuric Acid Filling & Storage	Sulphuric Acid 78%	Release of Sulphuric Acid from bulk tank due to: - Overfilling of Sulphuric Acid bulk tank - Tank integrity / leak - Fitting pipe leak	Release of Sulphuric Acid to surrounding area. Potential stormwater contamination.	**Equipment and Operational issues:** Tank corrosion, seal and gasket deterioration, weld failures or structural fatigue, valve and flange malfunctions, tank overfilling or Improper transfer procedures.	No	Sulphuric Acid Bulk Storage Design CCMS	**A0335-MI-11** Spill / Release of Sulphuric Acid at Storage and Load out Area	Emergency Response Plan

Hazard Assessment

Scenario				Assessment				Top Event	Assessment
20	**Bulk Filling & Storage**	**Sodium Hypochlorite 12.5 - 15%**	Accidental mixing of Sodium Hypochlorite and bulk acids (hydrochloric or sulphuric)	Incompatible mixing resulting in the evolution of chlorine gas due to the reduction in pH	**Operational issues:** Human error during transfer, failure to verify contents, shared piping systems, poor segregation of storage areas or shared containment areas and drains.	No	Sulphuric Acid Bulk Storage Design Hydrochloric Acid Bulk Storage Design Hypochlorite Bulk Storage Design	**A0335-MI-12** Chlorine Gas Evolution From Sodium Hypochlorite	Emergency Response Plan
21	**Bulk Filling & Storage**	**Sodium Hydroxide 32%**	Accidental mixing of Sodium Hydroxide and bulk acids (hydrochloric or sulphuric)	Incompatible mixing resulting in vigorous neutralisation reaction with heat evolution	**Operational issues:** Human error during transfer, failure to verify contents, shared piping systems, poor segregation of storage areas or shared containment areas and drains.	No	Sulphuric Acid Bulk Storage Design Hydrochloric Acid Bulk Storage Design Caustic Bulk Storage Design	**A0335-MI-13** Adverse Reaction Mixing of Acids and Bases	Emergency Response Plan
22	**Site Wide**	**Fire Risk Materials - Liquids**	No Flammable liquids stored on site. Risk Scenario Not Applicable	Not applicable	Not applicable	N/A		N/A	
23	**Site Wide**	**Fire Risk Materials - Gas**	Release of LPG from cylinders resulting in jet fire and or flash fire. (Use of LPG as ancillary fuel not yet confirmed. Waste hydrogen also being considered, however Hydrogen will be used not be stored.)	Ignited gas release, either immediate or delayed resulting in localised jet fire and or flash fire	**Equipment and Operational issues:** Damaged regulators, hoses or valves, or incorrectly fitted connections or cylinder mis handling.	No	CCMS	**A0335-MI-14** Release of LPG from cylinders resulting in jet fire and or flash fire.	Emergency Response Plan
24	**Site Wide**	**Natural Hazard**	Earthquake impacting site	Damage to site structures resulting loss of containment of hazardous material such as chlorine. Impact on operations.	**Natural Environment:** Earthquake in Gladstone area. Not a recognised earthquake prone location	No	Facility Structural Design CCMS	**A0335-MI-15** Earthquake impacting site	Emergency Response Plan

Hazard Assessment

Scenario				Assessment					Top Event	Assessment
25	Site Wide	Natural Hazard	Flooding impacting site	Flood water inundation to site infrastructure and process units resulting in impact on operations.	**Natural Environment:** Flooding of local rivers and creeks in Gladstone area. Not a recognised flood prone location	No	Facility Structural Design CCMS		**A0335-MI-16** Flooding impacting site	Emergency Response Plan
26	Site Wide	Natural Hazard	Bushfire in adjacent land use impacting the site	Bush fire and heat radiation impact to site infrastructure and process units resulting in potential ignition of combustibles on site and impact on operations.	**Natural Environment:** Bushfire in immediate surrounding area. Site is located in Medium Potential Bushfire Intensity zone.	No	Facility Structural Design Bush Fire Management Plan CCMS		**A0335-MI-17** Bushfire in adjacent land use impacting the site	Emergency Response Plan
27	Site Wide	Natural Hazard	Storm tide inundation impacting the site.	Storm tide water inundation to site infrastructure and process units resulting in impact on operations.	**Natural Environment:** High Storm tide event, particularly during cyclonic storm event	No	Facility Structural Design CCMS		**A0335-MI-18** Storm tide inundation impacting the site.	Emergency Response Plan
28	Site Wide	Natural Hazard	Wind Action from storms and cyclonic weather impacting the site.	Damage to site structures resulting in potential loss of containment of hazardous material such as chlorine. Impact on operations.	**Natural Environment:** High wind event, particularly during cyclonic storm event or localised thunderstorm.	No	Facility Structural Design CCMS		**A0335-MI-19** Wind Action from storms and cyclonic weather impacting the site.	Emergency Response Plan
29	Site Wide	Malicious acts	Security breach - either physical or cyber attack	Damage to site infrastructure or processes. Potential cessation of operations.	**External Interference:** Physical entry or damage by third party Cyber attack on IT network or operational technology (OT) systems	No	Facility physical security plans Cyber security plans CCMS		**A0335-MI-20** Security breach - either physical or cyber attack	Emergency Response Plan
30	Site Wide	Neigbouring Facility	Northern Oil Refinery - 400m West. Release of flammable hydrocarbons. Potential for fire / explosion and associated smoke impacts on Project Halogen site.	Heat radiation from combustible liquid (waste oil / reprocessed oil) fire at the Northern Oil Refinery would not directly impact the site; however the smoke plume may impact or potentially cease operations. Additionally, a fire may initiate local bushfire which may impact Project Halogen site.	**External Site:** Incident at neighbouring Facility	No	Emergency Response Plan		**A0335-MI-21** Impact from Neighbouring Facilities	Emergency Response Plan

Appendix D. Consequence Modelling

Results Summary

Table 15 Summary of Consequence Modelling Results

Ref.	Scenario Description	Material	Pressure of Release [bar(g)]	Temp. of Release [° C]	Elevation [m]	Consequence Type	Weather Conditions	Extent [km]
MI-01 MI-03 MI-04	Release of Chlorine from HCl production unit/ Electrolyzer	Chlorine	0.5	22.9	1	Toxic (AEGL-2)	1.5/F	3.6
							4.6/C	1.8
MI-05	Release of Chlorine from Chlorine Compressor Building	Chlorine	User defined release rate – 0.1 kg/sec	22.9	1	Toxic (AEGL-2)	1.5/F	3.0
							4.6/C	0.4
MI-06a MI-06b	Release of Chlorine from Transfer Pipework Between Chlorine Compressor Unit and Chlorine Liquefaction Unit	Chlorine	3.5	22.9	5	Toxic (AEGL-2)	1.5/F	6.1
							4.6/C	3.7
MI-07	Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)	Chlorine	User defined release rate – 0.55 kg/sec	22.9	1	Toxic (AEGL-2)	1.5/F	9.3
							4.6/C	0.9

Software

DNV Phast 9.11 has been utilised for these dispersion models. Software inputs are provided in Appendix D

Meteorological Conditions

The key parameters when estimating the effects of dispersion are wind speed, temperature, relative humidity, atmospheric (Pasquill) stability class, and surface roughness. Weather conditions such as wind velocity and stability affect the extent of dilution with air, and the cloud velocity.

To determine the maximum downwind impacts for a scenario, several different weather conditions have been considered.

Gladstone Airport (Bureau of Meteorology site number 039326) was used as the closest reference location for the purposes of gathering past weather and climate information. A general summary is provided in Table 16

Table 16 Summary of Gladstone Airport Historical Weather Conditions

	Typical hot summer day	Typical average spring or autumn day	Typical cold winter day	Typical calm night
Wind speed (m/s)	6.7	4.9	4.6	1.5
Pasquill stability	C	B	C	F
Atmospheric Temperature (°C)	30.9	25.8	23.2	12.1
Reference	Jan mean max	May mean max	Jul mean max	Jul mean min
Relative Humidity (%)	60%	51%	46%	65%
Solar radiation (MJ/m^2)	24.7	15.3	13.7	0

Topographical Assumptions

The dispersion model does not account for the surrounding topography, which can either assist or hinder the dispersion of drifting vapour clouds. As chlorine gas is heavier than air, it tends to gather in valleys and low-lying areas once released into the atmosphere. The resulting footprints modelled assume a flat surface.

Typical surface roughness length criteria that may reasonably be applied for this location is 250mm, representative of a rural landscape with high crops and occasional large obstacles.

Assessment Criteria

- Acute Exposure Guideline Levels (AEGL) thresholds were selected as criteria for determining toxicity of chemical exposure. They define the exposure limits for the general public, including vulnerable people (e.g. elderly) for short-term exposure;
- AEGL-60 values were used – the airborne concentration of a substance above which health effects may occur after 60 minutes of exposure;
- For a transient or slow release, a 60 min. exposure duration is taken as a conservative estimate. The nature of releases considered under this scope of work fit under this category. No instantaneous release scenarios where a more limited exposure duration e.g. a catastrophic vessel rupture where the entire inventory of a given vessel is released at once; and
- AEGL-2 value was used as the threshold for serious harm to a person resulting from toxic exposure.

Table 17 Toxic Exposure Criterion

Level	Description	Consequence	Value (60 min.) [ppm]
AEGL-1	Airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.	Notable effects	0.5
AEGL-2	Airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.	Serious Injury	2
AEGL-3	Airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life threatening health effects or death.	Life Threatening	20

Tool

All scenarios modelled involved chlorine at pressure or as a user defined rate (enclosed building releases). +

- Scenarios were modelled as a leak from pressure vessel using DNV Phast, version 9.11. The tool is designed to simulate LoC events of hazardous chemicals from pressurised equipment. Toxic exposure results to determine the potential impact extents were taken for each applicable scenario.
- Enclosed building releases were modelled as a user defined release rate using DNV Phast, version 9.11. The release rates were calculated based a sealed building air exchange rate of 0.1 per hour.

Assumptions applicable to this model are (unless stated otherwise):

- The effects of any surrounding structures on the dispersion of toxic material are ignored;
- Effects of enclosure on the dispersion of toxic material are represented on Phast, described for each scenario;
- There is sufficient quantity of material for continuous discharge up to 3600 seconds;
- Release orientation is horizontal if orientation is unclear;
- The representative hole sizes for leaks covered under the International Association of Oil and Gas Producers' (IOGP) geometric mean approach are realistic to the behaviour of the system; and
- The temperature of the stream remains constant over the duration of the release.

Inputs

Inputs specific to scenarios are shown below.

Table 18 Inputs to Pressure Vessel Model – MI-01/03/04

Parameter	Value	Comment
Stream Temperature [ºC]	22.9	Ambient temperature
Stream Pressure [bar(g)]	0.5	Provided by Grenof
Release Elevation [m]	1.0	Release modelled at 1 m above ground level
Hole Size 1 [mm]	2.0	IOGP Geometric mean approach
Hole Size 2 [mm]	6.0	IOGP Geometric mean approach
Hole Size 3 [mm]	22.0	IOGP Geometric mean approach
Hole Size 4 [mm]	86.0	IOGP Geometric mean approach
Vessel Inventory [kg]	250	Estimated available based anticipated throughput
Release Location	Outside	Provided by Grenof / site layout

Table 19 Inputs to Equivalent Building Release Model – MI-05

Parameter	Value	Comment
Stream Temperature [ºC]	22.9	Ambient temperature
User defined release rate [kg/s]	0.1	Anticipated throughput and ACH = 0.1
Release Elevation [m]	1.0	Release modelled at 1 m above ground level
Release Location	Chlorine Compressor Building	Provided by Grenof / site layout

Table 20 Inputs to Pressure Vessel Model – MI-06a/b

Parameter	Value	Comment
Stream Temperature [ºC]	22.9	Ambient temperature
Stream Pressure [bar(g)]	3.5	Provided by Grenof
Release Elevation [m]	5.0	Release modelled at 1 m above ground level
Hole Size 1 [mm]	2.0	IOGP Geometric mean approach
Hole Size 2 [mm]	6.0	IOGP Geometric mean approach
Hole Size 3 [mm]	22.0	IOGP Geometric mean approach
Hole Size 4 [mm]	86.0	IOGP Geometric mean approach
Hole Size 5 – Full-Bore Rupture [mm]	150.0	Diameter of largest line
Vessel Inventory [kg]	1000.0	Isolatable inventory based on throughput
Release Location	Outside	Provided by Grenof / site layout

Table 21 Inputs to Equivalent Building Release Model – MI-07

Parameter	Value	Comment
Stream Temperature [ºC]	22.9	Ambient temperature
User defined release rate [kg/s]	0.55	20t tank inventory and ACH = 0.1
Release Elevation [m]	1.0	Release modelled at 1 m above ground level
Vessel Inventory [kg]	20000	Provided by Grenof
Release Location	Liquid Chlorine Building	Provided by Grenof / site layout

Building dimensions relevant to release locations are described below.

Assumptions applicable to buildings:

- Air changes remain constant;
- A small opening is considered for all enclosed buildings as a conservative estimate; and
- Openings on the building are in a circle shape.

Table 22 Chlorine Compressor Building

Parameter	Value	Comment
Length [m]	18	Based on site layout
Width [m]	12	Based on site layout
Height [m]	10	Based on site layout
Air Changes [h^{-1}]	0.1	Sealed building assumption

Table 23 Liquid Chlorine Building

Parameter	Value	Comment
Length [m]	40	Based on site layout
Width [m]	30	Based on site layout
Height [m]	10	Based on site layout
Air Changes [h^{-1}]	0.1	Sealed building assumption

Results

Table 24 Maximum Impact Radii at Toxic Exposure Thresholds – A0335 – MI-01/03/04

Hole Size	Weather Conditions	Distance to Toxic Exposure Thresholds [m]		
		AEGL-1 [0.5 ppm]	AEGL-2 [2 ppm]	AEGL-3 [20ppm]
2 mm	1.5/F	549.9	**222.0**	36.3
	4.6/C	69.3	33.7	8.9
	4.9/B	46.1	22.7	6.5
	6.7/C	58.2	28.5	7.9
6 mm	1.5/F	2040.9	**875.7**	167.2
	4.6/C	213.8	100.9	28.3
	4.9/B	137.8	67.3	19.6
	6.7/C	176.0	83.6	23.2

Hole Size	Weather Conditions	Distance to Toxic Exposure Thresholds [m]		
		AEGL-1 [0.5 ppm]	AEGL-2 [2 ppm]	AEGL-3 [20ppm]
22 mm	1.5/F	7502.1	**3593.8**	794.6
	4.6/C	883.3	428.8	131.4
	4.9/B	559.4	273.4	87.4
	6.7/C	718.8	343.3	101.5
86 mm	1.5/F	7015.1	**3536.8**	1041.3
	4.6/C	3511.8	1854.2	564.2
	4.9/B	2420.3	1213.5	387.9
	6.7/C	3226.1	1563.8	472.7

- 1.5/F (stable, cold night) weather condition produces the largest impact radius for all AEGL levels, for all hole sizes
- Off-site impacts are likely – zones up to 20 km
- Unstable weather significantly reduces spread

Table 25 Maximum Impact Radii at Toxic Exposure Thresholds – A0335 – MI-05

Hole Size	Weather Conditions	Distance to Toxic Exposure Thresholds [m]		
		AEGL-1 [0.5 ppm]	AEGL-2 [2 ppm]	AEGL-3 [20 ppm]
User defined release rate	1.5/F	6282.8	**3020.5**	778.1
	4.6/C	753.7	363.3	108.0
	4.9/B	470.1	227.2	69.1
	6.7/C	609.7	291.5	85.5

- Toxic effects of small release are essentially negligible
- Consequence severity does not really increase with hole size above 22 mm – release rate capped

Table 26 Maximum Impact Radii at Toxic Exposure Thresholds – A0335 – MI-06a/b

Hole Size	Weather Conditions	Distance to Toxic Exposure Thresholds [m]		
		AEGL-1 [0.5 ppm]	AEGL-2 [2 ppm]	AEGL-3 [20 ppm]
2 mm	1.5/F	897.5	**320.7**	Not reached
	4.6/C	105.6	Not reached	Not reached
	4.9/B	68.5	Not reached	Not reached
	6.7/C	84.1	Not reached	Not reached
6 mm	1.5/F	3911.7	**1557.1**	219.3
	4.6/C	381.0	168.7	Not reached
	4.9/B	245.1	110.0	Not reached
	6.7/C	309.7	136.3	Not reached
22 mm	1.5/F	13458.0	**6478.0**	1328.1
	4.6/C	1626.4	759.0	193.2
	4.9/B	1057.0	485.7	127.5
	6.7/C	1363.6	610.4	149.4
86 mm	1.5/F	12527.9	**6148.5**	1719.7
	4.6/C	4636.1	3199.4	1163.1
	4.9/B	3924.6	2324.4	784.4
	6.7/C	5440.1	3051.5	910.5
150 mm	1.5/F	10681.6	**4900.2**	1651.4

	4.6/C	6453.6	3755.1	1550.1
	4.9/B	4798.6	2847.7	1222.4
	6.7/C	6292.2	3754.8	1515.8

Table 27 Maximum Impact Radii at Toxic Exposure Thresholds – A0335 – MI-07

Hole Size	Weather Conditions	Distance to Toxic Exposure Thresholds [m]		
		AEGL-1 [0.5 ppm]	AEGL-2 [2 ppm]	AEGL-3 [20 ppm]
User defined release rate	1.5/F	19191.5	9325.0	2401.8
	4.6/C	1942.5	905.5	265.1
	4.9/B	1206.9	575.6	176.7
	6.7/C	1580.1	744.6	221.3

Enclosed Building Assumptions

The assumptions outlined in Table 28 have been used in the assessment of offsite impacts for potential chlorine releases within enclosed / sealed chlorine process buildings

Table 28 Enclosed Process Building Assumptions

Assumption	Basis
Sealed building Air Changes per Hour (ACH) = 0.1	The enclosed chlorine process building is designed to well-sealed to detain any potential chlorine leaks. The ACH for these building are expected to be less than conventional chlorine dosing building ACH = 1 [5], and a certified 'Passive House' ACH = 0.6 [6]
Enclosed 'sealed' chlorine process building considered a passive (inherent) control	Potential chlorine gas leaks will be detained within the enclosed 'sealed' chlorine process buildings with leakage rate from the building based on the assumed building air changes per hour (ACH). Note: The Waste Gas Dechlorination System extraction fans which keep the building air space under continual slight negative pressure is considered an additional active control measure.
Releases from enclosed / sealed chlorine process building considered as a calculated equivalent point source release	With reference to the depiction in Figure 7 Equivalent Release from Enclosed Building releases into the enclosed / sealed building will be detained within the building and release to the external atmosphere through passive air exchanges. The following equivalent release rates were used for the following buildings: • Chlorine Compression building – maximum release into the building based on facility production rate (90tpd), exchanging with the outside atmosphere at an exchange rate of 0.1 per hour (= 0.1 kg/s) • Liquid Chlorine building - maximum release into the building based on maximum isolatable inventory of 20t. exchanging with the outside atmosphere at an exchange rate of 0.1 per hour (= 0.55 kg/s)

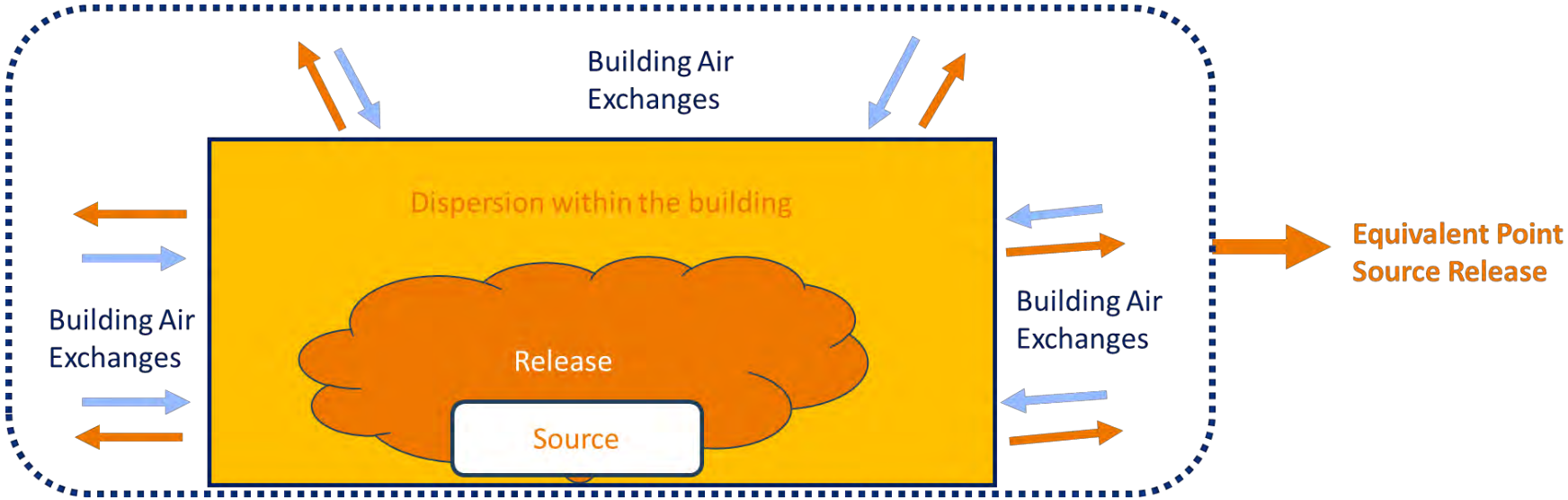


Figure 7 Equivalent Release from Enclosed Building (illustrative)

Appendix E. Rose of Wind direction versus Wind speed

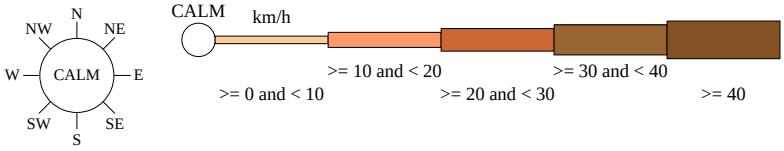
Rose of Wind direction versus Wind speed in km/h (26 Oct 1993 to 10 Aug 2025)

Custom times selected, refer to attached note for details

GLADSTONE AIRPORT

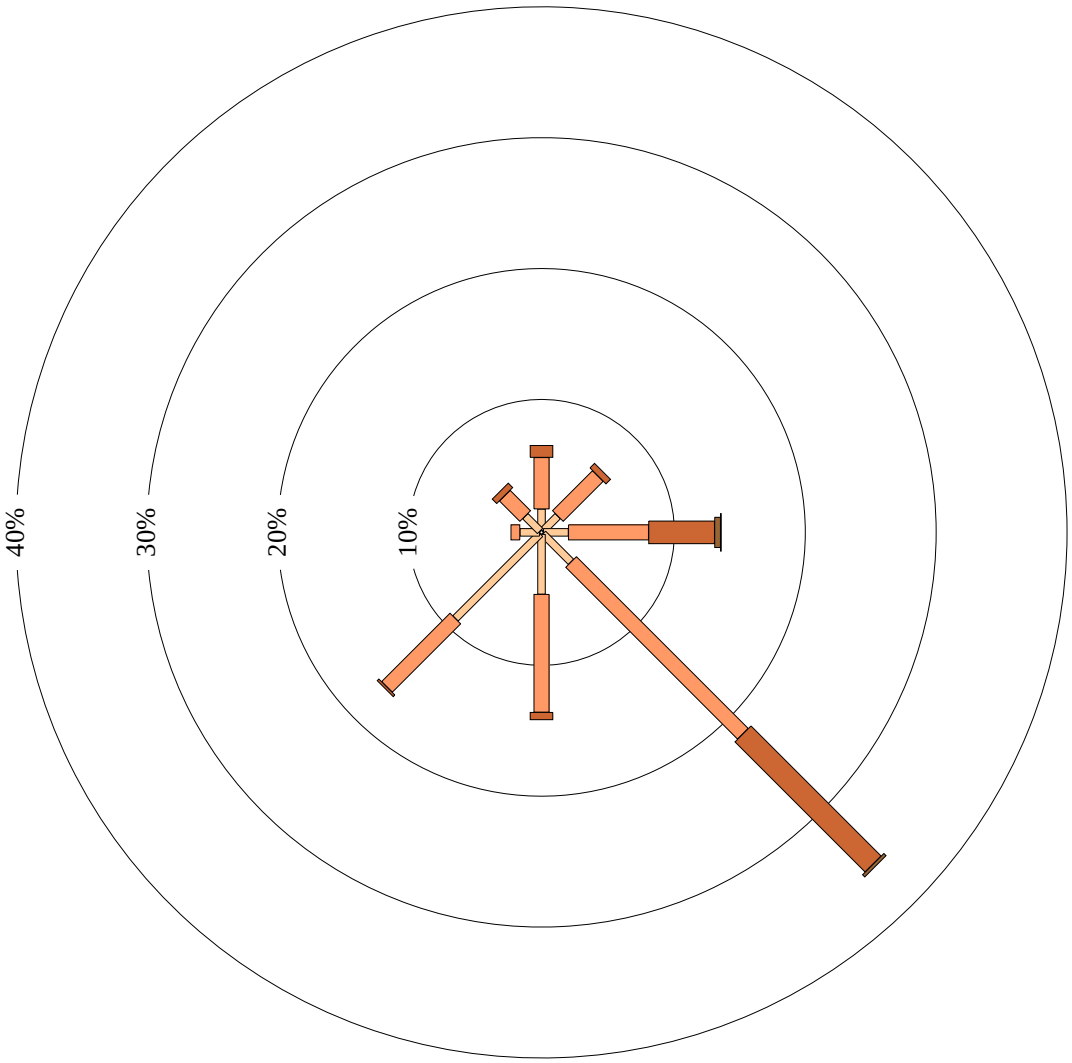
Site No: 039326 • Opened Oct 1993 • Still Open • Latitude: -23.8697° • Longitude: 151.2214° • Elevation 16.m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



9 am
11460 Total Observations

Calm 1%



Rose of Wind direction versus Wind speed in km/h (26 Oct 1993 to 10 Aug 2025)

Custom times selected, refer to attached note for details

GLADSTONE AIRPORT

Site No: 039326 • Opened Oct 1993 • Still Open • Latitude: -23.8697° • Longitude: 151.2214° • Elevation 16.m

An asterisk (*) indicates that calm is less than 0.5%.
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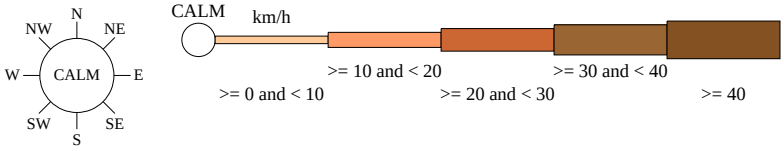
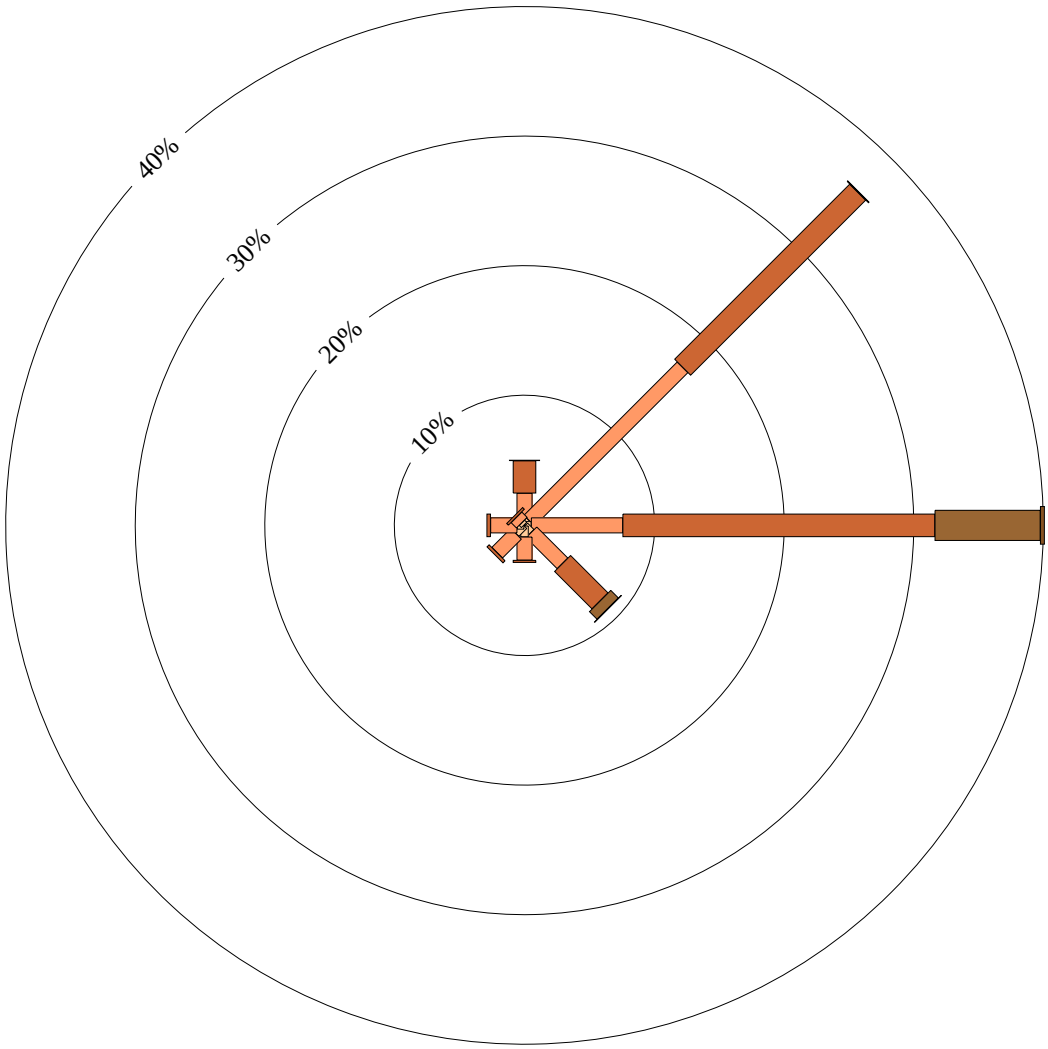


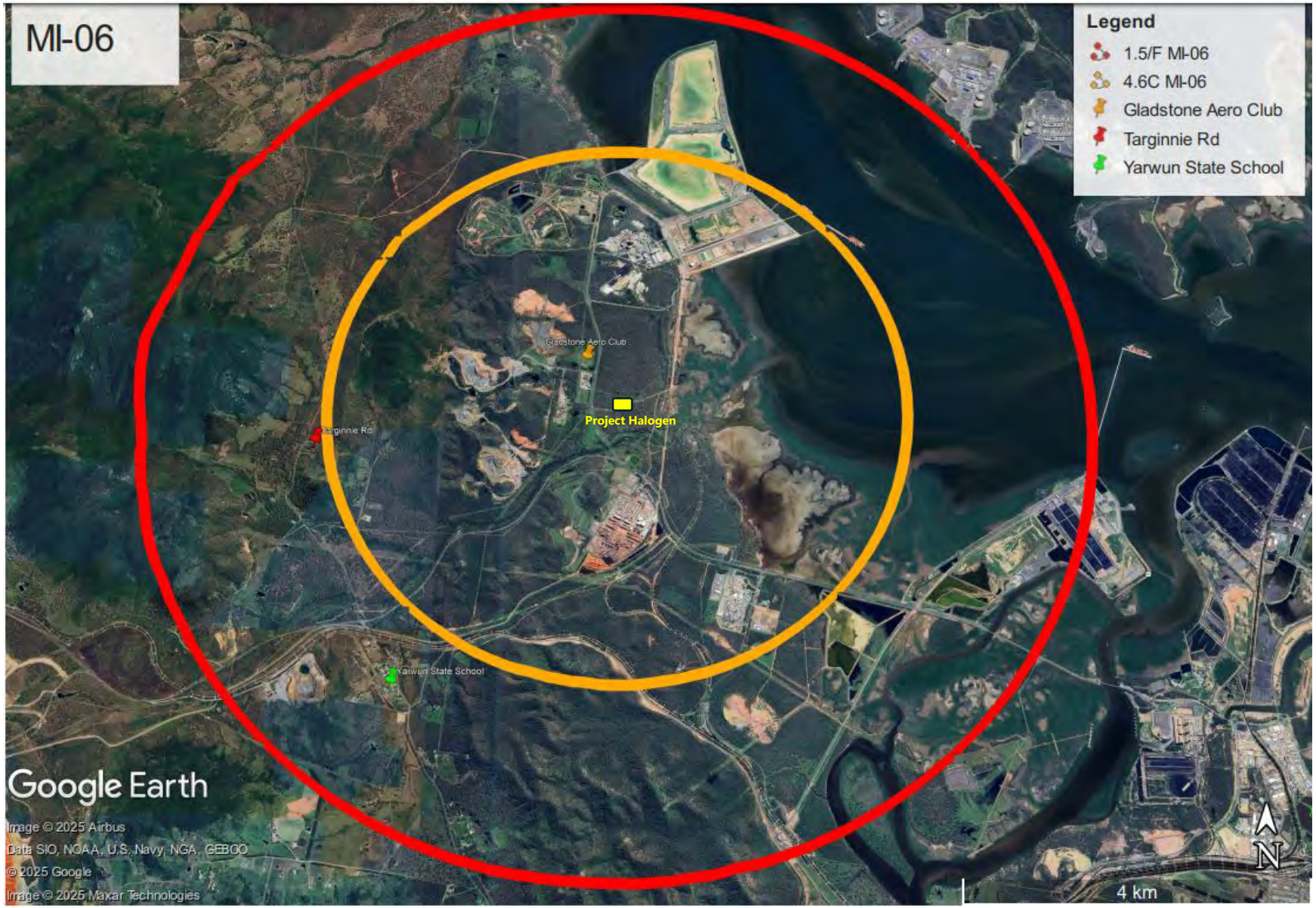
3 pm
11469 Total Observations

Calm *



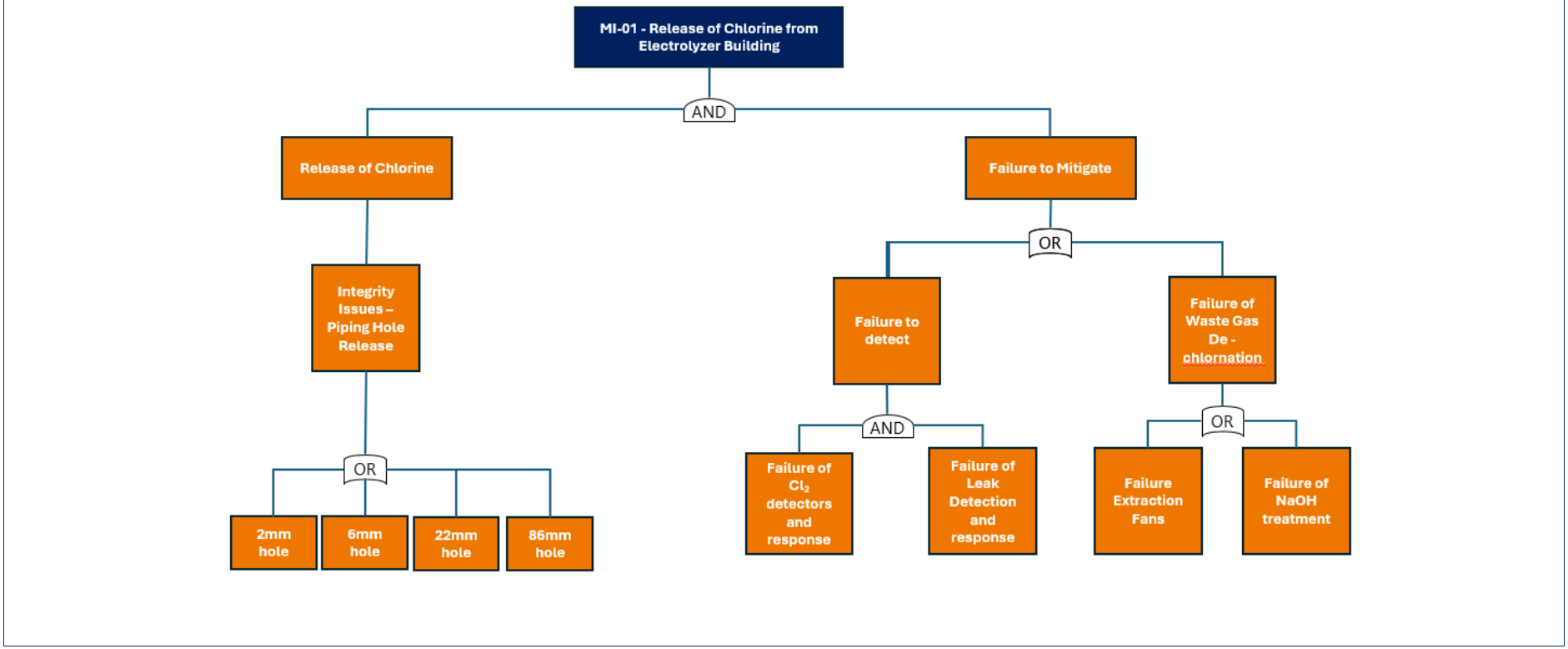
Appendix F. Consequence Contour Overlays

- MI-02/03 – 1.5/F and 4.6/C Consequence Contours
- MI-05 - 1.5/F and 4.6/C Consequence Contours
- MI-06 - 1.5/F and 4.6/C Consequence Contours
- MI-07 - 1.5/F and 4.6/C Consequence Contours

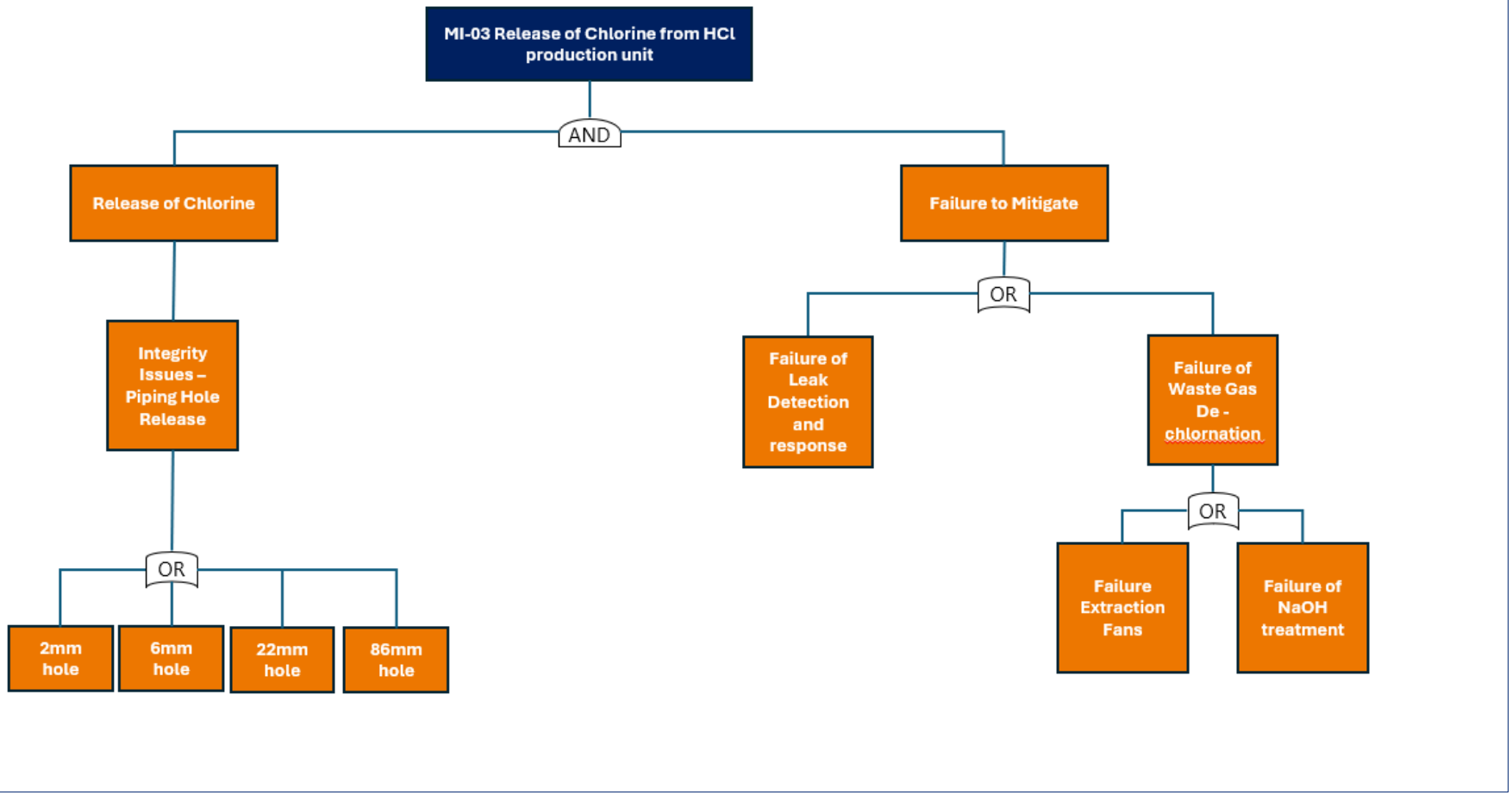


Appendix G. Incident Pathway – Fault Tree Analysis

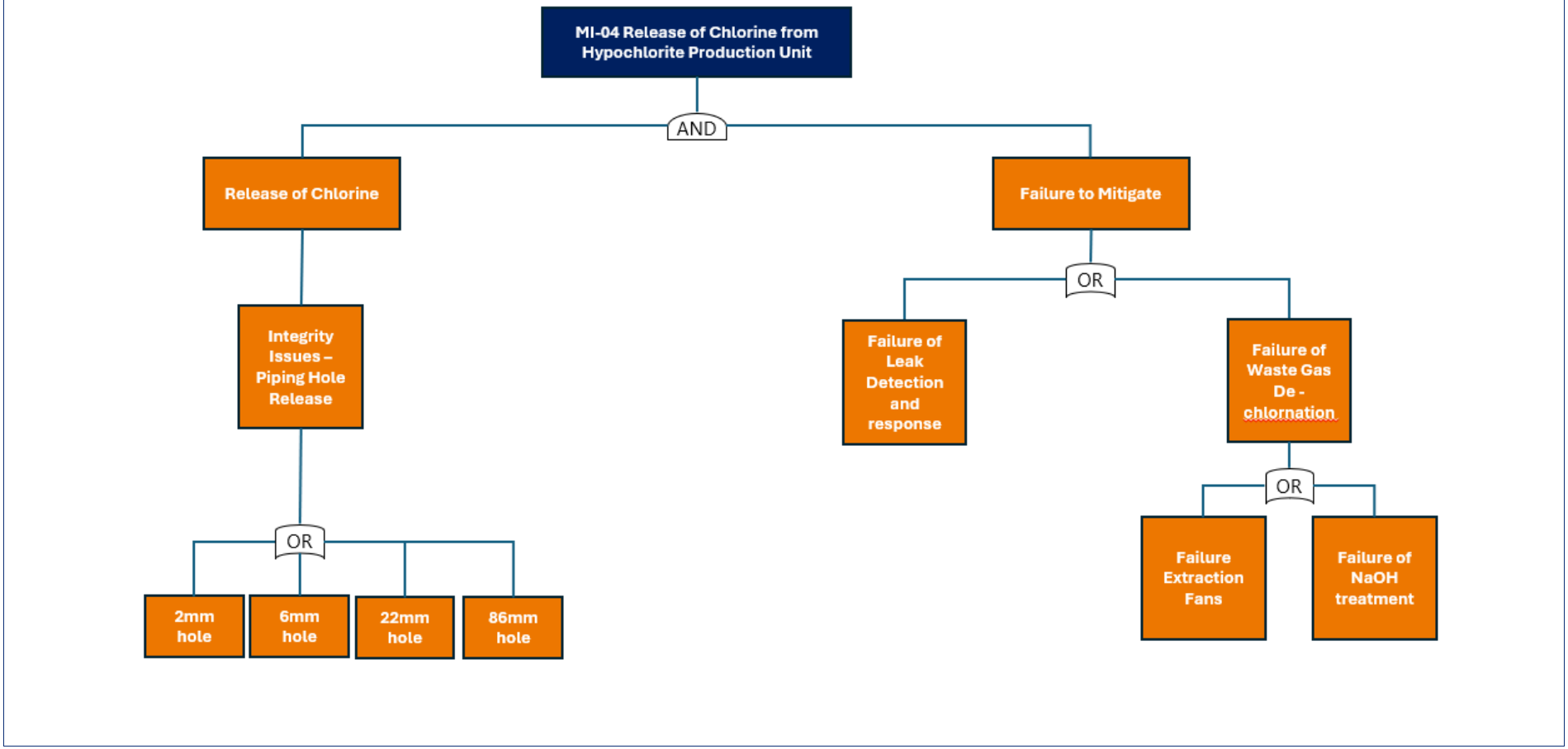
Fault Tree - MI-01 - Release of Chlorine from Electrolyzer Building



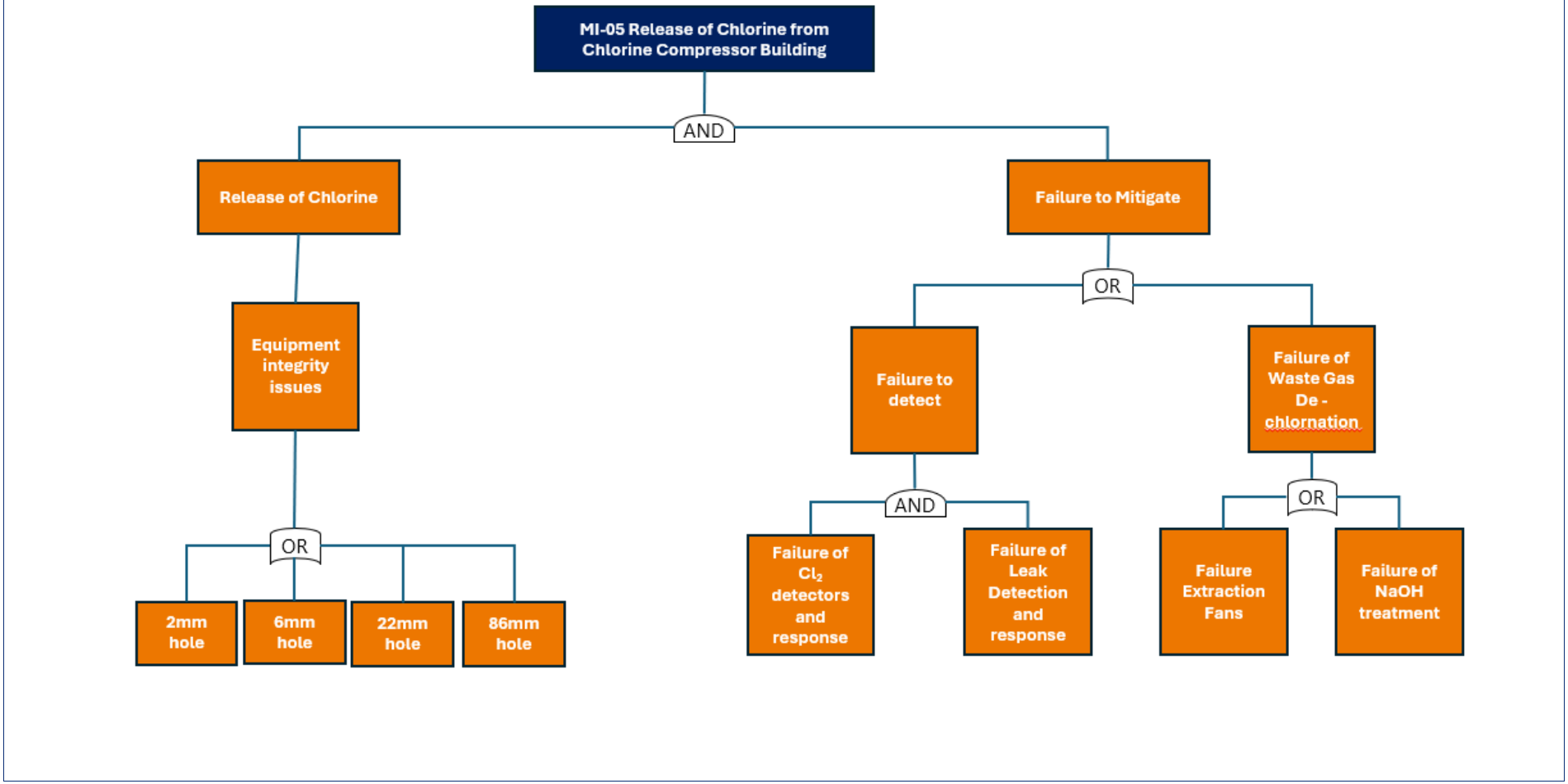
Fault Tree - MI-03 Release of Chlorine from HCl production unit



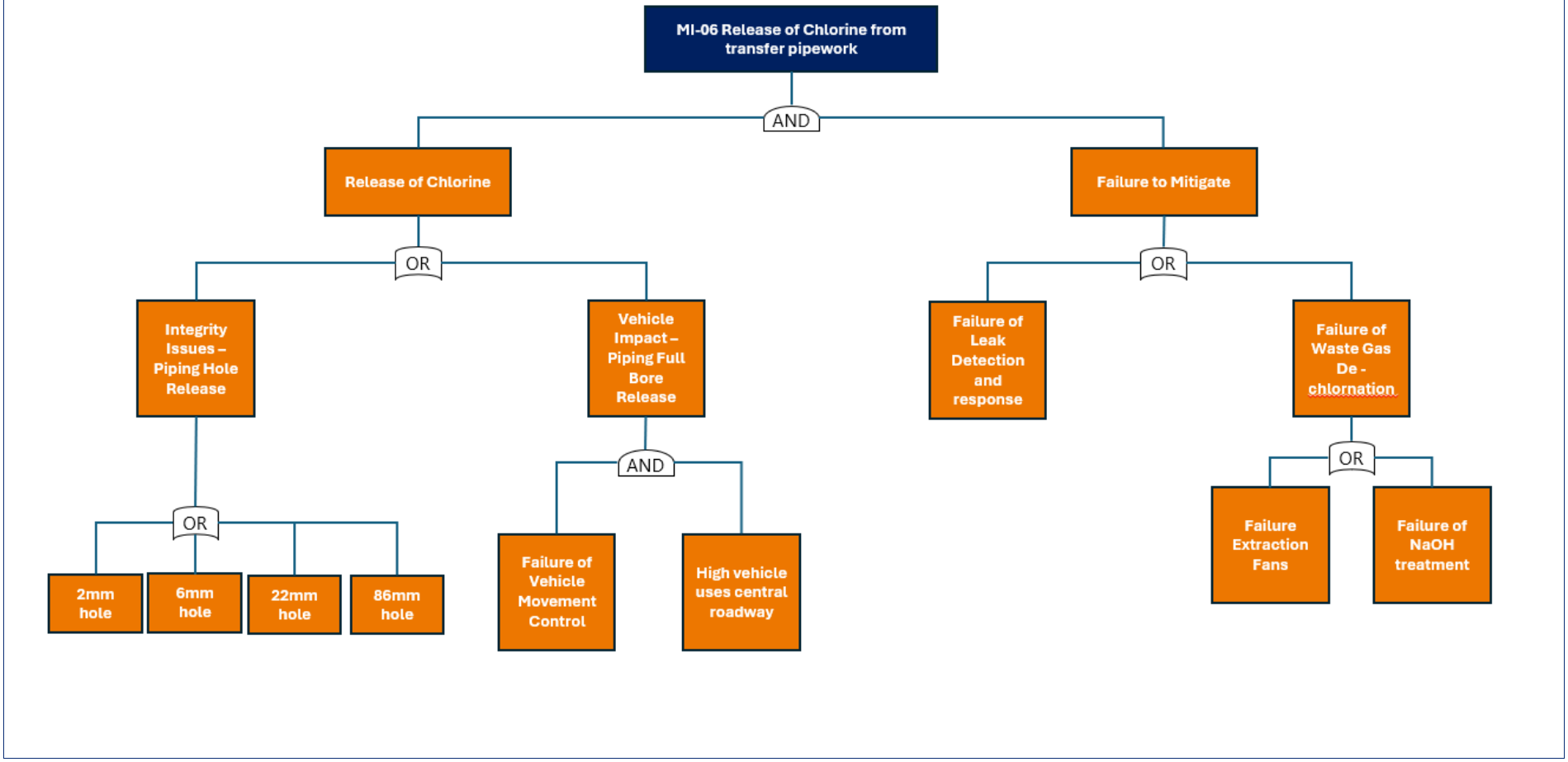
Fault Tree - MI-04 Release of Chlorine from Hypochlorite Production Unit



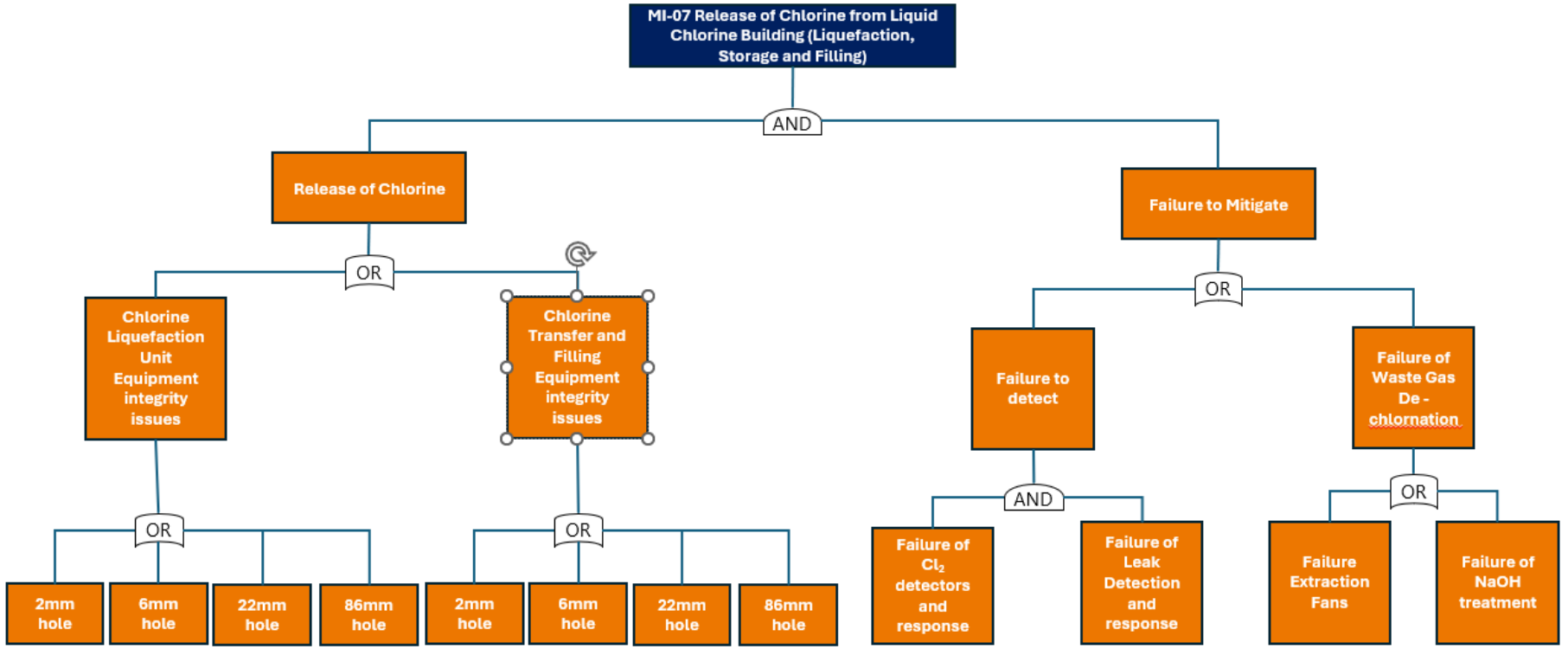
Fault Tree - MI-05 Release of Chlorine from Chlorine Compressor Building



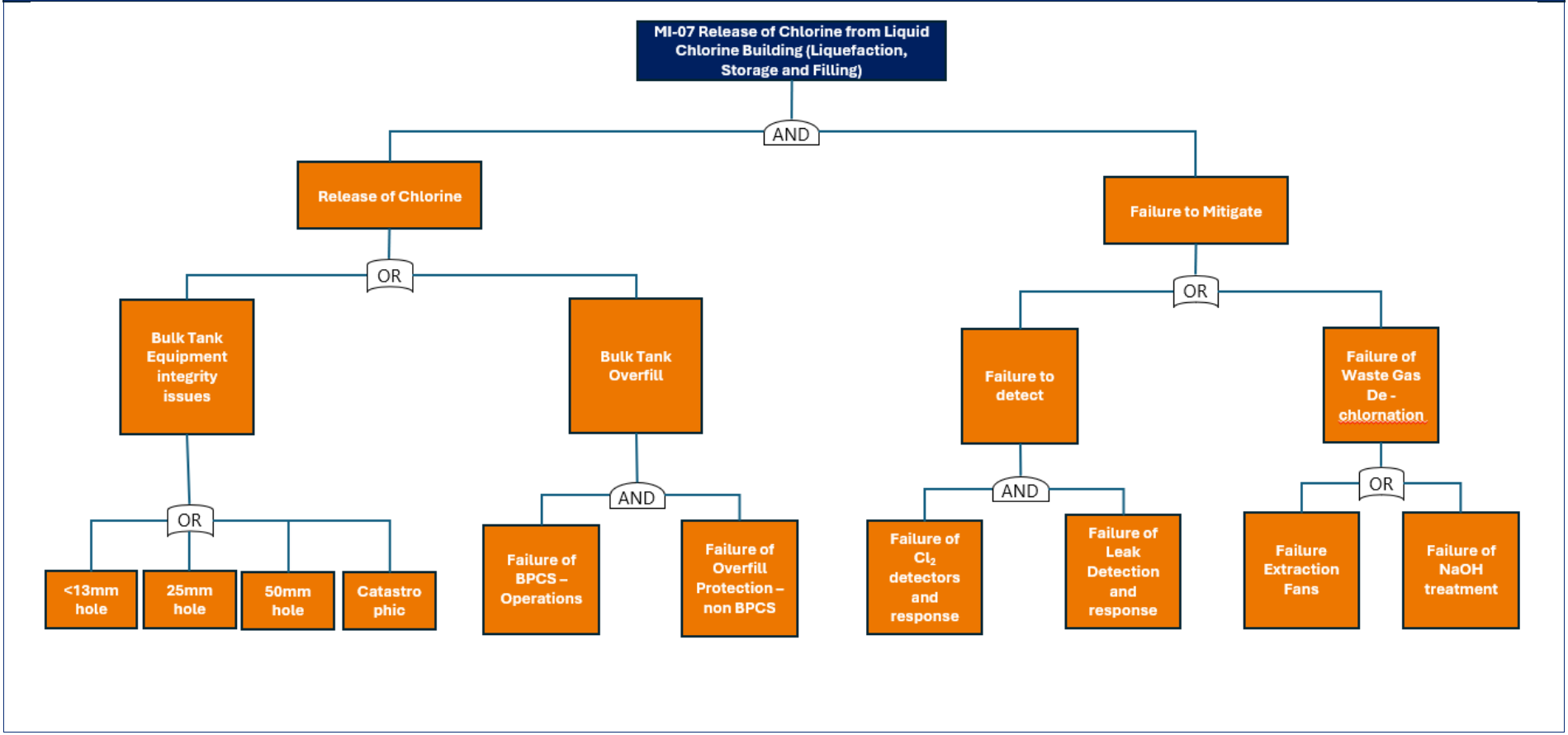
Fault Tree - MI-06 Release of Chlorine from transfer pipework



Fault Tree - MI-07 Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling) - Piping



Fault Tree - MI-07 Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling) – Bulk Storage Tanks



Appendix H. Risk Control Measures

Table 29 Key Risk Control Measures – Design / Engineering

Process Area	Control Measure	Description
General	Basic Process Control Systems	A Basic Process Control Systems (BPCS) will be in place to monitor and control the chlor-alkali industrial processes, ensuring safe, stable, and efficient operations by maintaining process variables such as temperature, pressure, and flow within set limits.
11 Electrolyzer	Single Element Electrode Unit	The standalone electrolysis cell consists of the anode and cathode within a steel frame unit with polytetrafluoroethylene sealing system and integrated headers minimises leaks from the unit Pressure differential is measured across each elecytrolysis cell with any pin hole leaks immediately identified by the distributed control system.
11 Electrolyzer	Electrode Unit leak detection	Pressure differential is measured across each elecytrolysis cell with any pin hole leaks immediately identified by the distributed control system
11 Electrolyzer	Hydrogen Vent Stack	Excess hydrogen within the electrolyser is vented to a safe location in a closed process via the hydrogen stack vent within required limits.
07 Anolyte Dechlorination	Hydrogen Peroxide Dosing	Hydrogen peroxide is dosed to the anolyte to achieve dechlorination within a closed system (removal of free chlorine)
General	Waste Gas Dechlorination System	Emergency chlorine gases from the plant are directed to sodium hydroxide scrubber unit to neutralize chlorine gas emissions within a controlled closed process. The duty/standby fans provide require suction on the on-chlorine lines preventing chlorine leaks within the plant, that are always in operation the plant is operating The resulting sodium hypochlorite is returned into the system within a closed loop for re processing.
General	Ambient air chlorine gas detectors	Chlorine gas detectors are strategically positioned throughout the plant to identify chlorine releases and initiate early mitigation action (process shutdown, Waste Gas Dechlorination System, etc). The chlorine gas detectors are integrated into the distributed control which alarm when activated, enabling the operator to isolate the process within the production facility.

Process Area	Control Measure	Description
General	Process Leak detection	The venting of chlorine gas lines to the 26 – Waste Gas Dechlorination process unit is managed through automated control process loops and precise pressure differentiation measures, allowing pin-hole accuracy in determining when venting is required. The system utilises dedicated pressure transmitters and interlocks to continuously monitor line pressure and trigger venting sequences when pre-set thresholds are reached. Automatic process loops govern the opening and closing of isolation and vent valves, ensuring a controlled flow path and maintaining process safety. This fully automated control philosophy minimises manual intervention while providing reliable venting, with all valve activations sequenced through the DCS to prevent uncontrolled releases and maintain stable downstream operating conditions.
41 Hydrogen Cooling	Hydrogen Vent Stack	Excess hydrogen (not required for HCl production) is vented to a safe location via the hydrogen stack vent under minimal pressure.
51 HCl Production	Hydrogen and chlorine feed rates to burner	Hydrogen is to be kept at constant stoichiometric excess of 10-15% to ensure that all chlorine reacts and avoid free chlorine content in the vent gas.
23 Chlorine Liquefaction	Sniff gas management	Sniff gas (uncondensed chlorine, nitrogen, oxygen and carbon dioxide) from the liquefaction unit are directed to sodium hypochlorite production and/or Waste Gas Dechlorination System to prevent chlorine releases in vent gas within a controlled closed process that is always in operation when the plant is operating
General	Enclosed building for Chlorine processes	Electrolyser, Chlorine Compression, Chlorine Liquefaction Chlorine Storage & Filling operations are contained within a fully enclosed buildings to contain any potential chlorine leaks. These buildings are also linked to the Gas Dechlorination System and are always maintained at a slight negative pressure.

Process Area	Control Measure	Description
General	Ambient air Chlorine gas detectors	Chlorine gas detectors are strategically positioned throughout enclosed buildings to identify chlorine releases and initiate early mitigation action (process shutdown, Waste Gas Dechlorination System, etc). The chlorine gas detectors are integrated into the distributed control which alarm when activated, enabling the operator to isolate the process within the production facility.
24 Chlorine Storage & Filling	Chlorine Bulk tank level control and over fill protection	Chlorine storage tanks are provided with weighing indicator with alarm (local and remote), a weighing switch with alarm (local and remote), a level indicator with alarm (local and remote), and a pressure indicator with alarm (local and remote). Redundant automatic system controlled by DCS. The process has an empty storage tank for emergencies and ability through closed loop to push gas into the emergency tank as or when required.
24 Chlorine Storage & Filling	Chlorine Bulk tank over pressure protection	Chlorine storage tanks are provided with dual burst disk / pressure relief valves to mitigate over pressurisation (as final protection). Vented chlorine from the pressure relief valves is directed to Waste Gas Dechlorination System for safe neuralisation within a controlled closed process that is always in operation when the plant is operating
24 Chlorine Storage & Filling	Chlorine Bulk tank bunding	Chlorine storage tanks are provided with external bunding to contain and initiate early mitigation action (directed to Waste Gas Dechlorination System for safe neuralisation within a controlled closed process that is always in operation when the plant is operating), in the event of a chlorine release from the tank.
24 Chlorine Storage & Filling	Spare Emergency Chlorine Bulk Tank	In the event of an emergency process upset or integrity issue with one of the in-use bulk chlorine storage tanks, chlorine can be transferred to the spare emergency chlorine bulk tank for containment, reuse or directed to Waste Gas Dechlorination System for safe neuralisation.

Process Area	Control Measure	Description
24 Chlorine Storage & Filling	Rupture disks releasing to expansion vessels on liquid chlorine fill lines	Rupture disks provide control release point should isolated fill lines over pressurise due to liquid chlorine expansion/vapourisation. Rupture disk release to expansion vessels and are directed to the Waste Gas Dechlorination System for safe neuralisation. Four tanks are in use for liquefied chlorine gas with one being a failsafe always remaining empty in the event gas needs to be transferred to the empty vessel in an emergency.
24 Chlorine Storage & Filling	Displaced gas directed to Waste Gas Dechlorination System	Displaced gases (padding air, chlorine) from the filling and testing of cylinders and containers is directed to the Waste Gas Dechlorination System for safe neuralisation.
27 Sodium Hypochlorite Storage	Hypochlorite Bulk Storage Design	Sodium hypochlorite bulk storage in accordance with AS 3780 *The storage and handling of corrosive substances* (Tank design, overfill protection, bunding design etc.) Bulk sodium hypochlorite does not share a common bund or bund drain with other products in particular hydrochloric acid or sulphuric acid
32 Caustic Soda Storage	Caustic Bulk Storage Design	Caustic soda bulk storage in accordance with AS 3780 *The storage and handling of corrosive substances* (Tank design, overfill protection, bunding design etc.) Bulk caustic soda does not share a common bund or bund drain with other products in particular hydrochloric acid or sulphuric acid
52 Hydrochloric Acid Storage	Hydrochloric Acid Bulk Storage Design	Hydrochloric acid bulk storage in accordance with AS 3780 *The storage and handling of corrosive substances* (Tank design, overfill protection, bunding design etc.) Bulk hydrochloric acid does not share a common bund or bund drain with other products in particular sodium hypochlorite or caustic soda
91 Sulphuric Acid Filling and Storage	Sulphuric Acid Bulk Storage Design	Sulphuric acid bulk storage in accordance with AS 3780 *The storage and handling of corrosive substances* (Tank design, overfill protection, bunding design etc.) Bulk sulphuric acid does not share a common bund or bund drain with other products in particular sodium hypochlorite or caustic soda

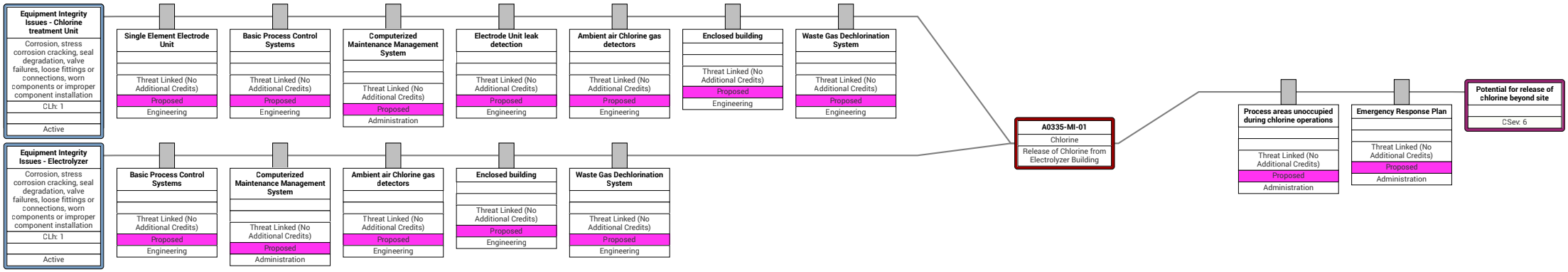
Process Area	Control Measure	Description
General	Facility Structural Design	In line with the requirements of the National Construction Code (NCC) the design and construction of the facility will address the specific requirements for buildings and structures to resist natural hazard events such as floods, earthquakes, cyclones, and bushfires.

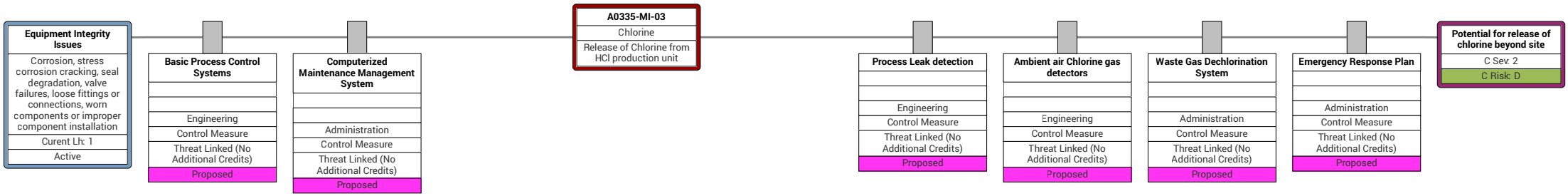
Table 30 Key Risk Control Measures -Operational / Administrative

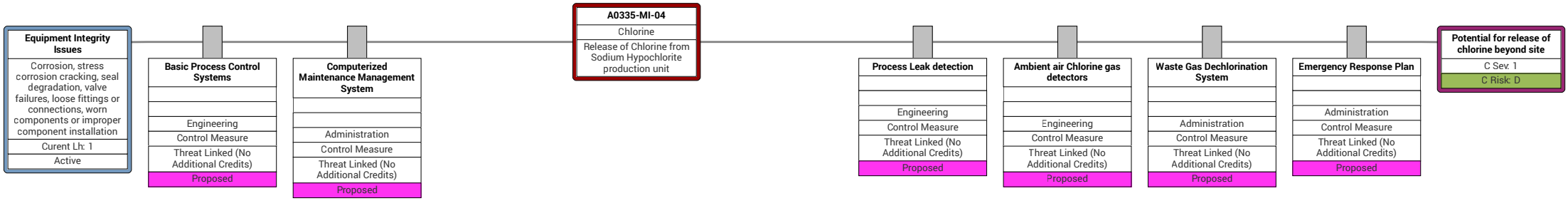
Process Area	Control Measure	Description
General	Process areas unoccupied during chlorine operations	Chlorine process areas, and specifically enclosed buildings, will be unoccupied during chlorine operations to minimise the risk to personnel to chlorine exposure and to detain and manage any chlorine within the building in the event of an accidental chlorine release from process equipment.
General	Emergency Response Plan	A comprehensive Emergency Response Plan (ERP) for the Grenof Project Halogen operations will be developed. This ERP will include clear on-site and off-site emergency notification and communication protocols, evacuation and shelter-in-place procedures, assignment of roles and responsibilities, emergency resources etc. The ERP will be an integral part of the Safety Management System for the facility.
General	Bush Fire Management Plan	A Bushfire Management Plan for the Grenof Project Halogen operations will be developed. This Bushfire Management Plan will outline the strategies protection measures to reduce bushfire risk and protect lives, the facility, and the environment.
General	Safety Management System	A Safety Management System (SMS) will be established that complies with the WHS Regulations providing the structured framework to identify, assess, and control hazards, ensuring that comprehensive safety measures are in place manage process safety risks.
General	Computerized Maintenance Management System (CMMS)	A CMMS will be implemented to manage work orders, schedule and track preventive maintenance, monitor asset history, provide better visibility into asset performance and provide data-driven reporting to improve efficiency, regulatory compliance and safety.

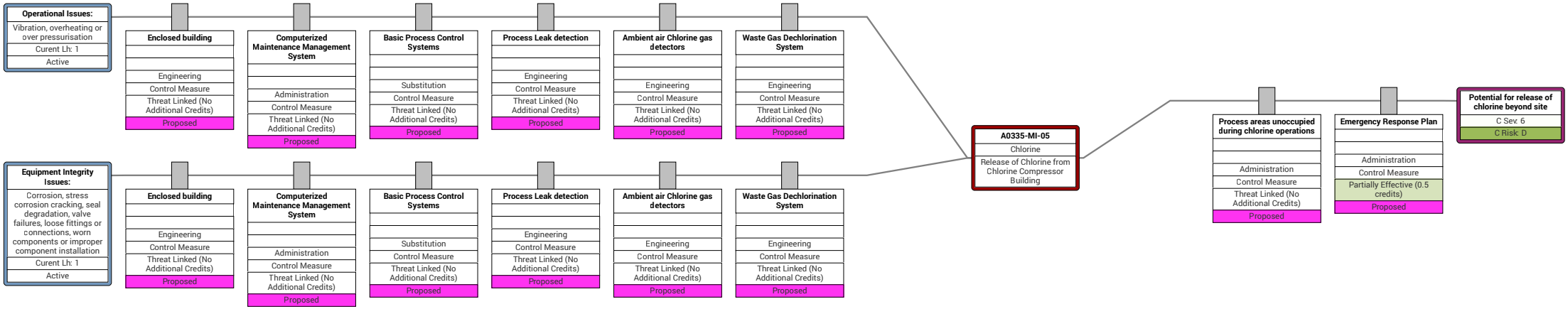
Process Area	Control Measure	Description
22 Chlorine Compression	Exclusion of Vehicles in proximity of pipe bridge	Vehicles movement will be excluded from the proximity of the pipe bridge crossing the central roadway in the Grenof Project Halogen facility to prevent any external impact to the piping or the pipe bridge structure. The exclusion of vehicle movements will be implemented using physical and procedural methods to be finalised during detailed design.
General	Facility physical security plans	Facility physical security plan will be implemented including perimeter security fencing, lighting, signage, facility access control and management and surveillance and monitoring. The Grenof Project Halogen operations will be 24/7 with security monitored by the control room.
General	Cyber security plans	A Cyber security plan will be implemented to protect against external cyber threats. This will include network segregation isolating OT systems from IT networks, access management, back-up and recovery and integration of cyber security incident response with ERP.

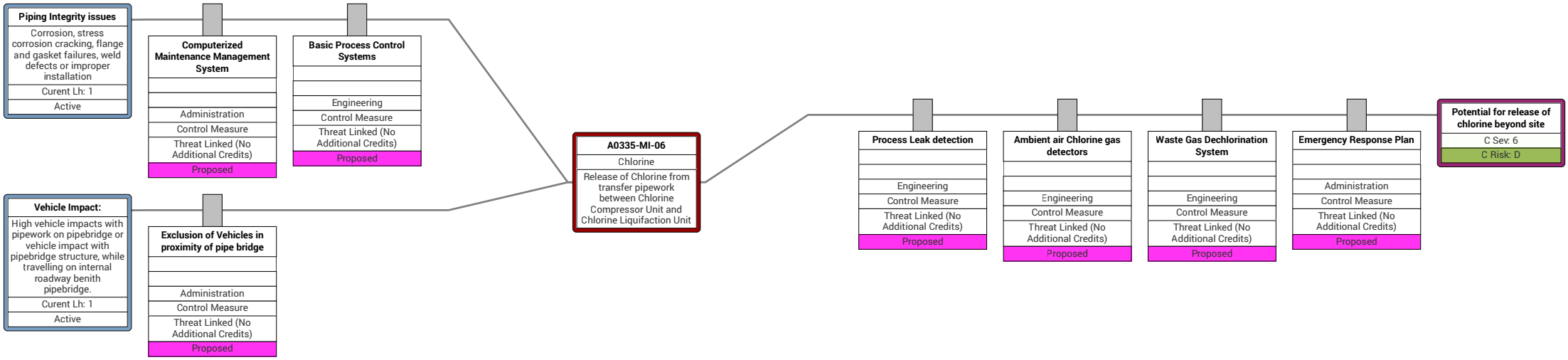
Appendix I. Scenario Bow Ties

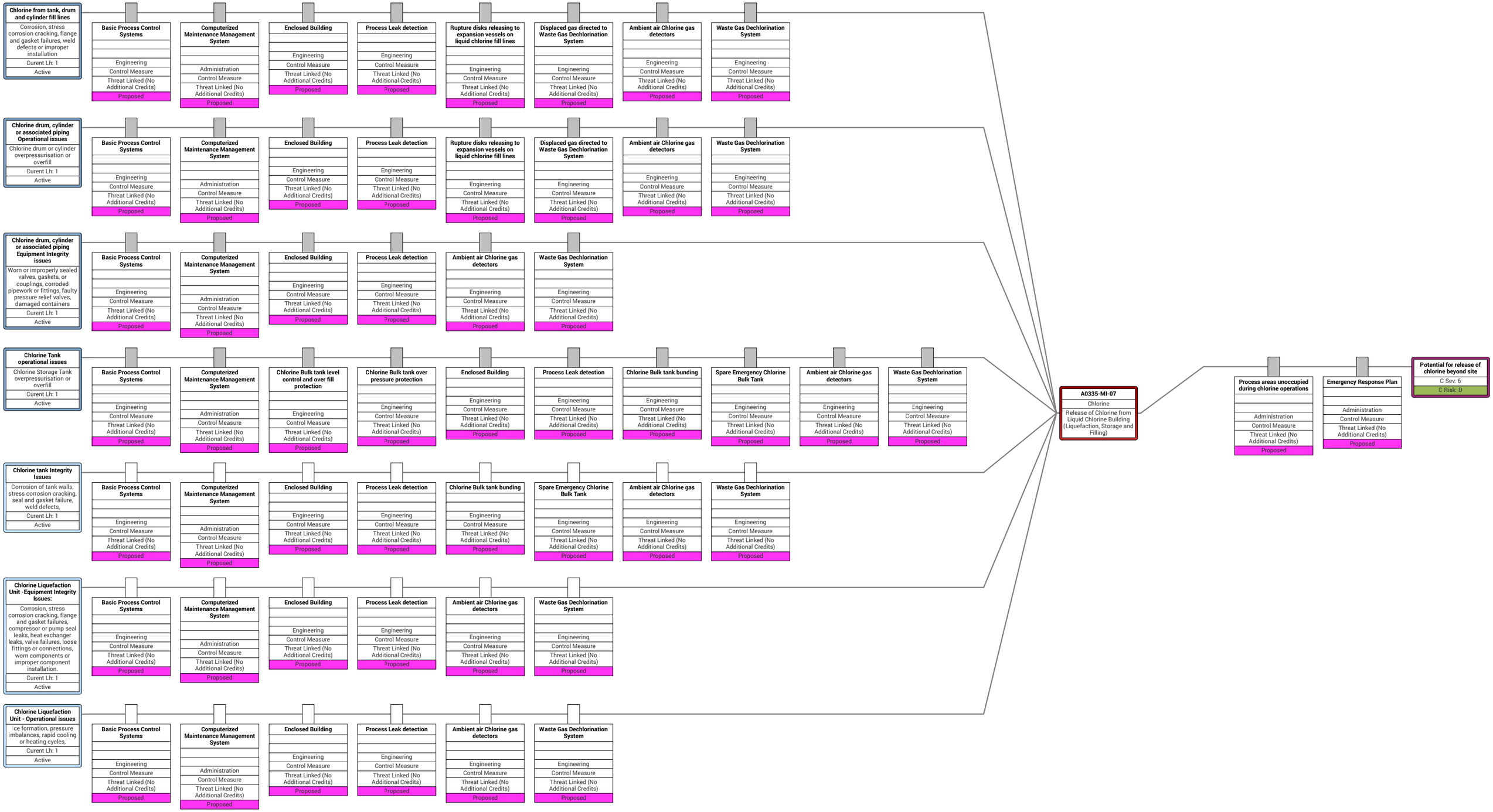

Equipment Integrity Issues - Chlorine treatment Unit
Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation
CLh: 1
Active
Single Element Electrode Unit
Threat Linked (No Additional Credits)
Proposed
Engineering
Basic Process Control Systems
Threat Linked (No Additional Credits)
Proposed
Engineering
Computerized Maintenance Management System
Threat Linked (No Additional Credits)
Proposed
Administration
Electrode Unit leak detection
Threat Linked (No Additional Credits)
Proposed
Engineering
Ambient air Chlorine gas detectors
Threat Linked (No Additional Credits)
Proposed
Engineering
Enclosed building
Threat Linked (No Additional Credits)
Proposed
Engineering
Waste Gas Dechlorination System
Threat Linked (No Additional Credits)
Proposed
Engineering
Equipment Integrity Issues - Electrolyzer
Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation
CLh: 1
Active
Basic Process Control Systems
Threat Linked (No Additional Credits)
Proposed
Engineering
Computerized Maintenance Management System
Threat Linked (No Additional Credits)
Proposed
Administration
Ambient air Chlorine gas detectors
Threat Linked (No Additional Credits)
Proposed
Engineering
Enclosed building
Threat Linked (No Additional Credits)
Proposed
Engineering
Waste Gas Dechlorination System
Threat Linked (No Additional Credits)
Proposed
Engineering
A0335-MI-01
Chlorine
Release of Chlorine from Electrolyzer Building
Process areas unoccupied during chlorine operations
Threat Linked (No Additional Credits)
Proposed
Administration
Emergency Response Plan
Threat Linked (No Additional Credits)
Proposed
Administration
Potential for release of chlorine beyond site
CSev: 6


Equipment Integrity Issues
Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation
Curent Lh: 1
Active
Basic Process Control Systems
Engineering
Control Measure
Threat Linked (No Additional Credits)
Proposed
Computerized Maintenance Management System
Administration
Control Measure
Threat Linked (No Additional Credits)
Proposed
A0335-MI-03
Chlorine
Release of Chlorine from HCl production unit
Process Leak detection
Engineering
Control Measure
Threat Linked (No Additional Credits)
Proposed
Ambient air Chlorine gas detectors
Engineering
Control Measure
Threat Linked (No Additional Credits)
Proposed
Waste Gas Dechlorination System
Administration
Control Measure
Threat Linked (No Additional Credits)
Proposed
Emergency Response Plan
Administration
Control Measure
Threat Linked (No Additional Credits)
Proposed
Potential for release of chlorine beyond site
C Sev: 2
C Risk: D


Equipment Integrity Issues
Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation
Curent Lh: 1
Active
Basic Process Control Systems
Engineering
Control Measure
Threat Linked (No Additional Credits)
Proposed
Computerized Maintenance Management System
Administration
Control Measure
Threat Linked (No Additional Credits)
Proposed
A0335-MI-04
Chlorine
Release of Chlorine from Sodium Hypochlorite production unit
Process Leak detection
Engineering
Control Measure
Threat Linked (No Additional Credits)
Proposed
Ambient air Chlorine gas detectors
Engineering
Control Measure
Threat Linked (No Additional Credits)
Proposed
Waste Gas Dechlorination System
Administration
Control Measure
Threat Linked (No Additional Credits)
Proposed
Emergency Response Plan
Administration
Control Measure
Threat Linked (No Additional Credits)
Proposed
Potential for release of chlorine beyond site
C Sev: 1
C Risk: D


Operational Issues:
Vibration, overheating or over pressurisation
Curent Lh: 1
Active
Enclosed building
Engineering
Control Measure
Threat Linked (No Additional Credits)
Proposed
Computerized Maintenance Management System
Administration
Control Measure
Threat Linked (No Additional Credits)
Proposed
Basic Process Control Systems
Substitution
Control Measure
Threat Linked (No Additional Credits)
Proposed
Process Leak detection
Engineering
Control Measure
Threat Linked (No Additional Credits)
Proposed
Ambient air Chlorine gas detectors
Engineering
Control Measure
Threat Linked (No Additional Credits)
Proposed
Waste Gas Dechlorination System
Engineering
Control Measure
Threat Linked (No Additional Credits)
Proposed
Equipment Integrity Issues:
Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation
Curent Lh: 1
Active
Enclosed building
Engineering
Control Measure
Threat Linked (No Additional Credits)
Proposed
Computerized Maintenance Management System
Administration
Control Measure
Threat Linked (No Additional Credits)
Proposed
Basic Process Control Systems
Substitution
Control Measure
Threat Linked (No Additional Credits)
Proposed
Process Leak detection
Engineering
Control Measure
Threat Linked (No Additional Credits)
Proposed
Ambient air Chlorine gas detectors
Engineering
Control Measure
Threat Linked (No Additional Credits)
Proposed
Waste Gas Dechlorination System
Engineering
Control Measure
Threat Linked (No Additional Credits)
Proposed
A0335-MI-05
Chlorine
Release of Chlorine from Chlorine Compressor Building
Process areas unoccupied during chlorine operations
Administration
Control Measure
Threat Linked (No Additional Credits)
Proposed
Emergency Response Plan
Administration
Control Measure
Partially Effective (0.5 credits)
Proposed
Potential for release of chlorine beyond site
C Sev: 6
C Risk: D


Piping Integrity issues
Corrosion, stress corrosion cracking, flange and gasket failures, weld defects or improper installation
Curent Lh: 1
Active
Computerized Maintenance Management System
Administration
Control Measure
Threat Linked (No Additional Credits)
Proposed
Basic Process Control Systems
Engineering
Control Measure
Threat Linked (No Additional Credits)
Proposed
Vehicle Impact:
High vehicle impacts with pipework on pipebridge or vehicle impact with pipebridge structure, while travelling on internal roadway benith pipebridge.
Curent Lh: 1
Active
Exclusion of Vehicles in proximity of pipe bridge
Administration
Control Measure
Threat Linked (No Additional Credits)
Proposed
A0335-MI-06
Chlorine
Release of Chlorine from transfer pipework between Chlorine Compressor Unit and Chlorine Liquifaction Unit
Process Leak detection
Engineering
Control Measure
Threat Linked (No Additional Credits)
Proposed
Ambient air Chlorine gas detectors
Engineering
Control Measure
Threat Linked (No Additional Credits)
Proposed
Waste Gas Dechlorination System
Engineering
Control Measure
Threat Linked (No Additional Credits)
Proposed
Emergency Response Plan
Administration
Control Measure
Threat Linked (No Additional Credits)
Proposed
Potential for release of chlorine beyond site
C Sev: 6
C Risk: D


Chlorine from tank, drum and cylinder fill lines
Corrosion, stress corrosion cracking, flange and gasket failures, weld defects or improper installation
Curent Lh: 1
Active
Chlorine drum, cylinder or associated piping Operational issues
Chlorine drum or cylinder overpressurisation or overfill
Curent Lh: 1
Active
Chlorine drum, cylinder or associated piping Equipment Integrity issues
Worn or improperly sealed valves, gaskets, or couplings, corroded pipework or fittings, faulty pressure relief valves, damaged containers
Curent Lh: 1
Active
Chlorine Tank operational issues
Chlorine Storage Tank overpressurisation or overfill
Curent Lh: 1
Active
Chlorine tank Integrity Issues
Corrosion of tank walls, stress corrosion cracking, seal and gasket failure, weld defects,
Curent Lh: 1
Active
Chlorine Liquefaction Unit -Equipment Integrity Issues:
Corrosion, stress corrosion cracking, flange and gasket failures, compressor or pump seal leaks, heat exchanger leaks, valve failures, loose fittings or connections, worn components or improper component installation.
Curent Lh: 1
Active
Chlorine Liquefaction Unit - Operational issues
ice formation, pressure imbalances, rapid cooling or heating cycles,
Curent Lh: 1
Active
Basic Process Control Systems
Computerized Maintenance Management System
Chlorine Bulk tank level control and over fill protection
Chlorine Bulk tank over pressure protection
Enclosed Building
Process Leak detection
Chlorine Bulk tank bunding
Spare Emergency Chlorine Bulk Tank
Ambient air Chlorine gas detectors
Displaced gas directed to Waste Gas Dechlorination System
Rupture disks releasing to expansion vessels on liquid chlorine fill lines
Waste Gas Dechlorination System
Engineering
Administration
Control Measure
Threat Linked (No Additional Credits)
Proposed
A0335-MI-07
Chlorine
Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)
Process areas unoccupied during chlorine operations
Emergency Response Plan
Potential for release of chlorine beyond site
C Sev: 6
C Risk: D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