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ICHTHYS ONSHORE LNG FACILITIES CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN REVISION 2 - ADDENDUM 1: TEST OF FIREFIGHTING SYSTEM

Plan

Document No.: L092-AH-PLN-10003
Security Classification: Restricted

Rev	Date	Description	Prepared	Checked	Line Mgr Endorsed	Director/GM Approved
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1 INTRODUCTION

1.1 Background

INPEX Operations Australia Pty td (INPEX) has a Construction Environmental Management Plan (CEMP; L092-AH-PLN-10001) in place for the construction and commissioning of the Ichthys LNG Facility, Bladin Point. The CEMP is approved by the Northern Territory Environment Protection Authority (NT EPA) and the Commonwealth Department of the Environment and Energy (DEE).

The NT EPA also issued Environment Protection Approval 7 (as amended; currently EPA7-7) to Ichthys LNG Pty Ltd (the Approval Holder) which includes requirements relating to revision of the CEMP as follows:

- *The Approval Holder must, for any works not addressed in the approved CEMP or Associated Application, if those works will or may cause or increase the potential for environmental harm, such as by increase in emissions of discharge:*
  - *revise the CEMP, or prepare an Addendum to the CEMP*
  - *have the revised CEMP or CEMP Addendum, reviewed and endorsed by a qualified person*
  - *submit the revised CEMP or CEMP Addendum, with a copy of the qualified person's certified review, to the NT EPA at least 30 business days prior to the implementation of the works.*

From a Commonwealth perspective, the CEMP meets the requirements of EPBC 2008/4208 Approval Condition 8 (Liquid Discharge Management Plan), with key requirements including:

- *submit for the Minister's approval a Liquid Discharge Management Plan* (LDMP) *or plans to mitigate the environmental effects of any liquid discharge from the proposal, including … surface water runoff.* [The LDMP] *must be for the protection of … habitat for listed species in Darwin Harbour and must:*
  - *a) identify all sources of liquid discharge*
  - *b) describe any impacts associated with the discharge of liquids*
  - *c) clearly articulate the objectives of the plan and set measurable targets to demonstrate achievement of these*
  - *d) outline measures to avoid impacts*
  - *e) where impacts are unavoidable describe why they are unavoidable and measures to minimise impacts*
  - *f) demonstrate how any discharges into Darwin Harbour are consistent with the guidelines for discharges, and the water quality objectives for Darwin Harbour, developed under the National Water Quality Management Strategy*
  - *g) identify all regulatory requirements relating to the discharge of liquids and how these will be met*
  - *h) include a monitoring regime to determine achievement of objectives and success of measures used*
- *The relevant activity may not commence until the plan is approved.*
- *The approved plan(s) must be implemented.*

1.2 Purpose and Scope

The purpose of this Addendum to the approved CEMP, in lieu of a full revision of the CEMP, is to inform the NT EPA of the activity and provide the qualified persons certified review prior to commencement of works, and to seek approval from DEE for a proposed change. This Addendum should be read in conjunction with the approved CEMP, as the Addendum purpose is only to provide new information not already in the CEMP, rather than to repeat information in the CEMP, i.e. the Addendum is not a stand-alone document.

This Addendum describes a proposed change to the manner in which an activity was originally planned to be conducted, the potential environmental effect of the proposed change, and the management controls that would be implemented to minimise the potential for environmental harm and impacts to habitat for listed species in Darwin Harbour.

This Addendum also includes a qualified person review (in accordance with the NT EPA requirements in EPA7 (as amended)) (Appendix A) and the DEE approval letter (Appendix B).

Once regulatory endorsements and approvals are obtained, the CEMP Addendum will be published on INPEX's website, in the same location as the approved CEMP.

This scope of work applies to the commissioning/construction phase only, and is to be completed under the existing approved CEMP and EPA7-7. The activity is scheduled to be completed prior to import of LNG and LPG to the site.

2 DESCRIPTION OF THE PROPOSED AMENDMENT AND JUSTIFICATION FOR THE CHANGE

Table 2-1 provides a summary of the proposed change and the reason for the change.

Table 2-1: Summary of proposed change and justification

Item	Description
Current Status	The Commissioning environmental hazard identification (ENVID) conducted in 2016 proposed not to use firefighting foam during the testing and instead rely on Flow/Pressure extrapolation. The approved CEMP (Revision 2, L092-AH-PLN-10001) states that potable water will be used for flushing and testing of the firewater system to demonstrate that the fire suppression system is functioning correctly.
Description of Change	Instead of potable water, INPEX proposes to use the firefighting foams that will be used in operations (to ensure process safety) for testing of the firefighting system. It is proposed that firefighting foam testing activities are conducted at seven safety-critical locations within the Onshore LNG Facilities. Dependent on the location and the test required, either firefighting foams Expandol or Tridol C6 S3 will be utilised for testing. Secondary containment will be utilised to collect the foam generated for each test and will prevent significant discharges to the environment. Some minor misting may not be captured and has been assessed as a very low quantity and associated risk. On completion of testing, the firefighting foam and firewater may be temporarily stored prior to disposal at a licensed facility. The firefighting foam test locations are shown in Figure 3-1, with the foam product, test type and applicable parameters, and containment measures to be implemented relevant to each of these locations are provided in Table 3-1.
Justification of Change	Firefighting systems are identified as safety critical elements (SCEs) through formal safety assessments process. Full test of firefighting foam systems using firefighting foam is necessary to demonstrate that the systems meets functional requirements and associated SCE performance standards. Full system performance cannot be demonstrated by water only test. INPEX has committed to NT WorkSafe that an independent verification of SCEs will be completed as part of the Safety Case. An Independent Verification Body (IVB) has indicated that a discharge test using firefighting foam is required to demonstrate that the fire water system meets performance criteria. Specifically, the use of firefighting foam during testing is required to physically verify the expansion rate, water drop out and concentration of the generated foam. The rate of foam expansion and 25 percent drainage time can only be verified when testing with foam in accordance with the National Fire Protection Association Code (NFPA 2011). The use of foam will also demonstrate the ability of the firewater monitor to throw sufficient distance. The throw distance achieved when using foam will likely vary to that achieved when using water only, and therefore there is the potential for calibration inaccuracies if the testing is carried out using potable water only. If the firefighting systems are not tested with foam, should these systems be required in the case of an emergency, INPEX would be unable to verify that the systems could meet expansion and drainage requirements which could result in failure to adequately control LNG, LPG or condensate fires or spills on demand over a period of time.

3 TESTING METHOD

3.1 Test Types and Locations

Testing of the firefighting system will be conducted at seven safety-critical locations (refer to Figure 3-1) comprising the following locations within the plant boundary:

- LNG boil-off gas (BOG) area;
- condensate tank;
- LNG train areas (Train 1 and Train 2);
- LNG storage tank;
- LNG jetty; and
- LPG/condensate jetty.

Table 3-1 provides an overview of the types of tests to be performed. The volumes of foam generated indicated in Table 3-1 represent an expected worst case scenario. They do not represent what is expected to be the actual case in terms of volume of foam generated. For example, if a test criterion is to achieve a 1 m depth of foam, this is expected to be achieved within approximately 30 seconds, and produce 20-25 m^3 of foam, not take 2 minutes and produce 200 m^3 of foam. The expected worst cases are provided to demonstrate the greatest potential amount of foam to be generated and therefore disposed of.

Safety data sheets for the two products Tridol C6 S3 and Expandol are provided in Appendix C. Management measures and monitoring to be implemented during testing activities are further described in sections 5.2 and 5.5. The test tank fill volumes shown in Table 3-1 are for the maximum text duration.

Table 3-1: Test type, foam product and parameters by foam test location

Test Type	Location	Foam product	Test type and parameters
Type 1	LNG BOG area LNG Storage Tank LNG Train 1 LNG Train 2	Expandol	High expansion foam test and flow test: • Pressure at foam maker: 500 kPag • Proposed pre-run time (without foam): 15 seconds • Test duration: <2 minutes • Tank capacity: 360 L • Expandol proportioning and expansion test tank fill: 20 L • Flow rate: 200 Lpm • Maximum Expandol expansion ratio 500:1 = 200 m^3
Type 2	Condensate tank	Tridol C6 S3	Low expansion foam test: • Pressure at base of riser: 677 kPag • Proposed pre-run time (without foam): 60 seconds • Test duration: <3 minutes • Tank total capacity: 8,000 L

Test Type	Location	Foam product	Test type and parameters
			• Tridol proportioning and expansion test tank fill: 200 L • Flow rate: 1701 Lpm • Tridol C6 S3 Expansion ratio: 8:1 = 41 m^3
Type 3	LNG jetty	Expandol	High expansion foam test and flow test: • Pressure at foam maker: 500 kPag • Proposed pre-run time (without foam): 15 seconds • Test duration: <2 minutes • Tank capacity: 360 L • Expandol proportioning and expansion test tank fill: 20 L • Flow rate: 200 Lpm • Maximum Expandol expansion ratio 500:1 = 200 m^3
Type 4	LPG/condensate jetty	Tridol C6 S3	Low expansion foam test: • Pressure required at monitor: 700 kPag • Proposed pre-run time (without foam): 60 seconds • Test duration: <3 minutes • Tank total capacity: 8,000 L • Tridol proportioning and expansion test tank fill: 350 L • Flow rate: 1 x 3200 Lpm • Tridol C6 S3 Expansion ratio: 8:1 = 77.8 m^3

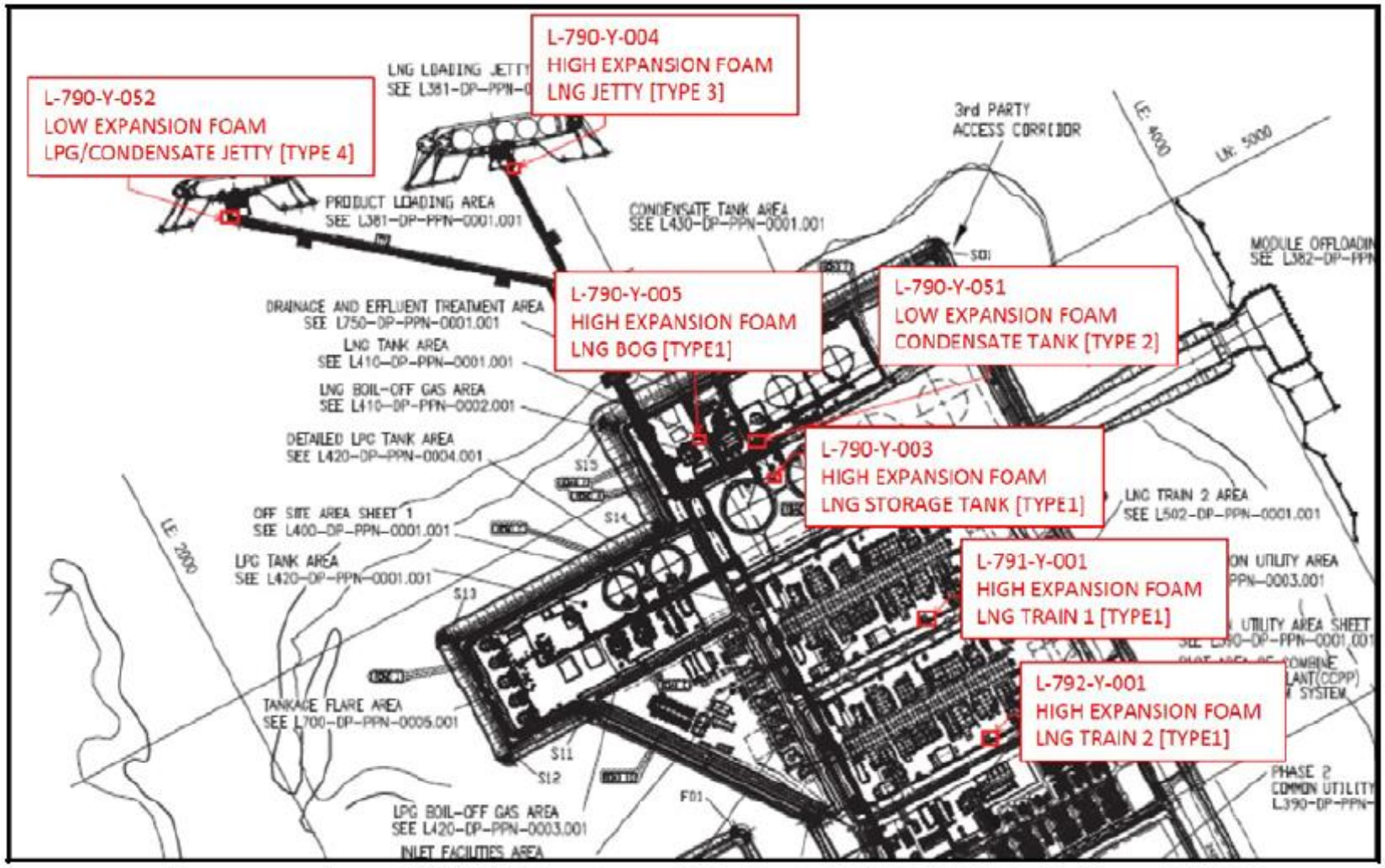

Figure 3-1: Firefighting foam test locations

3.2 Testing Philosophy

The requirement for firefighting foams to be used on site were assessed as part of the JKC Active Fire Protection Philosophy (L790-AF-PHI-0001) which specifies the type of fire water systems required to control specific flammable hazards on site. This philosophy is in accordance with the requirements of NFPA (2009). Requirements of the Active Fire Protection Philosophy were supplemented and informed by additional assessments made in regards to firefighting effectiveness and hazard management, including the Fire and Explosion Risk Assessment, the Consequence Analysis Report (L290-AH-REP-10000) and the LNG/LPG spill control Philosophy (L290-AF-PHI-0002). Specifically the active fire protection philosophy states the following in regards to fire protection for hydrocarbon spills:

- Hydrocarbon pool fires, other than LNG, MR, or LPG spill, shall be extinguished by low expansion foam (Tridol C6 S3) either via portable or fixed foam systems or monitors/foam hose streams. However, low expansion foam shall not be used for LNG/MR/LPG pool fires as this will increase the fire intensity.
- If a fire happens in LNG spill basins, fire intensity shall be controlled by high expansion foam (Expandol) fire water systems automatically activated by signals from spill detectors and flame detectors.
- For MR/LPG pool fires, no fire extinguishment should be applied, and the pool fire will be allowed to burn continuously until the fuel is exhausted. Therefore, it is important that the leakage source be immediately shut-off and depressurized to minimize the pool fire duration.
- High expansion foam is not normally applied for MR/LPG fires because application of such foam would sometimes extinguish MR/LPG fire that will result in a more dangerous situation because MR/LPG is heavier-than-air gas and the vapour of MR/LPG will be accumulated beneath the foam blanket and have a risk of re-ignition and explosion.

In regards to the condensate tank fire scenario the AFP philosophy states:

- Rim seal fire shall be the single fire case to be considered for Covered Floating Roof Condensate Tanks (CFRT) as the floating roof is constructed conforming to NFPA 11, section 5.4.2 such as double deck pontoon type. A full surface fire is not required to be considered into design accordingly.
- Fixed low expansion foam (Tridol C6 S3) fire water system shall be operated to extinguish rim seal fires on CFRTs.
- Water for shell cooling shall also be applied onto the shell of the tank on fire via fixed water spray system. Adjacent tanks and/or equipment shall also be cooled with water using fixed/portable monitors, hand hose streams, or fixed water spray system, if required.
- Considering rim seal fire event for the condensate tank, the use of mobile equipment is insufficient to suppress event of a rim seal fire. Thus, low expansion foam fire water system for condensate tanks/condensate buffer tank shall be fed from two separate section of ring main.

3.3 Foam test methodology

The general testing methodology at each site, to be performed after testing with potable water, will be:

- Fill the foam storage tank with the minimum amount of foam concentrate required for the testing (refer Table 3-1).
- Using local activation of the release valve, energise the foam system from the fire water main.
- Verify flowrate and pressure at key points in the system.
- Observe foam generation and assess the accumulation rate in the impoundment basin.
- Capture samples of foam solution and expanded foam for verification of foam composition.
- Remove residual foam solution from impoundment basin.

4 DESCRIPTION OF THE ENVIRONMENT

The following sections provide an overview of the receiving environment and sensitive receptors that may be affected in the event of an uncontrolled release of firefighting foam of firewater. In summary, it is expected that a substantial discharge of 3% firefighting foam solution has the potential to affect surface soil and surface water as well as beneficial uses of Darwin Harbour. It is not expected that there is potential for impacts to groundwater in the event of an uncontrolled release of firefighting foam or firewater, as the immediate actions would be to undertake clean-up of the affected soil before it would be able to penetrate to groundwater.

4.1 Surface Soil

Construction activities have significantly changed the topography and surface characteristics of the Site, becoming almost entirely bare of vegetation, flatter and compacted in some areas. The variation in pre-construction topography (approximately 10 m across the Site), has been decreased to 1.5 m through cut and fill activities. In addition, ground improvement works and creation of hardstand areas has led to significant decreases in the water absorption properties of the soil, decreasing the water infiltration in affected areas.

4.2 Surface Water

Bladin Point is located in a tropical monsoonal bioregion. The Site is bound by Lightning Creek on the western side, East Arm to the north, and by the mouth of the Elizabeth River on the eastern side. Water quality in Darwin Harbour is generally of a high quality although naturally turbid. Water quality parameters vary greatly spatially and temporally due to the ride (spring versus neap), sampling location and the wet and dry season.

Surface water monitoring of the Darwin Harbour has been undertaken monthly since June 2012 under the approved Environmental Impact Management Plan (EIMP; Revision 10). The surface water monitoring objectives for the site are to detect changes in the receiving water quality resulting from the Site activities and discharges offsite of water potentially containing nutrients, dissolved metals, hydrocarbons and other contaminants. Ongoing monitoring is undertaken to assess potential impacts resulting from surface water discharges on the receiving environment.

The EIMP monitoring results indicate that overall, the in situ measurements of physiochemical parameters generally compare well between intact and reference sites for corresponding sampling events and resemble an estuarine environment. Temporal trends between parameters have been observed. Surface water monitoring results and trends are summarised and discussed in the Annual Environmental Monitoring Report (AEMR) which is submitted to the NT EPA on an annual basis.

4.3 Darwin Harbour

Darwin Harbour experiences maximum tidal level variations of up to 8 metres with average spring tide variations around 7 metres, and mean neap tide variations around 3 metres. The large tidal ranges produce strong currents that peak at speeds of up to 2-2.5 m/s (Williams and Wolanski 2003). The greatest tidal variability is found in tidal creeks during the wet season when tidal exchange results in changes in water quality on an hourly basis (Padovan 2003).

4.3.1 Beneficial Uses of Darwin Harbour

The *Water Act* (NT) defines several beneficial uses for water bodies in the Northern Territory. Beneficial uses describe how a community values and uses a water resource. The declared beneficial uses for Darwin Harbour region (NTA 2010) are as follows:

- Aquaculture: to provide water for commercial production of aquatic animals
- Environment: to provide water to maintain the health of aquatic ecosystems
- Cultural: to provide water to meet aesthetic, recreational and cultural needs
- Agricultural: to provide irrigation water for primary production including related research
- Rural stock and domestic: to provide water for specific uses.

4.4 Mangroves and Benthic Communities

The seabed in Darwin Harbour varies from exposed pavement through sand-veneered pavement, to beds of sediment, which vary from gravel to fine sands and silt. Darwin Harbour supports a number of taxonomic groups and marine communities which are well represented throughout coastal environments. The seabed habitats in the nearshore area of the site, including the Jetty location, consist of soft-bottom benthos and rock pavement communities which occur throughout Darwin Harbour.

4.4.1 Mangroves

Extensive mangrove communities dominate in the bays and other protected areas throughout the intertidal zone. Mangroves in the Darwin Harbour area constitute approximately 44% of the mangrove communities in the Darwin Coastal Bioregion and approximately 5% of the total mangrove area of the Northern Territory, with 80% of these mangroves found in the 'inner' Harbour between Sadgroves Creek and Mandorah (INPEX 2010). Darwin Harbour is also recognised for its mangrove diversity, containing 36 of the 50 known species worldwide.

Mangrove communities are important to the ecological health of Darwin Harbour, providing food and shelter for a wide range of animals including nursery grounds for juvenile fish and crabs. Mangrove muds around the Site were surveyed by URS (INPEX 2010) and found to show moderate bioturbation present (~20 burrows/m^2), with fiddler crabs (*Uca* spp.), alpheid shrimp and mudskippers (*Periopthalmus* sp.) associated with many of the burrows. Turtles and fish also forage within the mangrove communities in periods of high tide.

Mangrove community health monitoring as part of the EIMP has shown that mangroves surrounding the Site are in good health with no sediment changes or detrimental health effects observed at monitoring sites. All monitoring sites contain at least 90% healthy trees with no stressed trees evident.

4.4.2 Benthic Communities

Darwin Harbour has a complex assemblage of marine habitats and there are large differences in the extent, diversity and significance of the associated biological communities (INPEX 2010).

Surveys of the sub-tidal marine benthic habitats in the nearshore area of Site undertaken in 2008, 2012 and 2015 (URS 2008, Cardno 2013, Cardno 2015) reported overall low biotic abundance and diversity. Similar taxa were numerically abundant in both the Darwin Harbour Inner and Darwin Offshore surveys including tanaid and amphipod crustaceans, several polychaete families, nematodes and nemerteans.

Benthic infauna collected from grab samples covering the nearshore habitat from the mouth of Cossak Creek past the jetty and in the vicinity of the Module Offloading Facility (MOF) showed that amphipods were the most abundant taxon, with Polychaetes the second most abundant taxon. Turtles and fish also forage within the mangrove communities in periods of high tide. The mud whelk (*Telescopium Telescopium*) located in mangrove communities is also a potential food source for humans and is a bioindicator species for the EIMP.

All of the numerically abundant species recorded are ubiquitous to most marine habitats and commonly found to occur in large numbers. Darwin Harbour supports an abundance of both resident and benthic and transient pelagic fish species. The most diverse groups in the Harbour area are the gobies (~70 species), cardinal fish (20 species) and the pipefishes (19 species) (Larson 2003). Barramundi is a particularly important commercial and recreational species in the Northern Territory.

4.5 Protected marine species

Marine fauna that are known to occur within Darwin Harbour and which are listed as matters of national environmental significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) are presented in Table 4-1.

No significant protected species habitats (e.g. marine turtle nesting beaches or dugong foraging habitat) are located within the vicinity of the nearshore area of the site, including at the jetty locations. However, it is acknowledged that such species may transient the nearshore area.

Table 4-1: Listed threatened and/or migratory marine species under the EPBC Act which are known to occur within Darwin Harbour

Scientific name	Common name	EPBC status
Reptiles		
Caretta caretta	Loggerhead turtle	Endangered, Migratory
Chelonia mydas	Green turtle	Vulnerable, Migratory
Eretmochelys imbricata	Hawksbill turtle	Vulnerable, Migratory
Lepidochelys olivacea	Pacific ridley turtle	Endangered, Migratory
Natator depressus	Flatback turtle	Vulnerable, Migratory
Crocodylus porosus	Saltwater crocodile	Migratory
Mammals		
Sousa sahulensis (also known as *S. chinsis*)	Indo-Pacific Humpback Dolphin	Migratory

Scientific name	Common name	EPBC status
Tursiops sp. (also known as *T. aduncus*)	Bottlenose Dolphin	Migratory
Dugong dugon	Dugong	Migratory
Orcaella heinsohni	Australian Snubfin Dolphin	Migratory
Fish		
Pristis clavata	Dwarf sawfish	Vulnerable, Migratory
Pristis pristis	Freshwater sawfish	Vulnerable, Migratory

5 POTENTIAL ENVIRONMENTAL EFFECT AND MANAGEMENT

5.1 Potential Impacts and Risks

All firefighting foams pose some risk to the environment if released during activities, including testing exercises. A combination of chemicals used in firefighting foams can have direct and indirect impacts when they are released and degrade.

In the unlikely event of a loss of containment, the guideline values adopted by Department of the Environment and Energy (DEE), *Commonwealth Environmental Management Guidance on PFOS and PFOA* (Draft Oct 2016) – draft exposure value of 95% species protection – slightly to moderately disturbed systems shall be adopted as the marine water investigation levels. The Commonwealth Environmental Management Guidance on PFOS and PFOA-commercial and industrial spaces (DEE 2016) shall be adopted as the soil investigation criteria (not taking into account water transport) for targeted, for-cause environmental sampling. If new investigation levels are brought into force during testing, these will be adopted accordingly.

Firefighting foams depend on a variety of compounds and formulations for their characteristics and effectiveness and some of these compounds and formulations can have adverse effects, both short and long term, on the environment, human health and other values. The primary impacts include biochemical oxygen demand (BOD), acute (short-term) toxicity, persistence, bioaccumulation and chronic (long-term) toxicity (QDEHP 2016b).

When considering the most appropriate foam, INPEX considered the range of short and long-term risks to the environment as well as compliance with the NFPA 11. As a result, INPEX has decided to use Tridol C6 S3 (a C6 purity-compliant foam and lower hydrocarbon concentrations) not Tridol S3. Tridol C6 S3 contains shorter length (≤C6) fluorinated compounds.

5.1.1 Tridol C6 S3 and Expandol Characterisation

Chemical analysis of Tridol C6 S3 and Expandol at a 3% solution (i.e. the product concentration required for test types 1-4) was undertaken by a National Association of Testing Authorities (NATA) accredited laboratory for 28 commercially available ultra-trace PFAS analytes.

As firefighting foam has a viscosity double that of water in the concentrated state, actual limits of laboratory reporting are matrix dependant and there is a greater potential for matrix interference during analysis using the liquid chromatography tandem-mass spectrometry (LC-MS/MS) technique. As a result, the limit of reporting (LOR) have been increased for both 3% solutions of Expandol and Tridol C6 S3 to filter out matrix interference from the NATA LOR (<0.001 µg/L) to <0.2 µg/L.

The laboratory analysis results for PFOS, PFHxS and PFOA concentrations present in Tridol C6 S3 and Expandol (at a 3% solution), are provided in Table 5-1 and Table 5-2, respectively. PFOA and PFOS concentrations have been presented in the context of the DEE (2016) and HEPA (2018) recommended investigation levels/ecological criteria for 95% species protection for slightly to moderately disturbed systems (the appropriate criteria for Darwin Harbour). Currently, there are no published investigation levels/ecological criteria for PFHxS for ecological water receptors outlined in DEE (2016) or HEPA (2018).

The results of the analysis demonstrate the following:

- Tridol C6 S3:

  - The PFOS concentration (<0.2 µg/L i.e. less than detection limits) is well below the DEE (2016) 95% species protection investigation level (7.8 µg/L), and are within the order of magnitude (with consideration of the 50% laboratory acceptance limit, i.e. 0.10 µg/L) of the HEPA (2018) 95% species protection ecological criterion (0.13 µg/L).
  - The PFOA concentration (<0.2 µg/L i.e. less than detection limits) is well below the DEE (2016) 95% species protection investigation level (8,500 µg/L) and are within the order of magnitude (with consideration of the 50% laboratory acceptance limit, i.e. 0.10 µg/L) of the HEPA (2018) 95% species protection ecological criterion and (220 µg/L).

- Expandol:
  - The PFOS concentration (0.20 µg/L) is well below the DEE (2016) 95% species protection investigation level (7.8 µg/L), and is only marginally above the HEPA (2018) 95% species protection ecological criterion (0.13 µg/L).
  - The PFOA concentration (0.56 µg/L) is well below the DEE (2016) and HEPA (2018) 95% species protection investigation level/ecological criterion (8,500 µg/L and 220 µg/L, respectively).

In the highly unlikely event that a spill occurs, the potential consequence of this is discussed further in Section 5.1.3.

Table 5-1: Low Expansion Firefighting Foam - Tridol C6 S3 chemical analysis summary

PFOS and PFOA	95% species protection investigation levels for marine waters (DEE 2016)	Interim 95% species protection ecological criteria marine waters (HEPA 2018)	Tridol C6 S3 3% solution (Test Type 2 and 4)
Perfluorooctanesulfonic acid (PFOS)	7.8 µg/L	0.13 µg/L	<0.2 µg/L
Perfluorohexanesulfonic acid (PFHxS)	No investigation levels or ecological criteria available for ecological water receptors.		<0.2 µg/L
Perfluorooctanoic acid (PFOA)	8,500 µg/L	220 µg/L	<0.2 µg/L

Table 5-2: High-Expansion Firefighting Foam - Expandol chemical analysis summary

PFOS and PFOA	95% species protection investigation levels for marine waters (DEE 2016)	Interim 95% species protection ecological criteria marine waters (HEPA 2018)	Expandol 3% solution (Test Type 1 and 3)
Perfluorooctanesulfonic acid (PFOS)	7.8 µg/L	0.13 µg/L	0.20 µg/L
Perfluorohexanesulfonic acid (PFHxS)	No investigation levels or ecological criteria available for ecological water receptors.		<0.01 µg/L
Perfluorooctanoic acid (PFOA)	8,500 µg/L	220 µg/L	0.56 µg/L

5.1.2 Firefighting Foam Test Risk Assessment

Tridol C6 S3 and Expandol are the only viable options for use, after firefighting effectiveness, short and long-term health, safety and environmental risks and property protection characteristics have all been appropriately considered.

In order to assess the potential environmental impacts associated with the use of firefighting foam, an ENVID risk assessment was conducted in accordance with the Risk Assessment Process described in the approved CEMP.

A conceptual site model presenting the key sources of identified hazards, and potential impact pathways is shown in Figure 5-1 . The conceptual site model represents potential impact pathways with no controls in place. In the unlikely event that 3% firefighting foam solution or firewater is accidently released or discharge to the environment there is the potential for impacts on surface soil, surface water, mangroves and benthic communities, and the beneficial uses of Darwin Harbour, these impacts are further described in Table 5-3.

The outcomes of the complete risk assessment, inclusive of the potential environmental impacts and proposed mitigation measures, are provided in Appendix D.

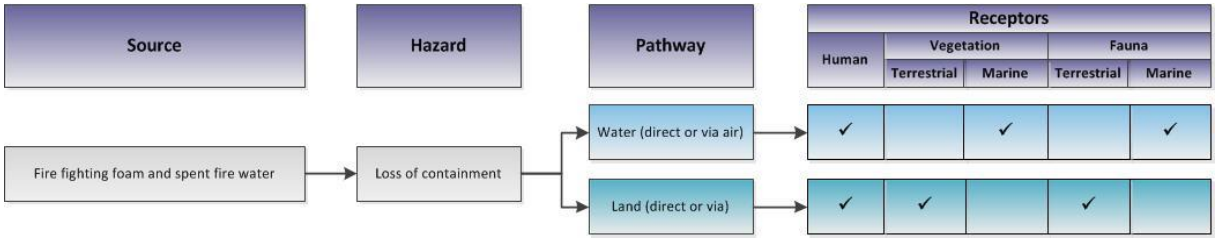

Figure 5-1: Conceptual Site Model

Table 5-3: Potential environmental impacts which may result in the event of loss of containment of firefighting foam or firewater

Activity	Potential environmental impact
Testing of systems using firefighting foam	Potential impacts to Beneficial Uses of Darwin Harbour Region: • impacts to the aquaculture industry • impacts to the health of aquatic ecosystems • impacts to cultural, recreational and aesthetic needs of Darwin Harbour • impacts to the aesthetic values of Darwin Harbour
	Potential impacts to surface soils and near shore sediments: • local contamination of surface soil • pollution of the nearshore environment as a result of contamination of surface water runoff
	Potential impacts to surface water: • local contamination of surface water • pollution of the nearshore environment • pollution of the marine environment

Activity	Potential environmental impact
	Potential impacts to mangroves and benthic communities: • short-term (acute) adverse impacts on benthic communities • short-term (acute) adverse impacts on mangrove communities • impacts to nursery habitat for juvenile fish and crabs
	Potential impacts to MNES: • short-term (acute) adverse impacts on mangrove communities • pollution of the marine environment (habitat for MNES).

5.1.3 Potential for contamination of Darwin Harbour

Testing of firefighting foam systems at the LNG Jetty (Test Type 3; Expandol) and LPG/Condensate Jetty (Test Type 4; Tridol C6 S3) locations pose a higher level of risk to the environment than other locations, in the unlikely event of loss of containment of foam solution (3% solution) or foam concentrate.

In order to assess the potential impact if foam solution or foam concentrate was lost to Darwin Harbour, a desktop assessment was undertaken, which considered two scenarios:

1. Loss of 100% of the test volume of concentrate Expandol/Tridol C6 S3 product during tank fill (assumes no controls are in place)
2. Loss of 10 L of 3% solution of Expandol/Tridol C6 S3, as a result of bund valve failure or foam overspray (assumes one or more containment controls fail).

For the purposes of assessment, dilution in seawater is assumed to occur in an area of 10 m x 10 m with a 0.5 m depth, resulting in a dilution volume of 50,000 L.

As PFOA and PFOS concentrations in Tridol C6 S3 were below laboratory limits of reporting (i.e. <0.2 µg/L; refer Table 5-1), 50% of the limit of reporting has been assumed (i.e. 0.10 µg/L) for the purpose of the assessment; this approach is considered to be conservative.

The outcomes of the assessment are presented in Table 5-4 and Table 5-5.

When PFOA and PFOS concentrations in seawater are considered in the context of the DEE (2016) and HEPA (2018) investigation levels/ecological criteria for 95% species protection, the following conclusions can be made:

- In all scenarios presented for Tridol C6 S3 and Expandol the concentrations of PFOA and PFOS remain well below the HEPA (2018) ecological criteria (PFOA 220 µg/L; PFOS 0.13 µg/L).
- In all scenarios presented for Tridol C6 S3 and Expandol the concentrations of PFOA and PFOS remain well below the DEE (2016) investigation levels (PFOA 8500 µg/L; PFOS 7.8 µg/L).

With consideration of the outcomes of the desktop assessment, it is highly unlikely that loss of concentrate or 3% solution of Tridol C6 S3 or Expandol in the relation to the worst-case scenarios presented would result in an impact to Darwin Harbour or habitat adjacent to the test locations.

Table 5-4: LNG Jetty loss of containment scenarios assessment (Test Type 3, Expandol)

Scenario	Volume	Maximum PFOA concentration (µg/L)	Maximum PFOS concentration (µg/L)	Load of PFOA (µg)	Load of PFOS (µg)	Concentration of PFOA in seawater (µg/L)	Concentration of PFOS in seawater (µg/L)
	A	B	C	D *(A x B)*	E *(A x C)*	F *(D / 50,000 L)*	G *(E / 50,000 L)*
Scenario 1 Loss of 100% of the tank test volume (fill) of concentrate	20 L	18.67 *(0.56 µg/L / 0.03)* *	6.67 *(0.20 µg/L / 0.03)* *	373	133	0.00746	0.00267
Scenario 2 Loss of 10 L of 3% solution	10 L	0.56†	0.20†	6	2	0.00011	0.00004

* PFOA and PFOS concentration for concentrated product based on known 3% solution for Expandol for both PFOA and PFOS (refer Table 5-2).

† Chemical characterisation for Expandol 3% solution for both and PFOA and PFOS (refer Table 5-2).

Table 5-5: LPG/Condensate Jetty loss of containment scenarios assessment (Test Type 4, Tridol C6 S3)

Scenario	Volume	Maximum PFOA concentration (µg/L)	Maximum PFOS concentration (µg/L)	Load of PFOA (µg)	Load of PFOS (µg)	Concentration of PFOA in seawater (µg/L)	Concentration of PFOS in seawater (µg/L)
	A	B	C	D *(A x B)*	E *(A x C)*	F *(D / 50,000 L)*	G *(E / 50,000 L)*
Scenario 1 Loss of 100% of the tank test volume (fill) of concentrate	350 L	3.33 *(0.10 µg/L / 0.03)* *	3.33 *(0.10 µg/L / 0.03)* *	1167	1167	0.02333	0.02333
Scenario 2 Loss of 10 L of 3% solution	10 L	0.10†	0.10†	1	1	0.00002	0.00002

* PFOA and PFOS concentration for concentrated Tridol C6 S3 product using an assumed 3% solution concentration of 0.10 µg/L for PFOA and PFOS.

† Assumed concentration for PFOA and PFOS given characterisation of these components was below laboratory detection limits (<0.20 µg/L; refer Table 5-1).

5.2 Impact Mitigation Measures

Figure 5-2 provides an overview of the approach undertaken to minimise environmental risk during testing activities. INPEX has critically reviewed the activity to minimise potential for environmental impact. An assessment was then undertaken to identify additional controls that can be implemented to minimise environmental risk to ALARP. Each of these controls will be reviewed prior to each test, to determine which controls are to be applied for each test. Following a precautionary approach, after each test a review of the efficacy of the controls will be undertaken, prior to proceeding with the next test.

The first box in Figure 5-2 shows what has already been undertaken to miminise the potential for environmental impacts. INPEX is undertaking two of the required tests with potable water prior to testing with product, to ensure the system is working as per design, prior to introducing foam. This mitigation measure has been included to minimise the need for repeat tests.

The second box in Figure 5-2 shows the additional controls to be implemented, to futher reduce the potential for environmental impact. These will be applied as applicable to the test location, noting not all controls are applicable to each test, depending on the test location (for example, closure of drains is only relevant to the tests on land, not the jetties; secondary containment/bunding is only applicable to the activity of transferring products and storage tanks; attended transfer is only applicable to transfer of product).

All tests will be viusually monitored to check for loss of containment (in addition to the proposed environmental monitoring).

To ensure no undue influence from adverse weather conditions, wind speed, rain/storm forecast will be monitored, as shown in the second box in Figure 5-2. Wind speed is only a relevant factor at the LPG jetty, as every other test location has full encapsulation (including a reinforced roof) or is internal to a tank. The LPG jetty (low expansion test with Tridol C6 S3) would not proceed if wind speed greater than 19 km/h, noting that INPEX has its own weather monitoring station, and a light wind is described as <19 km/h (BOM 2018). For rainfall, again, this is only relevant for the LPG jetty. In general, if severe weather is forecast, tests in other locations would not proceed.

Mitigation measures, including inductions and training, waste management, chemical management, spill prevention and response, and monitoring and inspection, already described in the approved CEMP (see Table 5-6), will be implemented to minimise the potential for impacts as a result of using firefighting foam for testing activities. In addition these, specific controls which will be in place for containment of foam product and wastewaters, as applicable to the individual test locations (including high-risk locations such as the jetties), are described in greater detail in Appendix E.

Table 5-6: Relevant mitigation measures already described in the approved CEMP

Mitigation measures	Approved CEMP reference
Inductions and training	Section 9.2
Waste management (including records, monitoring and inspection)	Section 6.12
Chemical management (including chemical assessment, records, monitoring and inspection)	Section 6.13
Spill prevention and response (including emergency	Section 6.14

Mitigation measures	Approved CEMP reference
response, monitoring and inspection)	

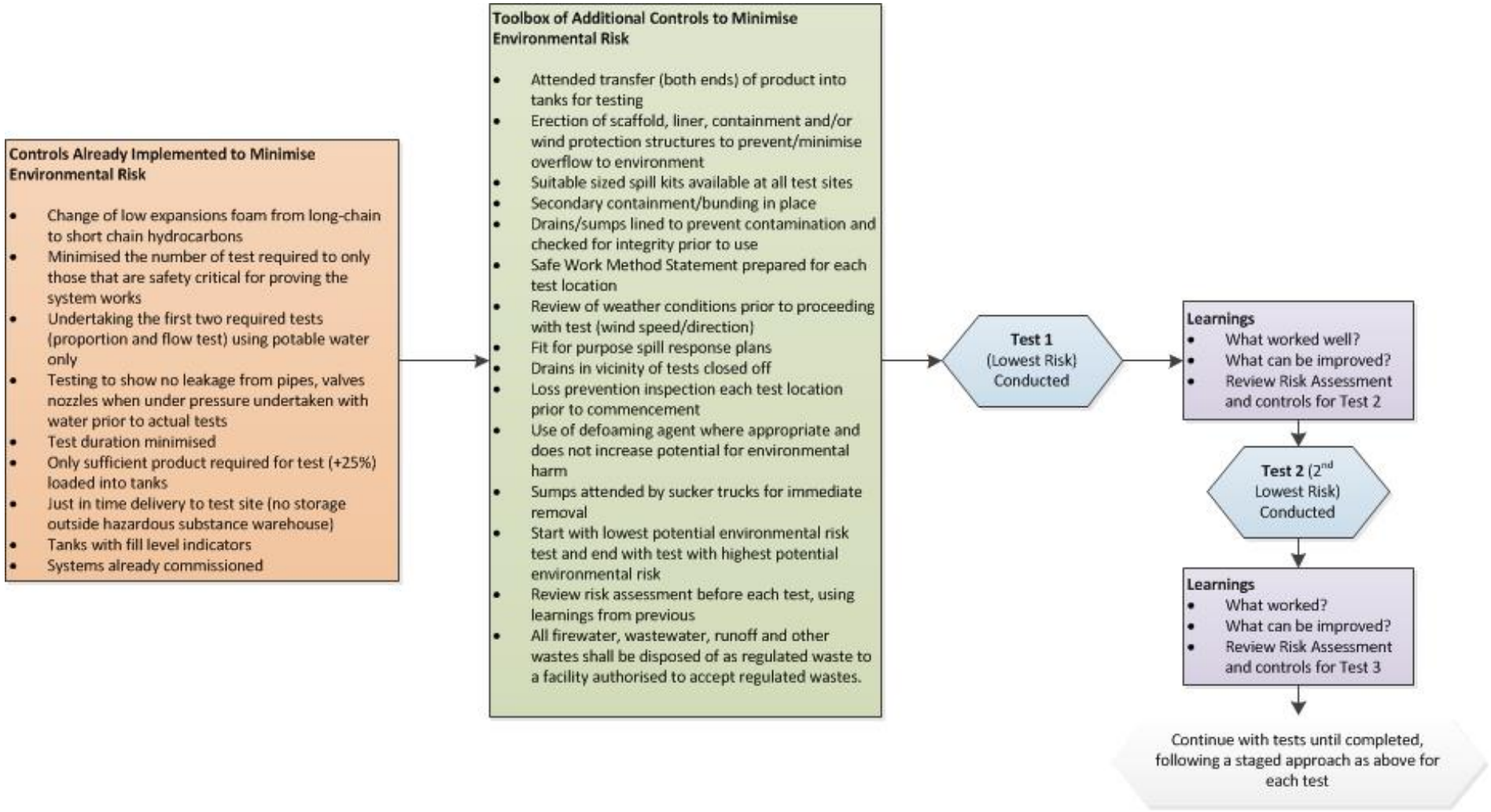

Figure 5-2: Risk mitigation approach to firefighting system tests

5.3 Drain Management

There is no credible pathway for foam products to leave the Site via the drainage network. This is because:

- At the location of each of the four onshore high expansion tests, there will be isolations installed to prevent foam products from entering the drainage network should containment fail.
- There will be secondary isolation points on standby within the downstream culverts of these locations.
- INPEX has the capacity and experience to further plug drainage lines as needed.
- At each of these locations, the sumps will be fully lined and the entire sump fully encapsulated.

The low expansion test for the Condensate Tank is fully contained within the tank, which is surrounded by a > 20 m high concrete bund structure as per design; the bund is designed to contain the full contents of the condensate tank (66,000 m^3).

Once testing is complete, the pits will be validated through NATA accredited testing as not having product present before any of the drain isolation points are removed.

Appendix F further illustrates how the drainage network can be managed to prevent foam products from discharging from site, during testing.

5.4 Contaminated Wastewater and Solid Waste Disposal

Following completion of firefighting foam testing, spent foam and wastewater will be pumped into a designated secondary containment storage vessel (double bunded to 110% of the volume in accordance with AS1940) and temporarily stored onsite. In addition, materials used for encapsulation purposes and other contaminated solid waste will be temporarily stored onsite in designated solid waste containers.

In order to inform offsite disposal options for wastewater, PFAS characterisation sampling will be undertaken as required by the waste receiving facility.

Offsite disposal of contaminated wastewater and solid waste will be undertaken by a waste contractor licensed to transport PFAS contaminated waste (under code (M160)) to an authorised interstate waste facility, in accordance with the National Environment Protection (Movement of Controlled Waste between State and Territories) Measure 1998.

The receiving waste facility shall be notified of the estimated volume of wastewater and solid wastes, and of the characteristics of the contaminated wastewater. Waste will be tracked using a Waste Transport Certificate (WTC) from the Northern Territory EPA (NT EPA). The waste consignment will be approved in writing by the receiving State environmental regulator.

Offsite disposal options include destruction of the PFAS contaminated waste, at either the Toxfree facility in Queensland, or the Cleanaway facility in New South Wales. Once destroyed, the waste facility will issue a certificate of destruction. Records of listed wastes will be maintained and audited as required under EPA7 (as amended) approval conditions.

5.5 Environmental Monitoring Program

A Sampling and Analysis Quality Plan (SAQP) will be developed in line with the Interim Guideline on the Assessment and Management of Perfluoroalkyl and Polyfluoroalkyl Substances (DER 2017) and Schedule B3 of the National Environment Protection (Assessment of Site Contamination) Measure 1999.

The SAQP will include, but is not limited to, the following:

- sampling media (e.g. sediment, etc.) and location coordinates
- sampling equipment, methods and procedures
- quality assurance (QA) and quality control (QC) procedures (e.g. field QA/QC procedures, sample handling, storage and transport, chain of custody, etc.)
- demonstration of a statistical power of 0.8 or greater and set out levels of accuracy, precision, confidence, and statistical significance
- details of analytes and parameters to be monitored
- laboratory analysis methods.

Mangrove sediment, biota (three taxa) and surface water sampling will be undertaken prior to the commencement of firefighting foam testing at the jetty locations to establish baseline PFAS concentrations of key receptors in proximity to the planned firefighting foam testing activities at the jetties.

In addition, environmental assessments will be undertaken as follows:

- surface water samples will be collected at the jetties approximately 1 hour before testing commences at four locations in the designated 50 m radius mixing zone surrounding each jetty test location (and these will be analysed as discrete samples)
- maintain a vessel in the vicinity of the jetties during the testing to observe the testing from the water
- on completion of the test at each jetty, and within the 6 hour tidal window seen in Darwin Harbour:
  - deploy a drogue, to indicate tidal direction and hence the sample collection transect for collection of surface water samples
  - collect a second round of water samples at the four locations in the designated 50 m radius mixing zone surrounding each jetty test location as well as single samples at each of 100, 150 and 200 m distances from the centroid of the mixing zone (i.e. along the tidal current transect established by the drogue)
  - follow the drogue, and if the drogue reaches land within the study area, collect sediment and water samples from three additional locations – at the landfall point and 50 m laterally on each side; if the drogue moves out of the study area without touching land then no sampling will be undertaken
  - undertake investigation (response) sampling in the event there is a loss of containment, or if the results of the post-test sampling and analysis indicates the screening levels have been triggered, as per the PFAS NEMP (HEPA 2018). This investigation sampling would mimic the post-test sampling described above, but also include repeat sampling of the baseline sediment and surface water sampling already conducted in the far-field (i.e. EIMP locations previously sampled - refer to Table 5-7, Figure 5-3 and Figure 5-4), and sampling of biota within the study boundary (three taxa as above) within one

week of the loss of containment/breach of trigger levels, over a period of one week (expected five days for sampling and contingency days).

Monitoring results from sampling will be compared against the products (i.e. Tridol C6 S3 and Expandol) constituents.

Samples will be sent to a NATA accredited laboratory for analysis. Each sample will be analysed for the 20 PFAS suite including PFOA/PFOS and 6:2 FTS, using standard methods.

Table 5-7: Summary of sampling locations

Program	Sample ID	Details	Easting (m)	Northing (m)
Mangrove sediment	BPMC10	Located on the northern boundary of the Site adjacent to the Jetty.	708134.82	8615674.51
	BPMC11	Located on the northern boundary of the Site adjacent to the MOF	708754.14	8616229.03
	BPMC16	Located on the eastern boundary of the Site adjacent the LNG trains	709160.69	8615381.51
	BPMC26	Located on the northern boundary of the Site adjacent to the MOF	708828.01	8616073.00
Surface water	BPSW20	Offsite marine locations - creek sampling	707430.74	8615395.71
	BPSW26	Offsite marine locations - harbour sampling	709619.91	8615367.51
	BPSW27	Offsite marine locations - harbour sampling	708859.94	8616247.11
	BPSW28	Offsite marine locations - harbour sampling	708500.11	8616141.28
	BPSW30	Offsite marine locations - harbour sampling	706994.96	8616305.72
	BPSW31	Offsite marine locations - harbour sampling	709924.96	8616262.15

* Coordinates (GDA 1994; Map Zone 52)

Figure 5-3: Sediment sampling locations

Figure 5-4: Surface water sampling locations

6 SUMMARY OF CHANGES TO THE APPROVED CEMP

Table 6-1 provides a summary of the relevant text changes that would be required to be made to the CEMP.

Table 6-1: Summary of changes to the approved CEMP

<table>
<tr><th>Location in CEMP</th><th>Original Text</th><th>Revised Text (in italics)</th></tr>
<tr><td>Section 6.4.3
Types of surface water on Site and sources
Non-contaminated potable water
(page 124)</td><td>Firewater system flushing, deluge spray, and hydrant, fire monitor and hose reel tests: Firewater system flushing is expected to generate 12 KL of water and testing is estimated to generate 15,000 KL of water. Potable water will be used for flushing and testing of the firewater system and will occur successively within discrete areas on Site. The test is to demonstrate that the fire suppression system is functioning correctly, which is also a requirement of the NT Fire and Emergency Services, who will participate in the testing. No foam products will be added for this test. Based on the process undertaken, the flushing and testing water is not expected to contain contaminants. Due to the short duration of the flushing and testing activities (estimated <1 hour per location), no metal leaching is expected.</td><td>Firewater system flushing, deluge spray, and hydrant, fire monitor and hose reel tests: Firewater system flushing is expected to generate 12 KL of water and testing is estimated to generate 15,000 KL of water. Potable water will initially be used for flushing and pressure/flow testing of the firewater system and will occur successively within discrete areas on Site prior to the introduction of firefighting foam to the system. The flushing and testing water is not expected to contain contaminants due to the short duration of the flushing and testing activities (estimated <1 hour per location), no metal leaching is expected. Once the hydraulic integrity of the firefighting system has been verified, a limited volume of firefighting foam concentrate shall be loaded into the foam proportioning tanks. The limited volume of foam concentrate shall be minimised to the amount required for the 30 second test at each of the seven foam testing locations. Controls will be implemented during the fire water test which will include construction of fire water containment equivalent to 110% volume as contingency and having a vacuum truck with pump on standby if additional storage is required (see Table 2-2 of Addendum to CEMP). The contained volume of foam shall be tested for portion and expansion rate and then allowed to reduce in volume prior to temporary storage and disposal by a licensed waste contractor to an authorised regulated waste facility.</td></tr>
<tr><td>Section 6.4.6
Table 6-15: key activities, potential environmental impacts and residual risk levels for surface water management
Page 140</td><td><table><tr><th>Activity</th><th>Potential environmental impact</th><th>Residual risk level</th></tr><tr><td>Commissioning of Fire Fighting (System 790/1/2):
• testing of fire water foam system
• flushing of fire water system
• deluge spray testing</td><td>Release of contaminated firewater (elevated copper in PWC water) to land and surface water resulting in deterioration of aquatic environmental health</td><td>Low</td></tr></table></td><td><table><tr><th>Activity</th><th>Potential environmental impact</th><th>Residual risk level</th></tr><tr><td>Commissioning of Fire Fighting (System 790/1/2)
Testing of fire water system
Flushing of fire water system
Deluge spray testing</td><td>Release of contaminated fire water (C6 purity compliant foam and elevated copper in PWC water) to land and surface water resulting in deterioration of aquatic environmental heath</td><td>Low - Moderate</td></tr></table></td></tr>
<tr><td>Appendix C: Environmental Risk Register
Page 494</td><td><table><tr><th>#ID</th><th>Aspect</th><th>Activity</th><th>Environmental Impact</th><th>Mitigation measures</th><th>CEMP Rev 18 C</th><th>CEMP Rev 18 L</th><th>Residual Risk CEMP Rev 18</th></tr><tr><td>168</td><td>Land/Sea Contamination</td><td>Fire Water and Foam system Deluge spray monitoring</td><td>Loss of containment or release of contaminated firewater to land and surface water.
Breach of CEMP criteria
Unanticipated pollution event with regulatory reporting.</td><td>Refer to related measures in item 108, 109, 110, 111
1. System relevant commissioning procedures, PTW, JHA, SWMS
2. All commissioning SWMS prepared by Contractor
3. Flush activity - no added chemicals
4. Post flush activity
5. WDL 211
6. Deluge testing broken up by area to allow for containment and reuse / discharge via outfall</td><td>F-Insignificant</td><td>5-Highly unlikely</td><td>Low</td></tr></table></td><td>No change to existing text, additional mitigation measures identified to prevent new or increased environmental impact (refer to Appendix D).</td></tr>
</table>

<table>
<tr><th>Location in CEMP</th><th>Original Text</th><th>Revised Text (in italics)</th></tr>
<tr><td>Appendix C: Environmental Risk Register

Page 498</td><td>
<table>
<tr><th>#ID</th><th>Aspect</th><th>Activity</th><th>Environmental Impact</th><th>Mitigation measures</th><th>CEMP Rev 18 C</th><th>CEMP Rev 18 L</th><th>Residual Risk CEMP Rev 18</th></tr>
<tr><td>181</td><td>Land/Sea Contamination</td><td>Fire Water system</td><td>Potential discharge of potable water with elevated copper concentrations.
Pollution event with regulatory reporting.
Discharge of off spec water.
Breach of CEMP criteria.</td><td>1. Potable water will be tested during filling activity
2. No fire fighting foam is to be used for commissioning
3. Individual management strategies for each area so that water can be contained
4. Reuse as first preference strategy then discharge under Waste Discharge Licence 211
5. Provide brief to NT EPA on risk assessment of copper water release demonstrating negligible impacts and any additional monitoring proposed to validate risk assessment findings.
6. Liaison with NT EPA providing advanced notification and discharge to the regulating reservoir.</td><td>E-Minor</td><td>2-Likely</td><td>Moderate</td></tr>
</table>
</td><td>No change to existing text, additional mitigation measures identified to prevent new or increased environmental impact (refer to Appendix D).</td></tr>
</table>

7 SUMMARY OF KEY COMMITMENTS

This section summarises the key commitments made by INPEX in association with this Addendum, as follows:

- INPEX will ensure that, as a consequence of testing the firefighting systems, in accordance with the Addendum there is no measurable increase in the concentration of PFOA, PFOS or PFHxS in the waters of Darwin Harbour or its sediments within 200 m of the jetties.
- INPEX has made all reasonable efforts to determine that there is no PFAS-free alternative firefighting foam available that will meet the firefighting performance requirements of the firefighting system.
- INPEX will implement the SAQP to detect PFOS, PFOA, and PFHxS in nearfield waters and far-field (as needed) waters at jetty test locations. The PFAS NEMP (HEPA 2018) trigger criteria will be used as screening values to be protective of affected communities where multiple exposure pathways may be present. This is especially important for bioaccumulative chemicals such as PFOS, PFHxS and PFOA. The consequence of this is that an exceedance of the screening values should trigger further investigation such as site‐specific risk assessment to refine the likely degree of possible risk (as opposed to the assumption that harm will have occurred).
- INPEX will provide the SAQP to the Department of the Environment and Energy prior to the commencement of testing. The SAQP will:
  - contain supporting documentation, including data quality objectives, methodology, sampling strategy, statistical analyses, and QA/QC processes that demonstrate that the monitoring effort is capable of detecting measurable changes of PFOS, PFOA, and PFHxS, should there be an unintended discharge of concentrate or foam
  - be aligned to the PFAS NEMP (HEPA 2018)
  - include an updated Conceptual Site Model
  - in the event that screening values are triggered and an investigation is required, a site specific risk assessment will be undertaken using a multiple lines of evidence approach to assess the potential for PFOA, PFOS or PFHxS impacts to the identified receptors resulting in environmental harm. This is consistent with the ASC NEPM, which requires that site conceptualisation and characterisation is undertaken to the extent necessary to reliably inform risk assessment and actions to manage unacceptable risks
  - use screening and investigation levels, as per the PFAS NEMP (HEPA 2018), specifically:
    - Trigger criteria will be used as screening values to be protective of affected communities where multiple exposure pathways may be present. This is especially important for bioaccumulative chemicals such as PFOS, PFHxS and PFOA. The consequence of this is that an exceedance of the screening values should trigger further investigation such as site‐specific risk assessment to refine the likely degree of possible risk (as opposed to the assumption that harm will have occurred).
  - refer to the existing baseline surface water and sediment samples already collected and analysed in a NATA accredited laboratory, noting these are

appropriate as long term monitoring locations for the site activities (as required by ANZECC), and represent far - field locations

- include an adaptive management response (in line with the PFAS NEMP (HEPA 2018)), which would be implemented should screening levels indicate an investigation is required
- include commitments to:
  - undertake sampling of biota (three taxa - fish, crustaceans and molluscs) for baseline assessment of PFAS contamination (if any)
  - undertake surface water samples at the jetties approximately 1 hour before testing commences at four locations in the designated 50 m radius mixing zone surrounding each jetty test location (and these will be analysed as discrete samples)
  - maintain a vessel in the vicinity of the jetties during the testing to observe the testing from the water
  - on completion of the test at each jetty, and within the 6 hour tidal window seen in Darwin Harbour:
    - deploy a drogue, to indicate tidal direction and hence the sample collection transect for collection of surface water samples
    - collect a second round of water samples at the four locations in the designated 50 m radius mixing zone surrounding each jetty test location as well as single samples at each of 100, 150 and 200 m distances from the centroid of the mixing zone (i.e. along the tidal current transect established by the drogue)
    - follow the drogue, and if the drogue reaches land within the study area, collect sediment and water samples from three additional locations – at the landfall point and 50 m laterally on each side; if the drogue moves out of the study area without touching land then no sampling will be undertaken
  - undertake investigation (response) sampling in the event there is a loss of containment, or if the results of the post-test sampling and analysis indicates the screening levels have been triggered, as per the PFAS NEMP (HEPA 2018). This investigation sampling would mimic the post-test sampling described above, but also include repeat sampling of the baseline sediment and surface water sampling already conducted in the far-field (i.e. EIMP locations previously sampled), and sampling of biota within the study boundary (three taxa as above) within one week of the loss of containment/breach of trigger levels, over a period of one week (expected five days for sampling and contingency days).

- Within six months of the completion of the testing of firefighting systems, INPEX will provide to the Department a report that includes:
  - the results of environmental samples collected (including laboratory reports) for the sampling program outlined in the SAQP
  - a review of the implementation of the SAQP, including an evaluation of the adequacy of the SAQP to detect PFOS, PFOA, and PFHxS in the nearfield waters at the jetty test locations and to assess the potential for PFOA, PFOS or PFHxS impacts to the identified receptors
  - an evaluation of the effectiveness of controls employed to contain or store firefighting foams onsite and documentation for transport and destruction of materials/wastewater involved in/stemming from the testing

  - a discussion of any deviations from the SAQP.
- If the six month report on the testing of firefighting systems indicates a detectable increase in the concentration of PFOS, PFOA, or PFHxS in sediment and waters at the jetty test locations, the report will include information on:
  - the location of elevated concentrations of PFOS, PFOA, and PFHxS
  - the likely point/s of contamination
  - proposed remedial actions
  - measures to prevent future contamination from systems testing.
- In addition to reporting requirements already described in the CEMP, INPEX will notify regulators:
  - within 24 hours of INPEX becoming aware of loss of containment which results in offsite discharge of foam products, including a description of immediate corrective actions and measures to prevent reoccurrence
  - within 24 hours of INPEX becoming aware of an increase in the concentration of PFOS, PFOA, or PFHxS in nearfield waters or sediments at the jetty test locations.

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APPENDIX A: QUALIFIED PERSON ENDORSEMENT

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10 March, 2018

Jake Tobin
INPEX Australia
144 Wickham Point Road
Wickham, Northern Territory

Our Reference: *0422035L01_10 MAR18.DOCX*

Attention: **Jake Tobin**

Dear Jake,

RE: CEMP ADDENDUM – QUALIFIED PERSON REVIEW & ENDORSEMENT

1. INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) was engaged by INPEX Operations Australia LNG Pty Ltd (INPEX) to undertake a qualified person review of an Addendum to the current Construction Environmental Management Plan (CEMP) (L092-AH-PLN-10001). The CEMP addresses the environmental impacts and the mitigation measures as they relate to the construction of an onshore liquefied natural gas (LNG) processing facility to be located on Bladin Point on Middle Arm Peninsula near Darwin in the Northern Territory.

The CEMP currently proposes the use of potable water for flushing and testing of the entire firewater system however, INPEX has identified that at seven safety critical locations it is necessary that the system be tested with firefighting foams (Expandol or Tridol C6 S3) depending on location demonstrate that the systems meets functional requirements in the event of a fire.

Where there is a proposed change to the site activities, it is a requirement of the current approvals to prepare a CEMP Addendum and seek endorsement by a 'qualified person'. Table 1 shows the Endorsement details and relevant approval conditions.

Table 1 Endorsement Particulars

Approval Number:	EPA7-7
Commencement Date:	19 April 2012
Date of Last Amendment:	24 January 2017
Expiry Date:	31 December 2018
Notice Holder:	Ichthys LNG Pty Ltd
Premises Address:	NT Portion 07002, 144 Wickham Point Road, Wickham NT 0822
Relevant Approval Condition:	***10.*** *The Approval Holder must, for any works not addressed in the approved CEMP or Associated Application, if those works will or may cause or increase the potential for environmental harm, such as by increase in emissions or discharge:* *10.1 Revise the CEMP, or prepare an Addendum to the CEMP;* *10.2 Have the revised CEMP or CEMP Addendum reviewed and endorsed by a qualified person; and,* *10.3 Submit the revised CEMP or CEMP Addendum, with a copy of the qualified person's certified review, to the NT EPA at least 30 days prior to implementation of the works.*

2. QUALIFIED PERSON

A "qualified person" required to undertake the CEMP Addendum review must be a NSW or Victorian EPA appointed Environmental Auditor as defined by the WMPCA.

Paul Fridell of ERM is a qualified person as he is a Victorian EPA appointed Environmental Auditor. Mr Fridell's personal qualifications include a Bachelor of Science (Geology & Geography) and Master of Environmental Science (Hydrogeology & Waste Management), both degrees from the University of Melbourne. Paul's hydrogeology expertise is in the fate and transport of groundwater contaminants. Over his 20 year environmental consulting career Paul's expertise includes environmental risk assessments, preparation of environmental management plans for construction projects of various size, development of operational environmental management plans for various industrial facilities (including landfills, ports and dredging), preparation of waste management plans, hazardous materials assessments, assessment of contaminated land, and preparation of regulatory environmental approval documentation for infrastructure and industrial facilities.

Paul was appointed as an Environmental Auditor in 2011 by the Victorian EPA and his appointment is subject to renewal in November 2018. Since becoming an auditor Paul has undertaken numerous environmental audits pursuant to the Environment Protection Act 1970 in Victoria and has completed a number of "qualified person" audits/reviews since November 2012 in the Northern Territory associated with NT EPA approvals (EPA7, EPA8, EPA9) of the Ichthys project.

More recently related to firefighting foams and per- and poly-fluorinated alkyl substances (PFAS), Paul has also provided technical review on ERM deliverables associated with Qantas AFFF spill at Brisbane Airport (April 2017) and a PFAS assessment at Darwin LNG, Wickham Point, NT. Paul has been engaged since 2016 by Department of Defence to audit the assessment works at RAAF Base Edinburgh (South Australia) and HMAS Cerberus (Victoria) as part of the National PFAS Investigation & Management Program.

In undertaking this review Paul Fridell has acted in a manner consistent with Victorian EPA Publication 865, Environmental auditor guidelines for appointment and conduct. It is understood that NT EPA expect that all Victorian EPA auditors abide by the code of conduct applicable in their state of appointment when fulfilling the role of "qualified person".

3. SCOPE OF QUALIFIED PERSON REVIEW

3.1 OBJECTIVES

The general duty on persons under the Section 12 of *Waste Management and Pollution Control Act* [NT] (WMPCA) is that a person who conducts an activity or performs an action that causes or is likely to cause pollution resulting in environmental harm or that generates or is likely to generate waste must take all measures that are reasonable and practicable to prevent or minimise the pollution or environmental harm; and reduce the amount of the waste.

In determining which measures are reasonable and practicable, pursuant to Section 12(2) of the WMPCA, a qualified person is to have regard to:

a) the nature of the environmental harm and the sensitivity of the environment into which a contaminant or waste is placed or may be placed;
b) current technical information reasonably available to the person in relation to the activity and the likelihood that a measure proposed in the information would minimise the pollution, environmental harm or waste that the activity or action may cause; and
c) the financial implications of implementing or carrying out the measures.

With this duty in mind, in undertaking a review of the CEMP Addendum, as the qualified person I have had regard to:

1. Adequacy of the identification of activities to be conducted, that is to say, have all the activities that cause or are likely to cause pollution resulting in environmental harm been identified in the CEMP Addendum;
2. Adequacy of the risk assessment, that is to say, have all the activities been assessed for the potential to cause environmental harm using a transparent and standard process and are the risk assessment conclusions reasonable considering the activities being undertaken;
3. Adequacy of the risk mitigation measures, that is to say, are the measures proposed in the CEMP Addendum reasonable and practicable having regard to items listed in Section 12(2) of the WMPCA and appropriate contingencies should the mitigation measures fail.
4. Adequacy of discharge limits and monitoring, that is to say, are discharges adequately limited and monitored such that the assumed contaminant loadings used for the risk assessment can be verified.

3.2 REVIEWED DOCUMENTS

The following documents were provided by the approval holder for review and endorsement by the Qualified Person:

- INPEX, 9 March 2018, *Ichthys Onshore LNG Facilities Construction Environmental Management Plan Revision 2 – Addendum 1: Test of Firefighting System*, Plan, Document number: L092-AH-PLN-10003, (Revision 3).

3.3 REFERENCE DOCUMENTS

In undertaking the review and endorsement, the Qualified Person has considered the following documents:

- *Waste Management and Pollution Control Act* [NT];
- NT EPA, June 2016, NT PFASs Investigation, Northern Territory Per- and Poly Fluorinated Alkyl Substances (PFASs) Legacy Site Investigation;
- Department of Health (enHealth) (2017), *Heath Based Guidance Values for PFAS for use in site investigations in Australia*;
- Department of Environment and Energy (DoEE), October 2016, *DRAFT Commonwealth Environmental Management Guidance on Perfluorooctance Sulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA);*
- NSW Office of Environmental Heritage (OEH) Science, May 2017, *PFAS Screening Criteria (DRAFT)*.
- Heads of EPAs Australia and New Zealand (HEPA) & DoEE, January 2018, *PFAS National Environmental Management Plan*.
- Concawe, June 2016, *Environmental fate and effects of poly-and perfluoroalkyl substances (PFAS)*. Reviewed by the Emerging Contaminants Working Group of NICOLE, the Network for Industrially Contaminated Land in Europe; and,
- National Ground Water Association (US) (NGWA), 2017, *Groundwater and PFAS: State of Knowledge and Practice.* National Ground Water Association Press;

3.4 QUALIFIED PERSON ACTIVITIES

In undertaking the review the Qualified Person undertook the following activities:

- Attendance (by teleconference as an observer) at the environmental hazard identification (ENVID) for the CEMP addendum held by INPEX on 24 August 2017;

- Review of ENVID risk assessment worksheet generated from the ENVID on 24 August 2017;
- Review of the draft version of the CEMP addendum and provision of comments;
- Review of the final version of the CEMP addendum (Rev 0);
- Attended teleconference meetings in December 2017 with INPEX, DoEE and NT EPA to discuss additional information requirements for the CEMP Addendum 2 (Rev 02);
- Attended teleconference meetings in February and March 2018 with INPEX and DoEE to discuss additional information requirements for the CEMP Addendum 2 (Rev 03);
- Undertook an on-site inspection (February 2018) at Bladin Point, Darwin, NT of areas proposed for fire-fighting foam testing areas and hazardous waste storage areas;
- Review the draft version of the CEMP addendum with provision of comments; and,
- Review of the final version of the CEMP addendum (Revision 3).

3.5 DEPARTMENT OF ENVIRONMENT AND ENERGY (DOEE) COMMENTS (DECEMBER 2017)

Comments provided by DoEE in an email dated 21 December 2017 to INPEX, can be summarised into the following points:

1. *'DoEE agree to use the 95% species protection level for aquatic ecosystems. This is because the Northern Territory Government has set water quality objectives for Darwin Harbour in accordance with slightly to moderately disturbed systems;*
2. *In relation to the guideline values, DoEE agree that it would be appropriate to use the DoEE October 2016 Guideline 95% marine ecosystem protection values;*
3. *To provide the necessary certainty around the timing/duration of the system tests, DoEE request that INPEX specify the number and period over which the tests are conducted;*
4. *DoEE is only concerned at PFOS, PFOA, and PFHxS concentrations in (a) the concentrate and (b) any unintended discharges (e.g. mists) to Darwin Harbour;*

5. *DoEE requests more precise information on the concentration of PFOS, PFOA, and PFHxS, than is available in the lab reports provided. If you can provide a lab report that demonstrates to the delegates satisfaction that these substances are not present or are in negligible concentrations then the Department has no further concerns regarding those substances (i.e. item 6 does not apply);*

6. *If you do not have the information in Item 5, or unable to provide this according to your timeframes, then we propose the following approach:*

    - *assume (a) the maximum value recorded in the lab report, or (b) adopt the maximum concentration value of the substances that underpins compliance with the EU Directive (and any information provided to you by the supplier/manufacturer);*

    - *describe, using images, drawings and text containment, treatment and disposal of contaminated wastewaters for the highest risk (your judgement) jetty and non-jetty tests. That is, two detailed descriptions. As it stands the Addendum does not, alone and unreferenced to the approved CEMP, provide sufficient information on which to make a decision; and*

    - *specify a plausible worst case scenario of a discharge/loss of contaminated test waters at the same two high risk tests, and estimate and state the volume and concentration of the wastewater. Mixing zones are not applicable, however, for context a proposed dilution effect in Harbour, and basis to that would provide context.'*

3.6 DEPARTMENT OF ENVIRONMENT AND ENERGY (DOEE) COMMENTS (MARCH 2018)

In March 2018 following the releases of the final HEPA document, DoEE made the comment that the *"recent release of the PFAS National Environmental Management Plan (NEMP) underpins the Department's continued concern at potential release of PFAS substances to the environment, and risk to nationally protected matters such as dolphins."*

Specific comments provided by DoEE in an email dated 2 March 2018 to INPEX, included the following points:

- *Inpex has advised the Department that, despite significant investigations, Inpex is unable to source alternative, PFAS-free firefighting foam that meet the performance requirements of the firefighting system. To better appreciate this, the Department requests a statement to that effect and supporting evidence substantiating this claim. The statement and evidence should be provided along with, but not as part of, the revised Addendum;*

- *The Department appreciates that Inpex will have trained staff conducting and monitoring system tests. However, the Department considers that visual monitoring for discharges alone is inadequate and that, as part of the Sampling and Analysis Quality Plan (SAQP), sampling should be conducted pre- and post-test in the vicinity of potential surface discharge points and jetties. To this end the Department proposes a series of commitments in respect of the SAQP, including that the SAQP will have regard for the NEMP (in particular, using screening and investigate levels).*

- *Please note that sampling need only be within 200m of potential surface discharge points and jetties, and not for all of Darwin Harbour.*

- *For Inpex's information, the Department considers that PFAS substances ("PFASs") include PFOS (perfluorooctane sulfonate), PFOA (perfluorooctanoic acid), PFHxS (perfluorohexane sulfonate), and their precursors. PFOS, PFOA and PFHxS are the expected ultimate environmental contaminants of a broader family of related per- and poly-fluoroalkyl substances. These PFOS-, PFOA-, and PFHxS-related substances are sometimes referred to as precursors. Precursors can contribute to the total load of PFOS, PFOA, and PFHxS in the environment over time and should be considered to the fullest extent possible. Where the identity of PFOS, PFOA, and PFHxS precursors are unknown, the suite of analytes in Eurofins report 578595-W (dated 21 Dec 17; method LTM-ORG-2100) is appropriate for the measurement of PFAS substances.*

- *In order to expedite the delegate's decision on the Addendum, the Department recommends that Inpex make the following commitments in the Addendum. If possible, it would be ideal for the following text to be directly inserted into the Addendum:*

    1. *Inpex has made all reasonable efforts to determine that there is no PFAS-free alternative firefighting foam available that will meet the firefighting performance requirements of the firefighting system.*

    2. *Inpex will ensure that, as a consequence of testing firefighting systems in accordance with the Addendum, there is no measurable increase in the concentration of PFOA, PFOS or PFHxS in sediment and waters within 200m from potential surface discharge points and jetties.*

    3. *The Sampling and Analysis Quality Plan (SAQP) will be provided to the Department prior to the commencement of testing. The SAQP will, amongst other matters:*

        a) *have regard for the PFAS National Environmental Management Plan (HEPA 2018);*

        b) *be able to demonstrate, at a statistical power of 0.8 or greater, that there has been no measurable increase in the concentration of PFOA, PFOS*

or PFHxS in sediment and waters within 200m from potential surface discharge points and jetties;

c) contain supporting documentation, including the derivation of statistical power, and QA/QC strategies.

4. *Within six months of the completion of the testing of firefighting systems, Inpex will provide to the Department a report that includes:*

    a) the results of environmental samples collected (including laboratory reports) prior to and within 2 hours after testing of firefighting foams, including any variation in concentrations from the baseline concentrations prior to testing of the firefighting system;

    b) a review of the implementation of the SAQP, including an evaluation of the adequacy of the SAQP to detect variation in the concentration of PFOS, PFOA, and PFHxS in the waters and sediment within 200m from potential surface discharge points and jetties; and

    c) an evaluation of the effectiveness of actions to contain, store, treat and dispose of materials containing PFOS, PFOA, and PFHxS.

5. *If the six month report on the testing of firefighting systems indicates a detectable increase in the concentration of PFOS, PFOA, or PFHxS in sediment and waters within 200m from potential surface discharge points and jetties, Inpex will in that report:*

    a) identify the location of elevated concentrations of PFOS, PFOA, and PFHxS;

    b) nominate the likely points of contamination; and

    c) specify measures to prevent future contamination from systems testing.

6. *In addition to reporting requirements already described in the CEMP, Inpex will notify DoEE:*

    a) within 24 hours of Inpex becoming aware of the failure of chemical containment, storage, or treatment systems;

    b) within 24 hours of Inpex becoming aware of an increase in the concentration of PFOS, PFOA, or PFHxS in sediment and waters within 200m from potential surface discharge points and jetties. Upon Inpex becoming aware Inpex will immediately cease firefighting system testing and only recommence testing when DoEE is satisfied

suitable actions have been taken to prevent future failure of chemical containment, storage, or treatment systems; and

c) *within five business days of Inpex becoming aware of any non-compliance with the SAQP, and will describe actions taken to prevent future non-compliance.*

4. REVIEW CONSIDERATIONS

4.1 PER- AND POLY-FLUORINATED ALKYL SUBSTANCES (PFAS)

PFAS have been widely used globally since the 1950s in a wide variety of industrial and commercial products that resist heat, stains, grease, water, and specifically relevant to this review, fire-fighting foams. Other products that may contain PFAS include furniture and carpets treated for stain resistance, fast food or packaging food containers, make up and personal care products and cleaning products. These chemicals have been identified worldwide as emerging contaminants of concern due to their highly persistent nature, mobility in the environment and significant potential for bioaccumulation and biomagnification. Their widespread use and persistence means that many types of PFAS are ubiquitous global contaminants. The PFASs of most concern are typically perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) and perfluorohexane sulfonate (PFHxS).

Chronic exposure studies to PFOS, PFOA and PFHxS on laboratory animals has shown adverse effects on liver, gastrointestinal tract and thyroid hormones however the applicability of these studies to humans is not well established (EnHealth, 2016). In humans, research to date has not conclusively demonstrated that PFASs are related to specific illnesses, even under conditions of occupational exposure (Enhealth, 2016). However because of their widespread use, and a trend of accumulation of PFASs in humans around the globe, State, Territory and Commonwealth governments are driving a proactive and precautionary approach to the management of PFASs (Enhealth, 2016).

4.2 FIREFIGHTING FOAM SELECTION

In considering appropriate firefighting foams, it is proposed to use Tridol C6 S3 and Expandol foams as they contain "*no PFOA or PFOS in accordance with EU Directive 2006/122/EC and amended Council Directive 76/769/EEC*". While it is noted that products in compliance with these Directives are still permitted to contain a maximum PFOS concentration of 0.005% (50,000µg/L), the main active compounds are understood to be fluorotelomer derivatives based on 4:2, 6:2 or 8:2 FTS and not PFOA or PFOS.

INPEX have confirmed that based on advice from the engineers *"Tridol C6 S3 and Expandol are the only viable options for use, after firefighting effectiveness, short and long-term health, safety and environmental risks and property protection characteristics have all been appropriately considered"* (Section 5.1.2). Independent enquiries made by the auditor confirm this statement.

PFASs are expected to transform either biotically or chemically in the environment. Literature suggests FTS will eventually transform to PFSAs (perflouroalkyl sulfonic acids) and PFCAs (perflouroalkyl carboxylic acids) in the environment.

There is very limited literature on these compounds at present with regard to potential ecological risks and no published investigation guidelines for use in Australia.

4.3 ADEQUACY OF THE IDENTIFICATION OF THE NATURE AND EXTENT OF THE ACTIVITIES

The Section 3 of the Addendum defines the activity as testing of the firefighting system at seven (7) safety critical locations: five (5) locations on land and two (2) locations on the jetty over water during the construction/commissioning phase (regulated under NT Environment Protection Approval (EPA7)). The facility is considered a major hazard facility (MHF) and therefore this testing is a mandatory requirement to inform the safety assessment of the MHF prior to operations commencing.

Table 3-1 in the addendum defines the foam types to be used at each location and the key test parameters including: operating pressures, pre-test duration (water only), foam test duration, flow rates, expansion ratios and tank capacities. Appendix F of the Addendum includes pictures of the various infrastructure that will be used in the testing.

The proposed foam solutions to be used at the test locations include a 3% foam solution of Tridol S3 C6 and 3% foam solution of Expandol. Samples of these 3% foam mixtures were prepared and sent to a NATA accredited laboratory (Eurofins-MGT) for PFAS analysis.

PFAS Compound	Expandol 3%(1) (µg/L)	Tridol 3%(2) (µg/L))	DoEE (2016)(3) (µg/L)	HEPA (2017)(4) (µg/L)
PFOS	0.20	<0.2	7.8	0.13
PFHxS	<0.01	<0.2	-	-
PFOA	0.56	<0.2	8500	220

(1) Eurofins-MGT, 5 Jan 2018, Report No. 578595-W

(2) Eurofins-MGT, 21 Dec 2017, Report No. 578126-W

(3) Marine water: 95% species protection – slightly to moderately disturbed systems, DoEE (2016).

(4) Australian interim and draft ecological criteria – ecological freshwater, slightly to moderately disturbed systems (95% species protection) (HEPA, 2017).

As discussed in the previous section foams that are labelled as "*no PFOA or PFOS in accordance with EU Directive 2006/122/EC and amended Council Directive 76/769/EEC*" may still have trace PFOS or PFOA compounds up to 0.005% (in concentrate) to meet the Directive. The above analysis demonstrates that in the 3% solutions the concentration of PFOS is marginally above the more conservative HEPA investigation levels. The laboratory reports also demonstrate that the dominant fluorinated compound is FTS derivatives as expected in a commercial *"no"* PFOS/PFOA foam.

Tables 5-4 and 5-5 in the Addendum further demonstrate that even in the very worst case scenario involving 100% failure of all controls and the entire volume of Tridol concentrate is lost to the harbour, the dilution is such that the resultant PFOS concentration would be one order of magnitude less than HEPA (2017) investigation level in a limited 10x10m area.

Assuming a reasonable worst case scenario involving a loss of 10% of the 3% Tridol foam solution due to failure of the controls, the resultant concentration would be four orders of magnitude below the HEPA (2017) investigation guideline and below the detection limit of all commercially available laboratory methods.

4.4 ADEQUACY OF THE RISK ASSESSMENT

The assessment of the risks posed by the activity was undertaken in accordance with the risk assessment framework based on likelihood and consequence outlined in Section 5 of the CEMP Revision 2 (March 2017) (Document No. L092-AH-PLN-1001).

The risk assessment considered the activities, associated hazards and potential impacts. The residual risk was determined considering the proposed controls. The risk assessment was undertaken with collaboration with key stakeholders to get a range of views. The qualified person listened in to the ENVID to witness the risk assessment process and provide feedback on the proposed controls being discussed.

The highest residual risk activities (moderate risk) identified were the foam tests on the LNG jetty and condensate jetty (items 4.1 and 5.1A in risk register) and the use of low expansion foam (Tridol C6 S3) test on a single condensate tank (item 3.2 in risk register). A copy of the risk register is included in Appendix E of the Addendum.

The risk assessment was deemed to adequately identify and assess the key hazards and impacts using the risk assessment framework outlined in the CEMP Rev 2 (2017).

4.5 ADEQUACY OF RISK MANAGEMENT MEASURES

The risk management measures (controls) are listed in the risk register against the various activities (Appendix F in the Addendum). In reviewing the controls proposed, the key controls related to the foam testing in addition to the existing controls in the CEMP are identified below:

- The adoption of the alternative foam products that aim to remove PFOS to the extent practicable;
- Only limited volumes of foam stored on-site and just in time delivery;
- Fit for purpose spill response plan;
- Additional temporary containment bund on jetty concrete underneath the storage tanks while transfers take place;
- Filling limited to the volume required for the test (+25%);
- Construction of scaffold and liner containment systems around all discharge areas and designed to minimise wind effects and overspray on jetties;
- Containment systems include an additional 50% volume compared to maximum foam volume generated to ensure sufficient containment;
- Undertake short test trial to confirm containment is achievable;
- Potential for use of water to supress foam;
- All relevant surface water drainage lines blocked at time of test to contain any potential spill;
- Undertake onshore tests first to apply lessons learnt to jetty testing;
- On jetties, water only pressure testing prior to start of foam test;
- Increase capacity of jetty sump; and,
- Testing to be undertaking when wind speed is low.

The existing relevant controls as listed in the CEMP Revision 2 (refer to Table 5-6 in the Addendum) and the additional measures proposed in the Addendum (Figure 5-2) are considered reasonable and practicable to achieve the lowest residual risk possible. I was also satisfied that where risks were assessed as moderate, there were no additional measures readily identifiable that would further reduce the risk to a lower risk ranking.

In the most recent revision of the Addendum, INPEX has provided additional information (Section 5.3 and Appendix G) further identifying the location of the drainage isolation measures to prevent off-site surface water migration. These areas were inspected by the auditor in February 2018 and based on historical knowledge of the existing drainage network, the auditor is of the view that the isolation measures reduce the residual risk to low and acceptable levels. It is noted that in containing the used foam and water it will generate contaminated waste water and solid waste requiring management. INPEX does not want to contaminate the onsite waste water treatment plants and therefore has proposed off-site disposal of the contaminated waste water. Section 5.3 of the Addendum identifies the Toxfree facility in Queensland or the Cleanaway facility in NSW as potential waste receivers. Characterisation will be undertaken as per the requirements of the receiving facility and transported in accordance with the *National Environment Protection (Movement of Controlled Waste between State and Territories) Measure 1998*.

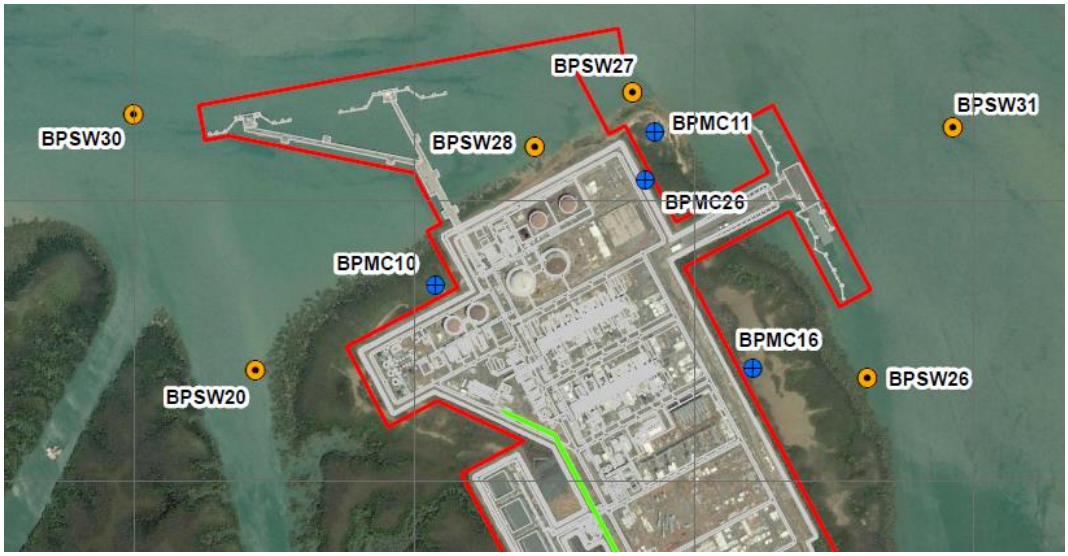
Condition 16 of NT EPA Approval (EPA7-7) requires INPEX to maintain records of listed waste disposal and these records are audited in detail annually during the Qualified Person compliance audit.

4.6 ADEQUACY OF MONITORING

One of the Commonwealth requirements of EPBC 2008/4208 Approval Condition 8 (Liquid Discharge Management Plan) includes provision of a monitoring regime to determine achievement of the environmental objectives and success of the risk management measures implemented.

Currently the site Environmental Impact Monitoring Program (EIMP) does not include specific monitoring of the environment for PFASs. A baseline investigation was therefore undertaken by Greencap Pty Ltd (reported in memorandum dated January 2018[1]) which established a baseline for per-and poly-fluoroalkyl substances (PFAS) concentrations in marine surface waters and mangrove sediments prior to potential testing of aqueous firefighting foam (AFFF) at the Ichthys Onshore LNG Facility. The sampling was undertaken at existing EIMP sediment (BPMC) and surface water (BPSW) sampling locations as shown below.

[1] Greencap Pty Ltd, 18 January 2018, *RE: PFAS Baseline Investigation Memorandum*, Doc No. J149075_January 2018.



It was reported that all mangrove sediment and marine surface water PFAS results were below the laboratory limit of reporting (LOR) and the adopted HEPA (2018) 95% ecosystem protection assessment criteria.

- To assess the adequacy of the implementation of the management measures, the addendum includes a commitment (Section 7) to implement a Sampling and Analysis Quality Plan (SAQP) that includes the following summarised key elements in response to DoEE comments (March 2018): :INPEX will implement the SAQP to detect PFOS, PFOA, and PFHxS in nearfield and farfield (as needed) waters at jetty locations;

- INPEX will provide the SAQP to the Department of the Environment and Energy prior to the commencement of testing that will address the DoEE comments with agreed minor amendments as discussed in a teleconference on 9 March 2018.

The proposed SAQP key elements as outlined in Section 7 have been reviewed by the auditor and are considered adequate to monitoring effectiveness and implementation of the proposed risk mitigation measures and meet the DoEE requirements with minor amendments as agreed in teleconference dated 9 March 2018 attended by the auditor. The main changes agreed in the teleconference included:

- INPEX could not reasonably *"ensure that, as a consequence of testing firefighting systems in accordance with the Addendum, there is no measurable increase in the concentration of PFOA, PFOS or PFHxS in sediment and waters within 200m from potential surface discharge points and jetties"*. It was therefore agreed that INPEX would use the HEPA NEMP marine water guideline values (95% species

protection) to screen for ecological risk and that additional investigations would be triggered in the event of a reported exceedance;

- The notification to DoEE and cessation of testing until DoEE granted approval to recommence was deemed impracticable given the short duration of the test and the time taken (7 days) to receive laboratory test results post testing. It was therefore agreed that Inpex would notify DoEE within 24 hours of a loss of containment with a description of corrective actions and notify with 24 hours of becoming aware of an increase at testing locations.

All other commitments made in Section 7 are deemed to be consistent with the DoEE requirements as outlined in Section 3.6 of this report.

5. STATEMENT OF REVIEW AND ENDORESMENT

I, Paul Fridell of Environmental Resources Management Australia Pty Ltd, an environmental auditor (appointed pursuant to the Victorian Environment Protection Act 1970; 'the Act') and therefore deemed a 'qualified person' in the Northern Territory in accordance with the NT Waste Management and Pollution Control Act, having:

- *been requested by INPEX Operations Australia LNG Pty Ltd to review and endorse the*
    - *Ichthys Onshore LNG Facilities Construction Environmental Management Plan Revision 2 – Addendum 1: Test of Firefighting System, Plan, Document number: L092-AH-PLN-10003, Revision 3*

  for the purpose of construction of Ichthys Onshore LNG Facility located at Bladin Point in Darwin Harbour in the Northern Territory,
- *had regard to the following Acts and Environmental Protection Objectives:*
    - *Waste Management and Pollution Control Act,*
    - *the Water Act,*
    - *Relevant Environment Protection Objectives:*
        a. *Declaration of Beneficial Uses and Objectives, Darwin Harbour Region, Northern Territory Government Gazette No. G27, 7 July 2010;*
        b. *Declaration of Beneficial Uses and Objectives, Elizabeth-Howard Rivers Region Groundwater, Northern Territory Government Gazette No. G27, 7 July 2010;*
- *and had regard the following relevant guidelines and documents:*
    - *Waste Management and Pollution Control Act [NT];*
    - *NT EPA, June 2016, NT PFASs Investigation, Northern Territory Per- and Poly Fluorinated Alkyl Substances (PFASs) Legacy Site Investigation;*
    - *Department of Health (2017), Heath Based Guidance Values for PFAS for use in site investigations in Australia;*
    - *Department of Environment and Energy (DoEE), October 2016, DRAFT Commonwealth Environmental Management Guidance on Perfluorooctance Sulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA);*
    - *DoEE, 21 December 2017 12:21pm [email], Subject: FW: CEMP Firefighting Addendum request for further information [SEC=UNCLASSIFIED];*
    - *DoEE, 2 March 2018 2:29PM [email], Subject: Addendum as discussed;*

- *NSW Office of Environmental Heritage (OEH) Science, May 2017, PFAS Screening Criteria (DRAFT).*
- *Concawe, June 2016, Environmental fate and effects of poly-and perfluoroalkyl substances (PFAS). Reviewed by the Emerging Contaminants Working Group of NICOLE, the Network for Industrially Contaminated Land in Europe;*
- *Heads of EPAs Australia and New Zealand (HEPA) & DoEE, January 2018, PFAS National Environmental Management Plan,;*
- *National Ground Water Association (US) (NGWA), 2017, Groundwater and PFAS: State of Knowledge and Practice. National Ground Water Association Press.*

HEREBY DECLARE that:

The ***Ichthys Onshore LNG Facilities Construction Environmental Management Plan Revision 2 – Addendum 1: Test of Firefighting System, Plan, Document number: L092-AH-PLN-10003, Revision 3****, contains adequate information of suitable quality such that all activities that cause or are likely to cause pollution resulting in environmental harm or that generate or are likely to generate waste are adequately identified, assessed and all measures that are reasonable and practicable can be implemented to prevent or minimise the pollution or environmental harm; and reduce the amount of the waste.*

DATED: 10 March 2018

Signed: 

ENVIRONMENTAL AUDITOR (Appointed Pursuant to the Environment Protection Act 1970 [Victoria]) and QUALIFIED PERSON (in accord with Waste Management and Pollution Control Act 2009 [Northern Territory])

APPENDIX B: DEE APPROVAL

Australian Government
Department of the Environment and Energy

Ms Sandy Griffin
Environmental Manager
INPEX Operations Australia Pty Ltd
22/100 St Georges Terrace
PERTH WA 6000

EPBC 2008/4208 ICHTHYS PROJECT: Addendum 1 – Test of Firefighting System

Dear Ms Griffin

Thank you for your email dated 15 March 2018, submitting for approval the *Ichthys Onshore LNG Facilities Construction Environmental Management Plan* Revision 2 – *Addendum 1 – Test of Firefighting System,* dated 15 March 2018 (the Addendum).

Officers of this Department have advised me on the Addendum and the requirements of Condition 8 of the approval for EPBC 2008/4208. On this basis, and as a delegate of the Minister for the Environment and Energy, I have decided to approve *Addendum 1 – Test of Firefighting System*, Rev 4, dated 15 March 2018, as meeting the requirements of Condition 8 of the approval.

The Addendum must now be implemented. Please note that prior to commencement of testing of the firefighting system Inpex must provide the Department with the Sampling and Analysis Quality Plan.

As you are aware, the Department has an active monitoring program which includes monitoring inspections, desk top document reviews and audits. Please ensure that you maintain accurate records of all activities associated with, or relevant to, the conditions of approval so that they can be made available to the Department on request.

Should you require any further information please contact Vaughn Cox on 02 6274 2005 or by email: post.approvals@environment.gov.au.

Yours sincerely

Greg Manning
Assistant Secretary
Assessments (WA, SA, NT) and Post Approvals Branch
Environment Standards Division

16 March 2018

APPENDIX C: SAFETY DATA SHEETS

SAFETY DATA SHEET

TRIDOLC6 S3

Infosafe No.: LQ5OD
Issued Date: 13/07/2016
Issued by: CHUBB FIRE & SECURITY

1. IDENTIFICATION

GHS Product Identifier
TRIDOLC6 S3

Company Name
CHUBB FIRE & SECURITY

Address
314 Boundary Road Dingley
Vic 3172 Australia

Telephone/Fax Number
Tel: +61 (3) 9264 9813
Fax: +61 (03) 9264 9751

Emergency phone number
1300 369 309 (Business hours: 24/7)

Recommended use of the chemical and restrictions on use
Fire fighting foam concentrate

2. HAZARD IDENTIFICATION

GHS classification of the substance/mixture
Classified as Hazardous according to the Globally Harmonised System of Classification and labelling of Chemicals (GHS) including Work, Health and Safety regulations, Australia
Not classified as Dangerous Goods according to the Australian Code for the Transport of Dangerous Goods by Road and Rail. (7th edition)
Eye Damage/Irritation: Category 2A

Signal Word (s)
WARNING

Hazard Statement (s)
H319 Causes serious eye irritation.

Pictogram (s)
Exclamation mark

Precautionary statement – Prevention
P264 Wash contaminated skin thoroughly after handling
P280 Wear protective gloves/protective clothing/eye protection/face protection.

Precautionary statement – Response
P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P337+P313 If eye irritation persists: Get medical advice/attention.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredients

Name	CAS	Proportion
Diethylene glycol monobutyl ether	112-34-5	1-10 %
Hexylene glycol	107-41-5	1-<10 %
Ingredients determined not to be hazardous		Balance

4. FIRST-AID MEASURES

Inhalation
If inhaled, remove affected person from contaminated area. Keep at rest until recovered. If symptoms develop and/or persist seek medical attention.

Ingestion
Do not induce vomiting. Wash out mouth thoroughly with water. Seek immediate medical attention.

Skin
Wash affected area thoroughly with soap and water. If symptoms develop seek medical attention.

Eye contact
If in eyes, hold eyelids apart and flush the eyes continuously with running water. Remove contact lenses. Continue flushing for several minutes until all contaminants are washed out completely. Seek medical attention.

First Aid Facilities
Eyewash, safety shower and normal washroom facilities.

Advice to Doctor
Treat symptomatically.

Other Information
For advice in an emergency, contact a Poisons Information Centre (Phone Australia 131 126) or a doctor at once.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media
Product is a fire extinguishing media. Use appropriate fire extinguisher for surrounding environment.

Hazards from Combustion Products
Under fire conditions this product may emit toxic and/or irritating fumes and gases including carbon monoxide, carbon dioxide, hydrogen fluoride, oxides of sulphur, sodium and nitrogen.

Specific Hazards Arising From The Chemical
No fire hazard.

Decomposition Temperature
Not available

Precautions in connection with Fire
Product is a fire extinguishing media.

6. ACCIDENTAL RELEASE MEASURES

Emergency Procedures
Wear appropriate personal protective equipment and clothing to prevent exposure. Increase ventilation. If possible contain the spill. Place inert absorbent material onto spillage. Collect the material and place into a suitable labelled container. Do not dilute material but contain. Dispose of waste according to the applicable local and national regulations. If contamination of sewers or waterways occurs inform the local water and waste management authorities in accordance with local regulations.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid inhalation of vapours and mists, and skin or eye contact. Use only in a well ventilated area. Keep containers sealed when not in use. Prevent the build up of mists or vapours in the work atmosphere. Maintain high standards of personal hygiene i.e. Washing hands prior to eating, drinking, smoking or using toilet facilities.

Conditions for safe storage, including any incompatibilities
Store in a cool, dry, well-ventilated area, out of direct sunlight. Store in suitable, labelled containers. Keep containers tightly closed. Store away from incompatible materials. Ensure that storage conditions comply with applicable local and national regulations. Protect from freezing.

Storage Temperatures
Store at temperatures not exceeding 60°C.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational exposure limit values
No exposure standards have been established for this material. However, the available exposure limits for ingredients are listed below:
Hexylene glycol
TWA: 25 ppm, 121 mg/m^3
NOTICES: Peak limitation

TWA (Time Weighted Average): The average airborne concentration of a particular substance when calculated over a normal eight-hour working day, for a five-day week.
Peak Limitation: A ceiling concentration which should not be exceeded over a measurement period which should be as short as possible but not exceeding 15 minutes.

Biological Limit Values
No biological limits allocated.

Appropriate Engineering Controls
This substance is hazardous and should be used with a local exhaust ventilation system, drawing vapours away from workers' breathing zone. If the engineering controls are not sufficient to maintain concentrations of vapours/mists below the exposure standards, suitable respiratory protection must be worn.

Respiratory Protection
If engineering controls are not effective in controlling airborne exposure then an approved respirator with a replaceable vapor/mist filter should be used. Refer to relevant regulations for further information concerning respiratory protective requirements. Reference should be made to Australian Standards AS/NZS 1715, Selection, Use and Maintenance of Respiratory Protective Devices; and AS/NZS 1716, Respiratory Protective Devices, in order to make any necessary changes for individual circumstances.

Eye Protection
Safety glasses with side shields, chemical goggles or full-face shield as appropriate should be used. Final choice of appropriate eye/face protection will vary according to individual circumstances. Eye protection devices should conform to relevant regulations. Eye protection should conform with Australian/New Zealand Standard AS/NZS 1337 - Eye Protectors for Industrial Applications.

Hand Protection
Wear gloves of impervious material. Final choice of appropriate gloves will vary according to individual circumstances. i.e. methods of handling or according to risk assessments undertaken. Occupational protective gloves should conform to relevant regulations. Reference should be made to AS/NZS 2161.1: Occupational protective gloves - Selection, use and maintenance.

Body Protection
Suitable protective workwear, e.g. cotton overalls buttoned at neck and wrist is recommended. Chemical resistant apron is recommended where large quantities are handled.

9. PHYSICAL AND CHEMICAL PROPERTIES

Properties	Description	Properties	Description
Form	Liquid	**Appearance**	Liquid
Colour	Amber	**Odour**	Characteristic
Decomposition Temperature	Not available	**Melting Point**	<=0°C
Boiling Point	Not available	**Solubility in Water**	Not available
Specific Gravity	1.01-1.03	**pH**	6.6-7.6
Vapour Pressure	Not available	**Vapour Density (Air=1)**	Not available
Evaporation Rate	Not available	**Odour Threshold**	Not available
Viscosity	2 mm²/s (20□°C) (approximate)	**Partition Coefficient: n-octanol/water**	Not available
Flash Point	>93°C	**Flammability**	Not combustible
Auto-Ignition Temperature	Not available	**Flammable Limits - Lower**	Not available
Flammable Limits - Upper	Not available		

10. STABILITY AND REACTIVITY

Chemical Stability
Stable under normal conditions of use and storage.

Reactivity and Stability
Reacts with incompatible materials.

Conditions to Avoid
Extremes of temperature and direct sunlight.

Incompatible materials
Alkali metals. Oxidizing agent. Water reactive substances.

Hazardous Decomposition Products
Thermal decomposition of product and/or containers may result in the release of toxic and/or irritating fumes including carbon monoxide, carbon dioxide, hydrogen fluoride, oxides of sulphur, sodium and nitrogen.

Possibility of hazardous reactions
Not available

11. TOXICOLOGICAL INFORMATION

Toxicology Information
No toxicity data available for this material. Data for ingredients is given below.

Acute Toxicity - Oral
Diethylene glycol monobutyl ether
LD50 (rat): 5660mg/kg
Hexylene glycol
LD50 (rat): 3700mg/kg (OECD 420)

Acute Toxicity - Dermal
Diethylene glycol monobutyl ether
LD50 (rabbit): 2764mg/kg (OECD 402)
Hexylene glycol
LD50 (rat): >2000mg/kg (OECD 402)
LD50 (rabbit): >8000mg/kg

Ingestion
Ingestion of this product may irritate the gastric tract causing nausea and vomiting.

Inhalation
Inhalation of product vapours may cause irritation of the nose, throat and respiratory system.

Skin
May be irritating to skin. The symptoms may include redness, itching and swelling.

Eye
Causes serious eye irritation. On eye contact this product will cause tearing, stinging, blurred vision, and redness.

Respiratory sensitisation
Not expected to be a respiratory sensitiser.

Skin Sensitisation
Not expected to be a skin sensitiser.

Germ cell mutagenicity
Not considered to be a mutagenic hazard.

Carcinogenicity
Not considered to be a carcinogenic hazard.

Reproductive Toxicity
Not considered to be toxic to reproduction.

STOT-single exposure
Not expected to cause toxicity to a specific target organ.

STOT-repeated exposure
Not expected to cause toxicity to a specific target organ.

Aspiration Hazard
Not expected to be an aspiration hazard.

12. ECOLOGICAL INFORMATION

Ecotoxicity
Ecological data available for product and ingredients is given below.

Persistence and degradability
The product is readily biodegradable.
Biochemical oxygen demand (BOD): 0.235 g Oxygen/g substance (28 days - CHEM009)
Chemical oxygen demand (COD): 0.353 g Oxygen/g substance (28 days - CHEM009)
Biodegradation: 66% (28 days - CHEM009)

Mobility
Diethylene glycol monobutyl ether
Surface tension: 0.034 N/m (25°C)
Hexylene glycol
Surface tension: 0.033 N/m

Bioaccumulative Potential
The product is not expected to bioaccumulate.
Hexylene glycol
Log Pow: 0.58 (QSAR)

Other Adverse Effects
Not available

Environmental Protection
Prevent this material entering waterways, drains and sewers.

Acute Toxicity - Fish
Diethylene glycol monobutyl ether
LC50 (Lepomis macrochirus):1300 mg/l/96h
LC50 (Leuciscus idus): 1805 mg/l/48h
Hexylene glycol

LC50 (Lepomis macrochirus):12,800 mg/l/96h
LC50 (Oncorhynchus mykiss): 9450 mg/l/96h

Acute Toxicity - Daphnia
Diethylene glycol monobutyl ether
EC50 (Daphnia magna): 2850 mg/l/24h (GLP)
EC50 (Daphnia magna): >100 mg/l/48h
Hexylene glycol
EC50 (Daphnia magna): 5410 mg/l/48h
EC50 (Daphnia pulex): 3300 mg/l/48h

Acute Toxicity - Algae
Diethylene glycol monobutyl ether
Threshold limit (Microcystis aeruginosa): 53 mg/l/192h
Threshold limit (Scenedesmus subspicatus):>= 100 mg/l/96h
Hexylene glycol
Threshold limit (Pseudokirchneriella subcapitata): > 429 mg/l/72h

13. DISPOSAL CONSIDERATIONS

Disposal considerations
Dispose of waste according to applicable local and national regulations.

14. TRANSPORT INFORMATION

Transport Information
Road and Rail Transport (ADG Code):
Not classified as Dangerous Goods according to the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code) (7th edition).

Marine Transport (IMO/IMDG):
Not classified as Dangerous Goods by the criteria of the International Maritime Dangerous Goods Code (IMDG Code) for transport by sea.

Air Transport (ICAO/IATA):
Not classified as Dangerous Goods by the criteria of the International Air Transport Association (IATA) Dangerous Goods Regulations for transport by air.

U.N. Number
None Allocated

UN proper shipping name
None Allocated

Transport hazard class(es)
None Allocated

Special Precautions for User
Not available

IMDG Marine pollutant
No

Transport in Bulk
Not available

15. REGULATORY INFORMATION

Regulatory information
Classified as Hazardous according to the Globally Harmonised System of Classification and labelling of Chemicals (GHS) including Work, Health and Safety regulations, Australia.

Not classified as a Scheduled Poison according to the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Poisons Schedule
Not Scheduled

16. OTHER INFORMATION

Date of preparation or last revision of SDS
SDS created: July 2016

References
Preparation of Safety Data Sheets for Hazardous Chemicals Code of Practice.
Standard for the Uniform Scheduling of Medicines and Poisons.
Australian Code for the Transport of Dangerous Goods by Road & Rail.
Model Work Health and Safety Regulations, Schedule 10: Prohibited carcinogens, restricted carcinogens and restricted hazardous chemicals.
Workplace exposure standards for airborne contaminants, Safe work Australia.
American Conference of Industrial Hygienists (ACGIH).
Globally Harmonised System of classification and labelling of chemicals.

END OF SDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **EXPANDOL**

Synonym(s) HIGH EXPANSION FOAM

1.2 Uses and uses advised against

Use(s) FIRE EXTINGUISHING AGENT • FIRE FIGHTING

1.3 Details of the supplier of the product

Supplier name **JKC AUSTRALIA LNG PTY LTD**

Address Level 6, 66 Smith Street, Darwin, NT, 0800, AUSTRALIA

Telephone (08) 8980 9887

1.4 Emergency telephone number(s)

Emergency 13 11 26 (Poison Information Centre)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

CLASSIFIED AS HAZARDOUS ACCORDING TO AUSTRALIAN WHS REGULATIONS

GHS classification(s)
Serious Eye Damage / Eye Irritation: Category 2A
Acute Toxicity: Oral: Category 4
Skin Corrosion/Irritation: Category 2
Acute Toxicity: Inhalation: Category 4
Acute Toxicity: Skin: Category 4

2.2 Label elements

Signal word **WARNING**

Pictogram(s)

Hazard statement(s)

H302	Harmful if swallowed.
H312	Harmful in contact with skin.
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H332	Harmful if inhaled.
AUH019	May form explosive peroxides

Prevention statement(s)

P261	Avoid breathing dust/fume/gas/mist/vapours/spray.
P264	Wash thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/protective clothing/eye protection/face protection.

Response statement(s)

P301 + P312	IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P340	IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P321	Specific treatment is advised - see first aid instructions.
P330	Rinse mouth.
P362	Take off contaminated clothing and wash before re-use.

Storage statement(s)
None allocated.

Disposal statement(s)
P501 Dispose of contents/container in accordance with relevant regulations.

2.3 Other hazards
No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
ETHYLENE GLYCOL MONOBUTYL ETHER	111-76-2	203-905-0	10 to <20%
WATER	7732-18-5	231-791-2	Remainder
SODIUM LAURYL ETHOXY SULPHATE	68585-34-2	500-223-8	5 to <10%
DISODIUM 1-[2-[(1-OXODODECYL)AMINO]ETHYL] 2-SULPHONATOSUCCINATE	25882-44-4	247-310-4	3 to <5%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. To protect rescuer, use an Air-line respirator where an inhalation risk exists. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.

Ingestion For advice, contact a Poison Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If swallowed, do not induce vomiting.

First aid facilities No information provided.

4.2 Most important symptoms and effects, both acute and delayed
See Section 11 for more detailed information on health effects and symptoms.

4.3 Immediate medical attention and special treatment needed
Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media
Extinguishing agent.

5.2 Special hazards arising from the substance or mixture
Non flammable. May evolve carbon oxides and hydrocarbons when heated to decomposition. May evolve sodium oxides, sulphur oxides and nitrogen oxides when heated to decomposition. This product is a fire extinguishing medium and does not support combustion.

5.3 Advice for firefighters
Treat as per requirements for surrounding fires. Evacuate area and contact emergency services. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

5.4 Hazchem code
None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS.

6.2 Environmental precautions
Prevent product from entering drains and waterways.

6.3 Methods of cleaning up
Contain spillage, then cover / absorb spill with non-combustible absorbent material (vermiculite, sand, or similar), collect and place in suitable containers for disposal.

6.4 Reference to other sections
See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities
Store at temperature below 40°C. Store above freezing. Store removed from incompatible substances.

7.3 Specific end use(s)
No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters
Exposure standards

Ingredient	Reference	TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
2-Butoxyethanol (EGBE)	SWA (AUS)	20	96.9	50	242

Biological limits

Ingredient	Determinant	Sampling Time	BEI
ETHYLENE GLYCOL MONOBUTYL ETHER	Butoxyacetic acid (BAA) in urine (with hydrolysis)	End of shift	200 mg/g creatinine

Reference: ACGIH Biological Exposure Indices

8.2 Exposure controls
Engineering controls Avoid inhalation. Use in well ventilated areas. In a fire situation, ventilation may be difficult to control. Contact emergency personnel. Maintain vapour levels below the recommended exposure standard.

PPE

Eye / Face	Wear splash-proof goggles.
Hands	Wear PVC or rubber gloves.
Body	When using large quantities or where heavy contamination is likely, wear coveralls.
Respiratory	Where an inhalation risk exists, wear a Type A-Class P1 (Organic gases/vapours and Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	PALE YELLOW LIQUID
Odour	SOLVENT ODOUR
Flammability	NON FLAMMABLE
Flash point	NOT RELEVANT
Boiling point	100°C

9.1 Information on basic physical and chemical properties

Melting point	-6.5°C
Evaporation rate	NOT RELEVANT
pH	7.0
Vapour density	NOT AVAILABLE
Specific gravity	1.0
Solubility (water)	SOLUBLE
Vapour pressure	NOT RELEVANT
Upper explosion limit	NOT RELEVANT
Lower explosion limit	NOT RELEVANT
Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	7 cSt @ 20°C
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

10. STABILITY AND REACTIVITY

10.1 Reactivity

Carefully review all information provided in sections 10.2 to 10.6.

10.2 Chemical stability

Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions

Polymerization will not occur.

10.4 Conditions to avoid

No known conditions to avoid.

10.5 Incompatible materials

Incompatible with oxidising agents (e.g. hypochlorites) and acids (e.g. nitric acid).

10.6 Hazardous decomposition products

May evolve carbon oxides and hydrocarbons when heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity

Information available for the product:
Harmful if swallowed, in contact with skin, and/or if inhaled.

Information available for the ingredient(s):

Ingredient	Oral Toxicity (LD50)	Dermal Toxicity (LD50)	Inhalation Toxicity (LC50)
ETHYLENE GLYCOL MONOBUTYL ETHER	300 mg/kg (rabbit)	230 mg/kg (guinea pig)	700 ppm (mouse)

Skin	Irritating to the skin. Contact may result in irritation, redness, rash and dermatitis.
Eye	Causes serious eye damage.
Sensitization	Not classified as causing skin or respiratory sensitisation.
Mutagenicity	Not classified as a mutagen.
Carcinogenicity	Not classified as a carcinogen.
Reproductive	Not classified as a reproductive toxin.
STOT – single exposure	Based on available data, the classification criteria are not met.
STOT – repeated exposure	May cause damage to the blood, liver and kidneys.
Aspiration	Not expected to present an aspiration hazard.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

EC50 Water flea (Daphnia magna): 37 ppm 24 Hours.
EC50 Water flea (Daphnia magna): 10 ppm 48 Hours.
LC50 Rainbow trout, donaldson trout (Oncorhynhus mykiss): 89 ppm 24 Hours.
LC50 Rainbow trout, donaldson trout (Oncorhynhus mykiss): > 180 ppm 3 Hours.
LC50 Rainbow trout, donaldson trout (Oncorhynhus mykiss): 60 ppm 48 Hours.
LC50 Rainbow trout, donaldson trout (Oncorhynhus mykiss): > 180 ppm 6 Hours.
LC50 Rainbow trout, donaldson trout (Oncorhynhus mykiss): 45 ppm 72 Hours.
LC50 Rainbow trout, donaldson trout (Oncorhynhus mykiss): 45 ppm 96 Hours.

12.2 Persistence and degradability

This product is biodegradable.

12.3 Bioaccumulative potential

Not expected to bioaccumulate.

12.4 Mobility in soil

The product is water soluble and may spread in water systems.

12.5 Other adverse effects

No information provided.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal For small amounts, absorb with sand, vermiculite or similar and dispose of to an approved landfill site. For large quantities, contact the manufacturer/supplier for additional information. Prevent contamination of drains and waterways as aquatic life may be threatened and environmental damage may result.

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None Allocated	None Allocated	None Allocated
14.2 Proper Shipping Name	None Allocated	None Allocated	None Allocated
14.3 Transport hazard class	None Allocated	None Allocated	None Allocated
14.4 Packing Group	None Allocated	None Allocated	None Allocated

14.5 Environmental hazards No information provided

14.6 Special precautions for user

Hazchem code None Allocated

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule Classified as a Schedule 6 (S6) Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safework Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals.

The classifications and phrases listed below are based on the Approved Criteria for Classifying Hazardous Substances [NOHSC: 1008(2004)].

Hazard codes

E	Explosive
Xi	Irritant
Xn	Harmful

Risk phrases	R19	May form explosive peroxides.
	R20/21/22	Harmful by inhalation, in contact with skin and if swallowed.
	R36/38	Irritating to eyes and skin.
Safety phrases	S9	Keep container in a well ventilated place.
	S40	To clean the floor and all objects contaminated by this material use [appropriate material to be specified by the manufacturer].
	S53	Avoid exposure - obtain special instructions before use.

Inventory listing(s) **AUSTRALIA: AICS (Australian Inventory of Chemical Substances)**
All components are listed on AICS, or are exempt.

16. OTHER INFORMATION

Additional information

This 'JKC Converted' Safety Data Sheet (SDS) was prepared based on the information from the original 'Manufacturer's' SDS. JKC Converted SDSs are for JKC use or undertakings only. JKC is not a distributor or retail supplier of this product. Original Manufacturer Details:
Angus Fire
Thame, Oxfordshire, OX9 3RT
Emergency: +44 (0)18 4426 5000
Date of the original SDS: 28/02/2011

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a ChemAlert report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

Prepared by

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[End of SDS]

APPENDIX D: RISK REGISTER

Item	Activity	Hazard/ Aspect	Potential Impact	Controls	L	C	Residual Risk
1. Storage and Loading							
1.1	Storage of foam onsite at the hazardous materials warehouse (Expandol and Tridol C6 S3)	Loss of containment	Breach of CEMP criteria Groundwater and surface water pollution	Spill kits suitably sized Storage of chemical only in warehouse per Australian Standards AS/NZS 4681:2000 Emergency Response Team Secondary containment Stored in a hazardous chemical bunded area per CEMP requirements Storage shall be risk assessed against drainage scenario Chemical segregation Only limited volumes of firefighting foams are stored onsite (10 m^3 Tridol; 2 m^3 Expandol)	6	D	Low (L9)
1.2	Onshore loading of foam into the storage tanks on the fire system (Expandol and Tridol C6 S3)	Spills Loss of containment	Breach of CEMP criteria Groundwater and surface water pollution	Dangerous Goods classification for Expandol Not Dangerous Goods classification for Tridol Fit for purpose foam spill response plan Spill kits Emergency Response Team Area work clearance Just in time delivery Secondary containment for fire foam IBCs / containers Safe Work Method Statement (SWMS) for each loading location	6	D	Low (L9)

Item	Activity	Hazard/ Aspect	Potential Impact	Controls	L	C	Residual Risk
				Secure connections and air bleeder valve per OTP / Fire foam loading procedure Attended transfer at both ends with positive radio contact. Storage tanks have fill level indicator Piping and pumping system to be tested prior to use Bunds/drip tray provided at connection point			
1.3	Jetty loading of foam into the storage tanks on the fire system (Expandol and Tridol C6 S3)	Spills Loss of containment	Breach of CEMP criteria Groundwater and surface water pollution	Dangerous Good classification Fit for purpose foam spill response plan Spill kits Emergency Response Team Area work clearance Just in time delivery Secondary containment for fire foam IBCs / containers SWMS for each loading location Secure connections and air bleeder valve per OTP / Fire foam loading procedure Attended transfer at both ends with positive radio contact. Storage tanks have fill level indicator For Jetty loading- additional temporary containment bund on jetty concrete underneath the storage tank while transfer takes place Piping and pumping system to be tested prior to use Bunds/drip tray provided at connection point	5	D	Moderate (M8)

Item	Activity	Hazard/ Aspect	Potential Impact	Controls	L	C	Residual Risk
				Fill only amount needed for the test +25% to minimise potential spill			
2. Four locations for high expansion foam units on main site with collection in lined COC sump							
2.1	Conduct foam testing with Expandol Small tests and using the 3% mixture	Loss of containment Contamination of the DAF treatment plant with surfactant	Breach of CEMP criteria Groundwater and surface water pollution	Spill kits Emergency Response Team Area work clearance Just in time delivery Water only pressure test prior to start of the foam testing Attended monitoring with foam and water isolation valves and positive radio contact and spotters Construction of a scaffold and liner containment system All drainage lines closed off in vicinity of the test 50% additional volume allowed within the containment system compared to the maximum foam volume to be generated Conduct a short test trial to confirm that containment is achievable per QLD Policy 6.2.4- foams containing short chain fluorotelomers Do not discharge foam wastewater to the AOC or DAF plant SWMS to include review weather condition before activity commencement Loss Prevention Inspection (LPI) walk down to be conducted prior to commencement of activity Progressive lessons learnt from location to location	5	E	Low (L9)

Item	Activity	Hazard/ Aspect	Potential Impact	Controls	L	C	Residual Risk
				Consider de foaming - use of water to supress foam			
3. One low expansion foam unit on a single condensate tank							
3.1	Conduct foam testing with Tridol C6 S3 Foam directed internally to the foam gutter	Loss of containment Contamination of the DAF treatment plant with surfactant	Breach of CEMP criteria Groundwater and surface water pollution	Spill kits Emergency Response Team Area work clearance Just in time delivery Water only pressure test prior to start of the foam testing Attended monitoring with foam and water isolation valves with positive radio contact and spotters Foam direct discharge inside the tank as per designed and collected in the internal foam gutter. Evaporates and never removed. Tank is already inside containment bund Do not discharge foam wastewater to the AOC or DAF plant Discharge as per design conditions- foam will remain inside tank until drained	6	F	Low (L10)
4. One high expansion foam unit test on LNG jetty							
4.1	Conduct foam testing with Expandol	Loss of containment Test is on jetty over water	Breach of CEMP criteria Groundwater and surface water pollution Legacy	Spill kits Emergency Response Team Area work clearance Just in time delivery Water only pressure test prior to start of the foam	5	D	Moderate (M8)

Item	Activity	Hazard/ Aspect	Potential Impact	Controls	L	C	Residual Risk
			contamination of Darwin Harbour	testing Attended monitoring with foam and water isolation valves with positive radio contact and spotters Monitor tides prior to and during testing to determine flow direction Spotters with appropriate spills kits positioned in the Harbour Construction of a scaffold and liner containment system 50% additional volume allowed within the containment system compared to the maximum foam volume to be generated Conduct a short test trial to confirm that containment is achievable per QLD Policy 6.2.4- foams containing short chain fluorotelomers Add height of the jetty sump using scaffolding and use liner for the sump Lessons learnt from onshore to be transferred to the jetty test LPI walk down to be conducted prior to commencement of activity Valves and overflow shut Consider de foaming - use of water to supress foam			
5. One low expansion foam unit on condensate jetty							
5.1A	Conduct foam testing with Tridol C6 S3 Partial encapsulation	Loss of containment Test is on jetty	Breach of CEMP criteria Groundwater and	Encapsulation along the foam trajectory Spill kits	5	D	Moderate (M8)

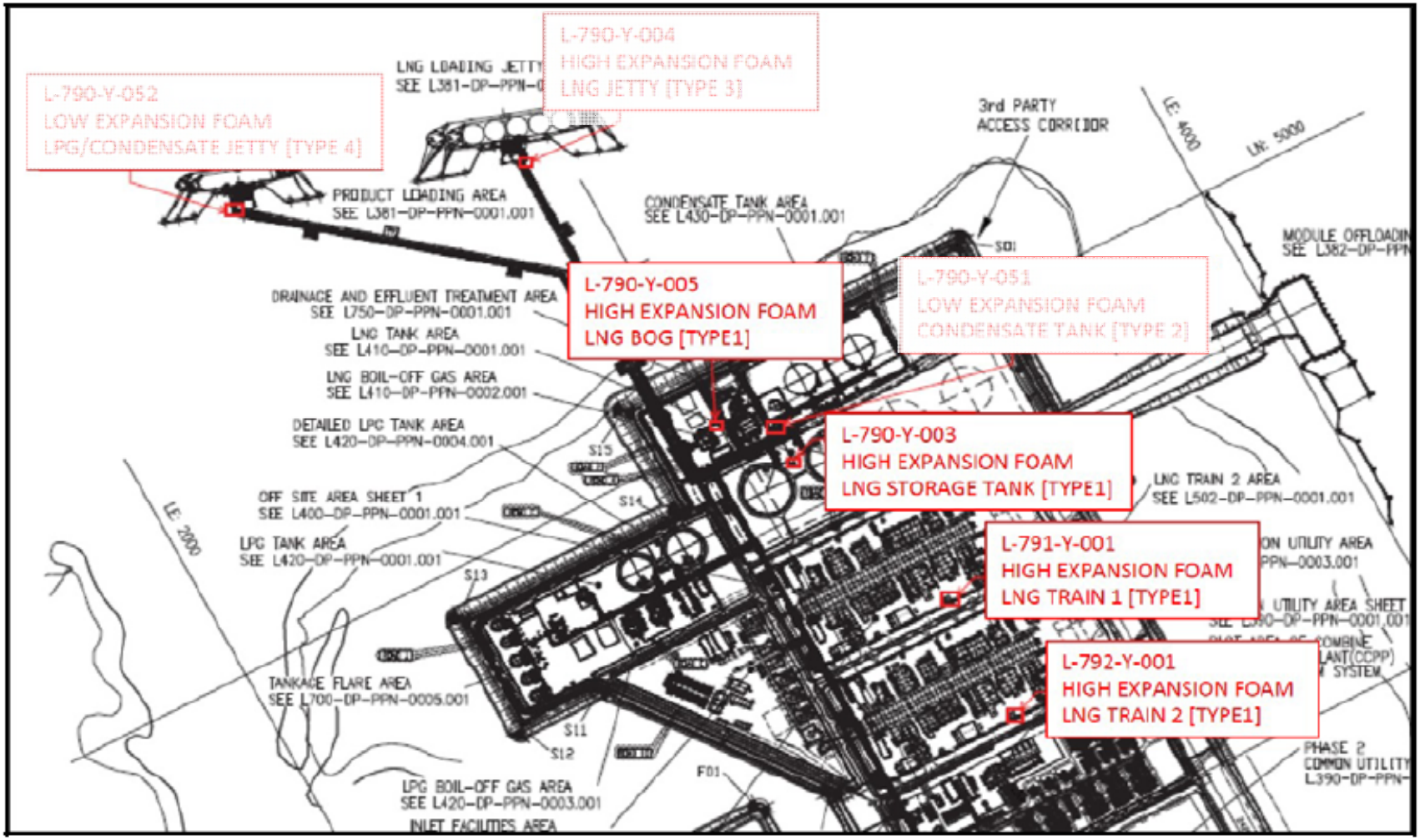
Item	Activity	Hazard/ Aspect	Potential Impact	Controls	L	C	Residual Risk
	with assessment of wind speed, potential of nominal loss of foam as mist Tridol foam is heavier than Expandol - less floating distance	over water	surface water pollution	Emergency Response Team Area work clearance Just in time delivery Water only pressure test prior to start of the foam testing Attended monitoring with foam and water isolation valves with positive radio contact and spotters Monitor tides prior to and during testing to determine flow direction Spotters with appropriate spills kits positioned in the Harbour Jetty head is partially scaffolded and lined to minimise wind effects and catch overspray from the foam test inside the structure. The foam event contained within the jetty bunded system and directed to the sump. Sump attended by sucker truck to remove liquid and ensure sufficient capacity is maintained. 50% additional volume allowed within the containment system / sucker trucks compared to the maximum foam volume to be generated Test undertaken on low wind period Conduct a short test trial to confirm that containment is achievable per QLD Policy 6.2.4-foams containing short chain fluorotelomers			
5.1B	Conduct foam testing with Tridol C6 S3 with wind barriers and assessment of	Spray drift Test is on jetty over water	Breach of CEMP criteria Groundwater and surface water	Encapsulation along the foam trajectory Spill kits Emergency Response Team Area work clearance	5	F	Low (L10)

Item	Activity	Hazard/ Aspect	Potential Impact	Controls	L	C	Residual Risk
	wind speed Tridol foam is heavier than Expandol - less floating distance		pollution	Just in time delivery Water only pressure test prior to start of the foam testing Attended monitoring with foam and water isolation valves with positive radio contact and spotters Monitor tides prior to and during testing to determine flow direction Spotters with appropriate spills kits positioned in the Harbour Jetty head is partially scaffolded and lined to minimise wind effects and catch overspray from the foam test inside the structure. The foam event contained within the jetty bunded system and directed to the sump. Sump attended by sucker truck to remove liquid and ensure sufficient capacity is maintained. 50% additional volume allowed within the containment system / sucker trucks compared to the maximum foam volume to be generated Test undertaken on low wind period Conduct a short test trial to confirm that containment is achievable per QLD Policy 6.2.4-foams containing short chain fluorotelomers			
5.2	Conduct foam testing with Tridol C6 S3 Full containment Tridol foam is heavier than Expandol - less	Spray drift Test is on jetty over water	Breach of CEMP criteria Groundwater and surface water pollution	Spill kits Emergency Response Team Area work clearance Just in time delivery Water only pressure test prior to start of the foam testing	6	D	Low (L9)

Item	Activity	Hazard/ Aspect	Potential Impact	Controls	L	C	Residual Risk
	floating distance			Attended monitoring with foam and water isolation valves with positive radio contact and spotters Jetty head is scaffolded and lined to prevent wind effects and catch overspray from the foam test inside the structure. The foam event contained within the jetty bunded system and directed to the sump. Sump attended by sucker truck to remove liquid and ensure sufficient capacity is maintained. 50% additional volume allowed within the containment system / sucker trucks compared to the maximum foam volume to be generated Full containment around affected area Test undertaken on low wind period Conduct a short test trial to confirm that containment is achievable per QLD Policy 6.2.4- foams containing short chain fluorotelomers			

APPENDIX E: CONTAINMENT PROCEDURES TO BE IMPLEMENTED AT TEST LOCATIONS

TYPE 1: HIGH EXPANSION FOAM ONSHORE



INSERT 1a: High expansion foam unit consisting of foam concentrate storage tank and foam mixer.

Basin discharge to be isolated

Holding Basin

High Expansion Foam Generator

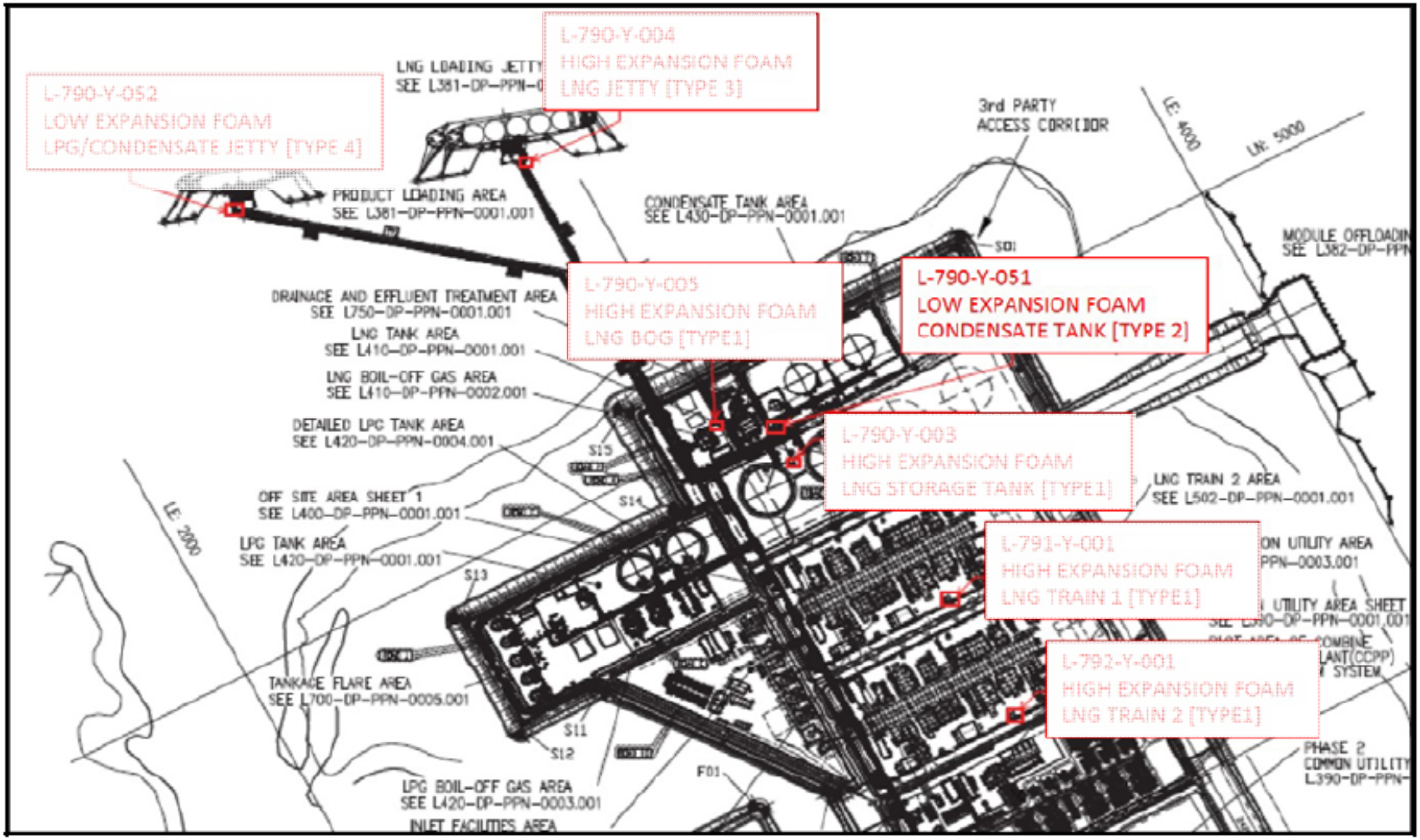
Foam discharge

Mitigation Measures:

- Prior to commencing testing authorisation will be obtained from the Contractor Project Environmental Manager. Authorisation will be dependent on environmental conditions and an inspection to confirm the implementation of all controls. Environmental conditions (e.g. wind, rainfall forecasts) will be monitored prior to and during the test.
- The holding basin will be completely drained of any water, to ensure its full capacity is available to contain spent foam.
- Holding basin drains and overflow points will be isolated to ensure containment of the foam and to prevent ingress of stormwater.
- The foam storage tank, foam tank drain and the foam tank spill pan will be verified leak-free prior to testing and all piping will be leak tested with water.
- The holding basin will be fully lined and sealed water-tight with encapsulation material. The liner will be secured such that it does not float or dislodge during foam testing.
- The liner will be marked with heavy black lines at 250mm vertical intervals to indicate depth of foam during testing.
- A temporary containment structure will be constructed using scaffolding and encapsulation material (see Figure 16). This will, cover the holding basin (extending ~2 metres on each side) and will have a sloped roof to divert rainfall. The structure will provide weather protection, preventing wind, rain, or other factors from dispersing foam or foam mist into the environment.
- Bunding and ground sheeting will be installed at the work zones (i.e. the foam unit, the foam generator, and the sample testing area) to capture any drips during sampling and field testing, and to capture any spray or misting at the foam generator inlet.
- All sample and waste containers will have tight sealing lids, be clearly labelled, and be made ready prior to start of testing.
- A chemical spill kit of sufficient capacity will be installed at the test site prior to receiving foam concentrate from the warehouse.
- Foam concentrate will be delivered to the worksite on an “as-needed”, “just-in-time”, “required amount only” basis. This negates the need for storage of foam concentrate at the test location, and ensures that only the minimum amount of concentrate required for the test is transferred to the foam storage tank.
- Following testing, spent foam within the holding basin will be pumped into a designated storage vessel. The holding basin and encapsulation materials will then be washed down to remove trace amounts of the foam, and generated wastewater will again be pumped into a designated storage vessel. All contaminated encapsulation materials will be carefully rolled up and bound. These, together with any other contaminated solid wastes, will be placed in designated solid waste containers.
- The test area will be inspected to ensure no breaches of containment have occurred, and that all materials and equipment have been removed.

Figure 1: High expansion foam generation unit, Onshore [TYPE 1 test].

TYPE 2: LOW EXPANSION FOAM CONDENSATE TANK



Mitigation Measures:

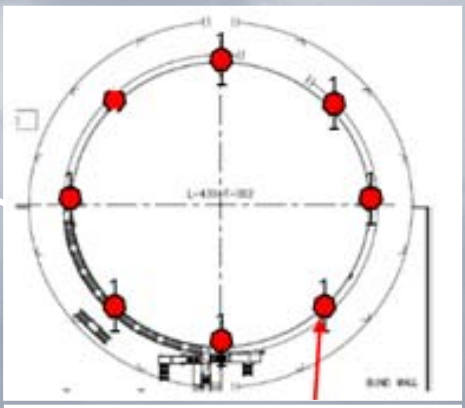
- Prior to commencing testing, authorisation will be obtained from the Contractor Project Environmental Manager. Authorisation will be dependent on environmental conditions and an inspection to confirm the implementation of all controls. Environmental conditions (e.g. wind, rainfall forecasts) will be monitored prior to and during the test.
- The foam storage tank, foam tank drain, and the foam tank spill pan will be verified leak-free prior to testing, and all piping will be leak tested with water.
- The condensate tank bund will be drained of water, and collapsible bunds will be installed where there is a potential for leaks or drips (drain-hose connection on the tank and on the piping) during testing and clean-up.
- Bunding and ground sheeting will be installed at the work zones (i.e. the foam unit and the sample testing area) to capture any drips during tank filling, sampling or field sample testing.
- All sample and waste containers will have tight sealing lids, be clearly labelled, and be made ready prior to start of testing.
- A chemical spill kit of sufficient capacity will be installed at the test site prior to receiving foam concentrate from the warehouse.
- Foam concentrate will be delivered to the worksite on an “as-needed”, “just-in-time”, “required amount only” basis. This negates the need for storage of foam concentrate at the test location, and ensures that only the minimum amount of concentrate required for the test is transferred to the foam storage tank.
- Following testing, spent foam will remain in the condensate tank until disposal is determined. Once disposal is confirmed spent foam will then be pumped into a designated storage vessel . Following removal the condensate tank will be washed down (internally) and generated wastewater will again be pumped into a designated storage vessel. All contaminated ground sheeting will be carefully rolled up and bound. These, together with any other contaminated solid wastes, will be placed in designated solid waste containers.
- The test area will be inspected to make sure no breaches of containment have occurred, and that all materials and equipment have been removed.

Foam system piping

Condensate Tank (foam test **conducted inside tank**)

Firewater spray piping (water - not foam)

INSERT 2a: Low expansion foam generation unit [TYPE 2 test] consisting of foam concentrate storage tank and foam admixing pump

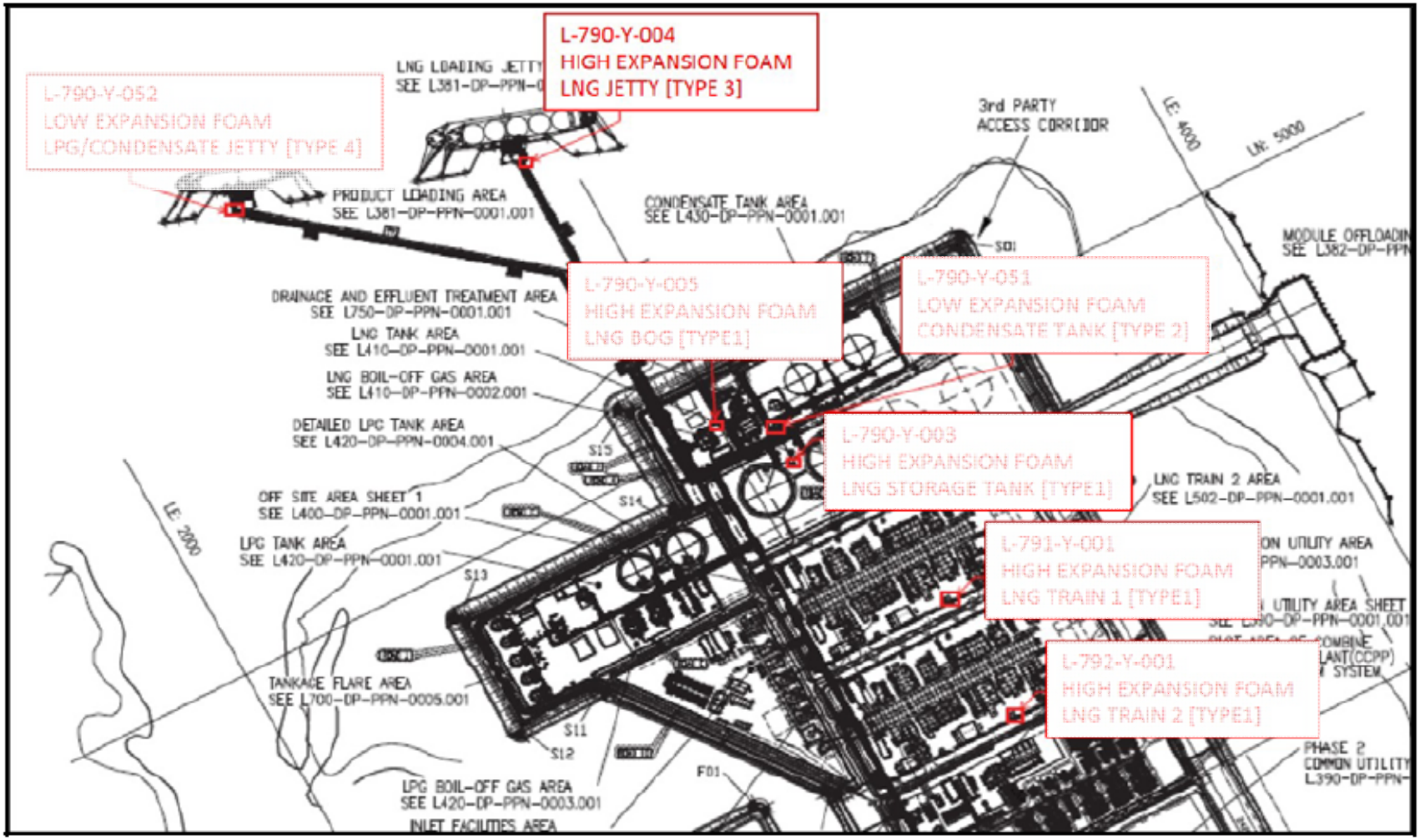


INSERT 2b: Foam maker locations on the condensate tank. Arrow shows one of 8 foam makers which blow foam into the tank.

Condensate tank bund

Figure 2: Low expansion foam generation unit, Condensate Tank [TYPE 2 test].

TYPE 3: HIGH EXPANSION FOAM LNG JETTY

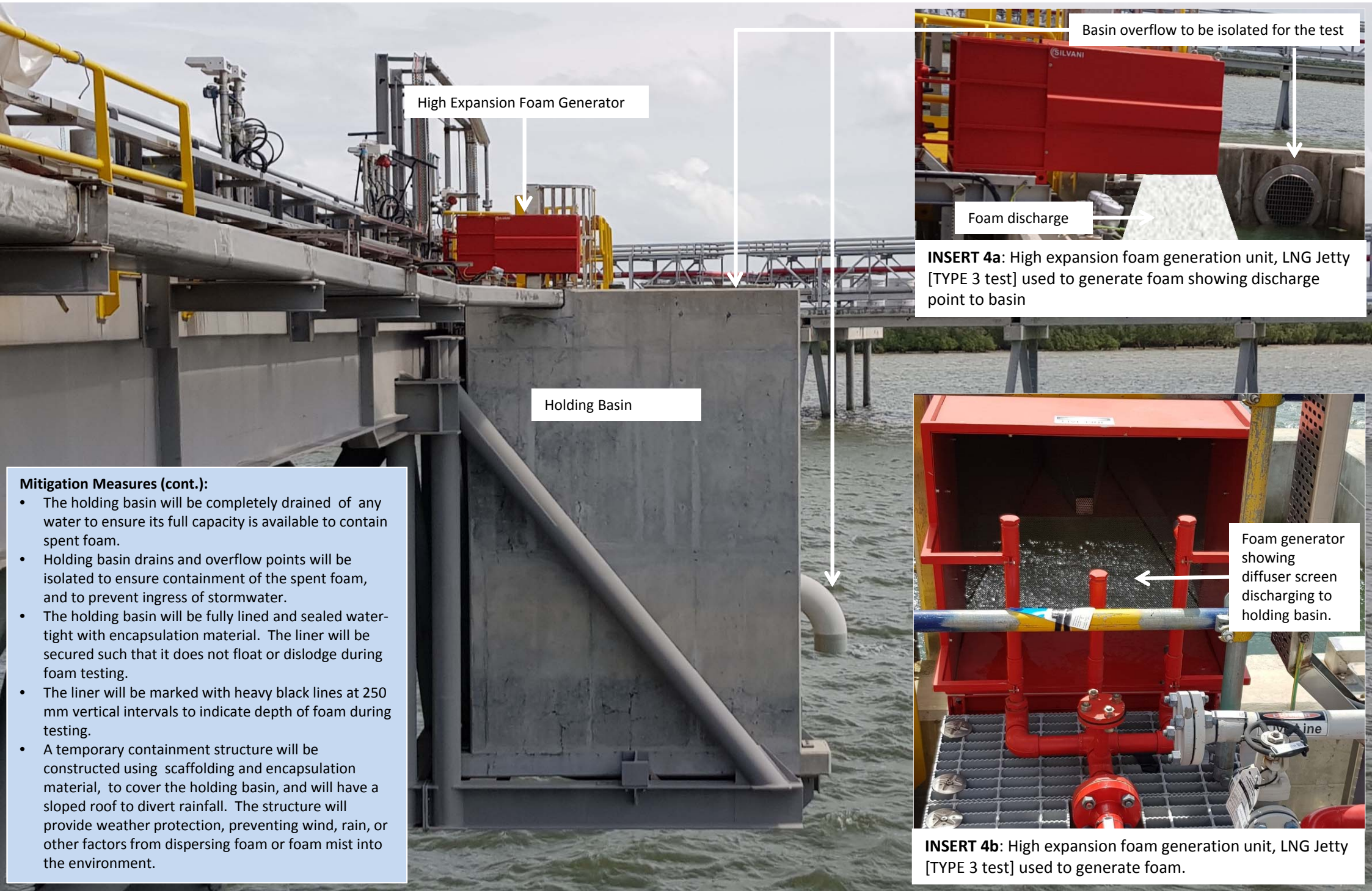


INSERT 3a: High expansion foam unit consisting of foam concentrate storage tank and foam mixer.

Mitigation Measures:

- Prior to commencing testing authorisation will be obtained from the Contractor Project Environmental Manager. Authorisation will be dependent on environmental conditions and an inspection to confirm the implementation of all controls. Environmental conditions (e.g. wind, rainfall forecasts) will be monitored prior to and during the test.
- Bunding and ground sheeting will be installed at the work zones (i.e. the foam unit, the foam generator and the sample testing area) to capture any drips during sampling and field testing, and to capture any spray or misting at the foam generator inlet.
- The foam storage tank, foam tank drain, and the foam tank spill pan will be verified leak-free, and all piping will be leak tested with water.
- Containment measures specific to the holding basin are described on the proceeding page.
- All sample and waste containers will have tight sealing lids, be clearly labelled, and be made ready prior to start of testing.
- A chemical spill kit of sufficient capacity will be installed at the test site prior to receiving foam concentrate from the warehouse.
- Foam concentrate will be delivered to the worksite on an “as-needed”, “just-in-time”, “required amount only” basis. This negates the need for storage of foam concentrate at the test location, and ensures that only the minimum amount of concentrate required for the test is transferred to the foam storage tank.
- Following testing, spent foam within the holding basin will be pumped into a designated storage vessel. The holding basin will then be washed down to remove trace amounts of the foam, and generated wastewater will again be pumped into a designated storage vessel. All contaminated encapsulation materials will be carefully rolled up and bound. These, together with any other contaminated solid wastes, will be placed in designated solid waste containers.
- The test area will be inspected to make sure no breaches of containment have occurred and that all materials and equipment have been removed.

Figure 3: High expansion foam generation unit, LNG Jetty [TYPE 3 test].



Mitigation Measures (cont.):

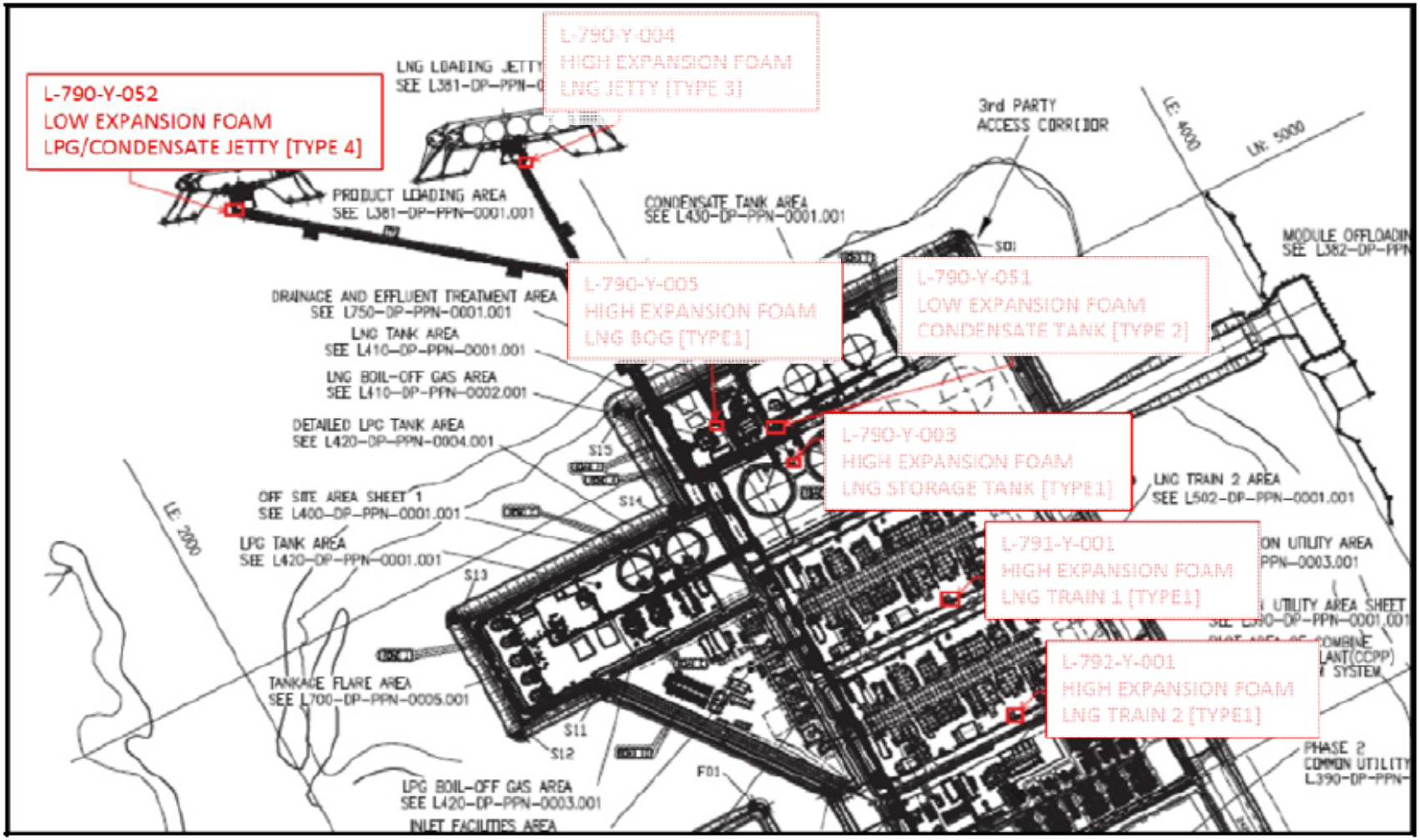
- The holding basin will be completely drained of any water to ensure its full capacity is available to contain spent foam.
- Holding basin drains and overflow points will be isolated to ensure containment of the spent foam, and to prevent ingress of stormwater.
- The holding basin will be fully lined and sealed water-tight with encapsulation material. The liner will be secured such that it does not float or dislodge during foam testing.
- The liner will be marked with heavy black lines at 250 mm vertical intervals to indicate depth of foam during testing.
- A temporary containment structure will be constructed using scaffolding and encapsulation material, to cover the holding basin, and will have a sloped roof to divert rainfall. The structure will provide weather protection, preventing wind, rain, or other factors from dispersing foam or foam mist into the environment.

INSERT 4a: High expansion foam generation unit, LNG Jetty [TYPE 3 test] used to generate foam showing discharge point to basin

INSERT 4b: High expansion foam generation unit, LNG Jetty [TYPE 3 test] used to generate foam.

Figure 4: High expansion foam generation unit, LNG Jetty [TYPE 3 test].

TYPE 4: LOW EXPANSION LPG / CONDENSATE JETTY



Mitigation Measures:

- Prior to commencing testing authorisation will be obtained from the Contractor Project Environmental Manager. Authorisation will be dependent on environmental conditions and an inspection to confirm the implementation of all controls. Environmental conditions (e.g. wind, rainfall forecasts) will be monitored prior to and during the test.
- The holding basin will be completely drained of any water to ensure its full capacity is available to contain foam.
- Holding basin drains and overflow points will be isolated to ensure containment of the spent foam, and to prevent ingress of stormwater.
- The holding basin will be fully lined and sealed water-tight with encapsulation material. The liner will be secured such that it does not float or dislodge during foam testing.
- The drainage channel connecting the module deck bund (see Figures 7 & 8) to the holding basin will be covered with encapsulation material to prevent wind, rain, or other factors from dispersing foam or foam solution into the environment.
- The foam storage tank, foam tank drain, and the foam tank spill pan will be verified leak-free, and all piping will be leak tested with water.

Insert 5a: Low expansion foam storage tank at LPG/condensate jetty

Holding Basin

Drainage channel from module deck bund

Insert 5b: Low expansion foam monitor (west)

Insert 5c: Low expansion foam monitor (east)

Figure 5: Low expansion foam generation unit, LPG/Condensate Jetty [TYPE 4 test].

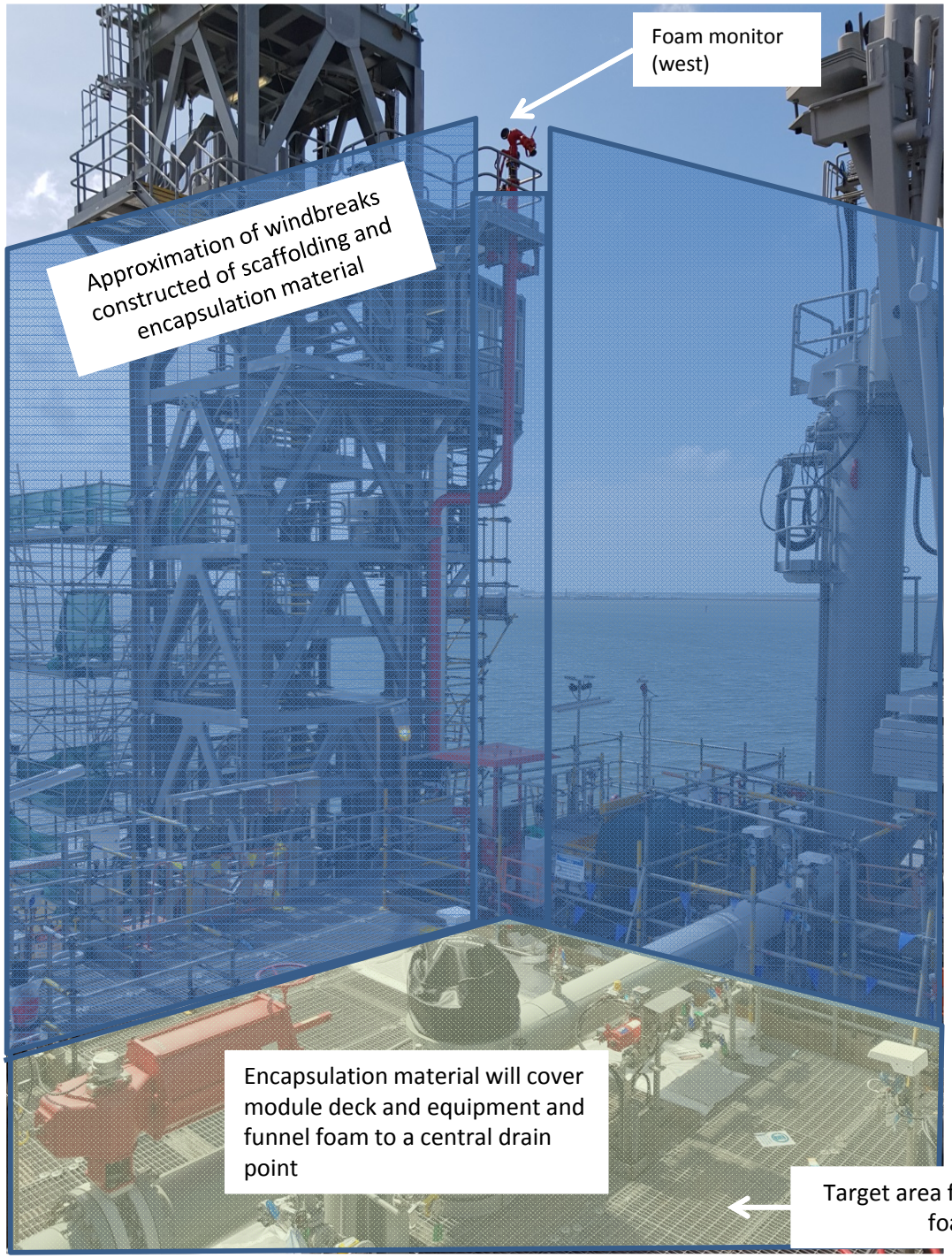
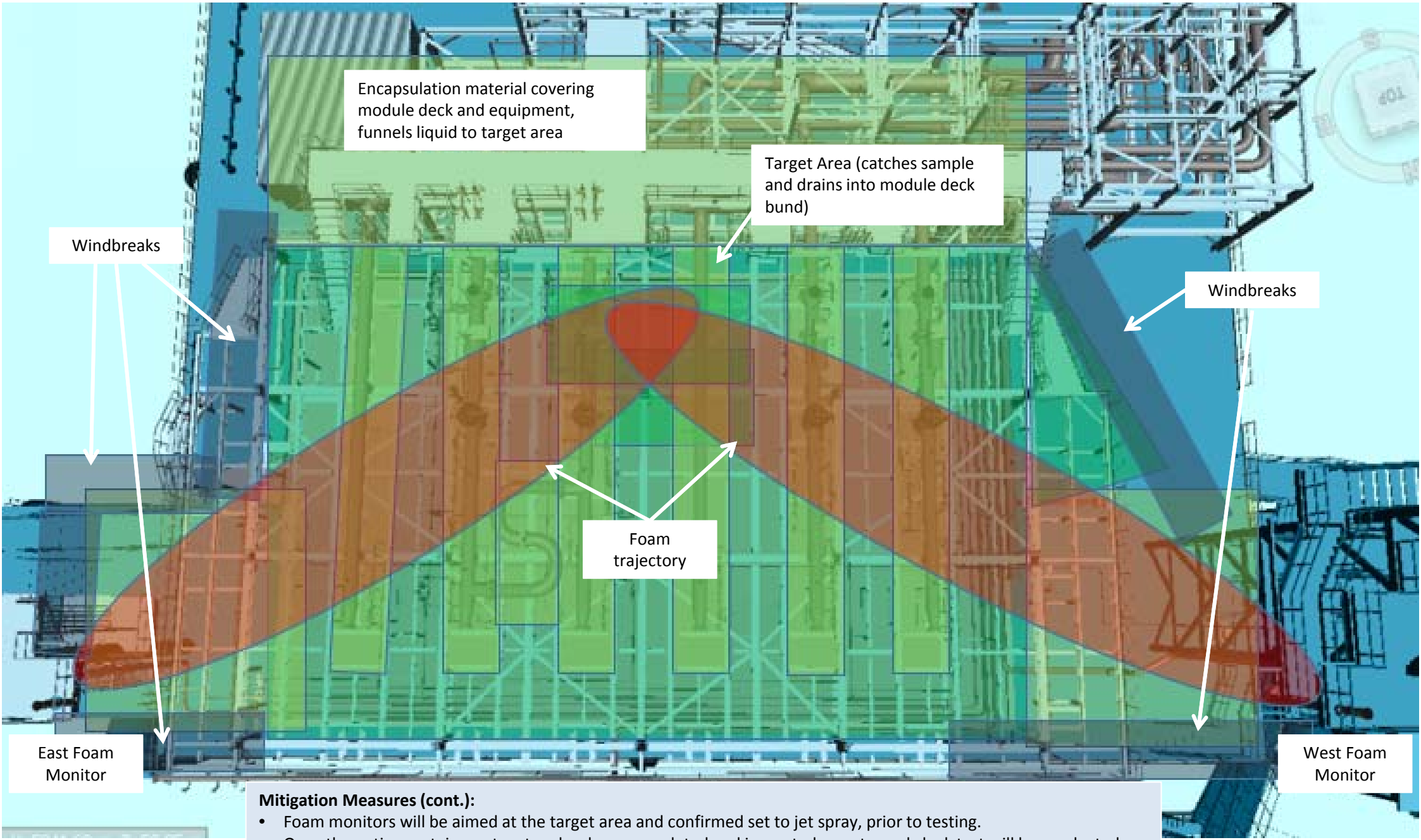


Figure 6: Low expansion foam monitor (west)

Figure 7: Low expansion foam monitor (east)



Mitigation Measures (cont.):

- Foam monitors will be aimed at the target area and confirmed set to jet spray, prior to testing.
- Once the entire containment system has been completed and inspected, a water-only leak test will be conducted, using both monitors, to verify the integrity of the containment system, prior to introducing foam.

Figure 8: Low expansion foam generation unit, LPG/Condensate Jetty [TYPE 4 test]. Note – only one monitor will be tested, the image shows potential spray for either.

Mitigation Measures (cont.):

- Bunding and ground sheeting will be installed at the work zones (i.e. the foam unit, the foam generator, and the sample testing area) to capture any drips during sample taking and field testing, and to capture any spray or misting at the foam generator inlet.
- All sample and waste containers will have tight sealing lids, be clearly labelled, and be made ready prior to start of testing.
- A chemical spill kit of sufficient capacity will be installed at the test site prior to receiving foam concentrate from the warehouse.
- Foam concentrate will be delivered to the worksite on an "as-needed", "just-in-time", "required amount only" basis. This negates the need for storage of foam concentrate at the test location, and ensures that only the minimum amount of concentrate required for the test is transferred to the foam storage tank.
- Following testing, spent foam within the holding basin will be pumped into a designated storage vessel. The holding basin will then be washed down to remove trace amounts of the foam, and generated wastewater will again be pumped into a designated storage vessel. All contaminated encapsulation materials will be carefully rolled up and bound. These, together with any other contaminated solid wastes, will be placed in designated solid waste containers.
- The test area will be inspected to make sure no breaches of containment have occurred, and that all materials and equipment have been removed.

Figure 9: Low expansion foam generation unit, LPG/Condensate Jetty [TYPE 4 test].

EXAMPLES OF CONTROLS - ENCAPSULATION AND GROUND SHEETING

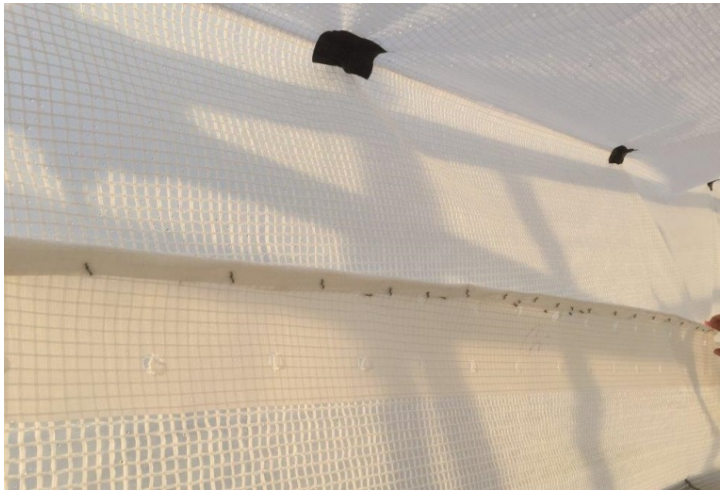


Figure 10: Examples of encapsulation.

Figure 11: Examples of ground sheeting placed at work areas.

Figure 12: Examples of encapsulation and wrapping of infrastructure.

EXAMPLES OF CONTROLS - SECONDARY CONTAINMENT

Figure 13: Examples of temporary bunding used for secondary containment.

Figure 14: Examples of temporary containment structures – concrete bunding.

Figure 15: Examples of temporary bunding used for secondary containment.

Figure 16: Examples of scaffold and encapsulation that will be constructed over holding basins.

EXAMPLES OF CONTROLS - WASTE MANAGEMENT

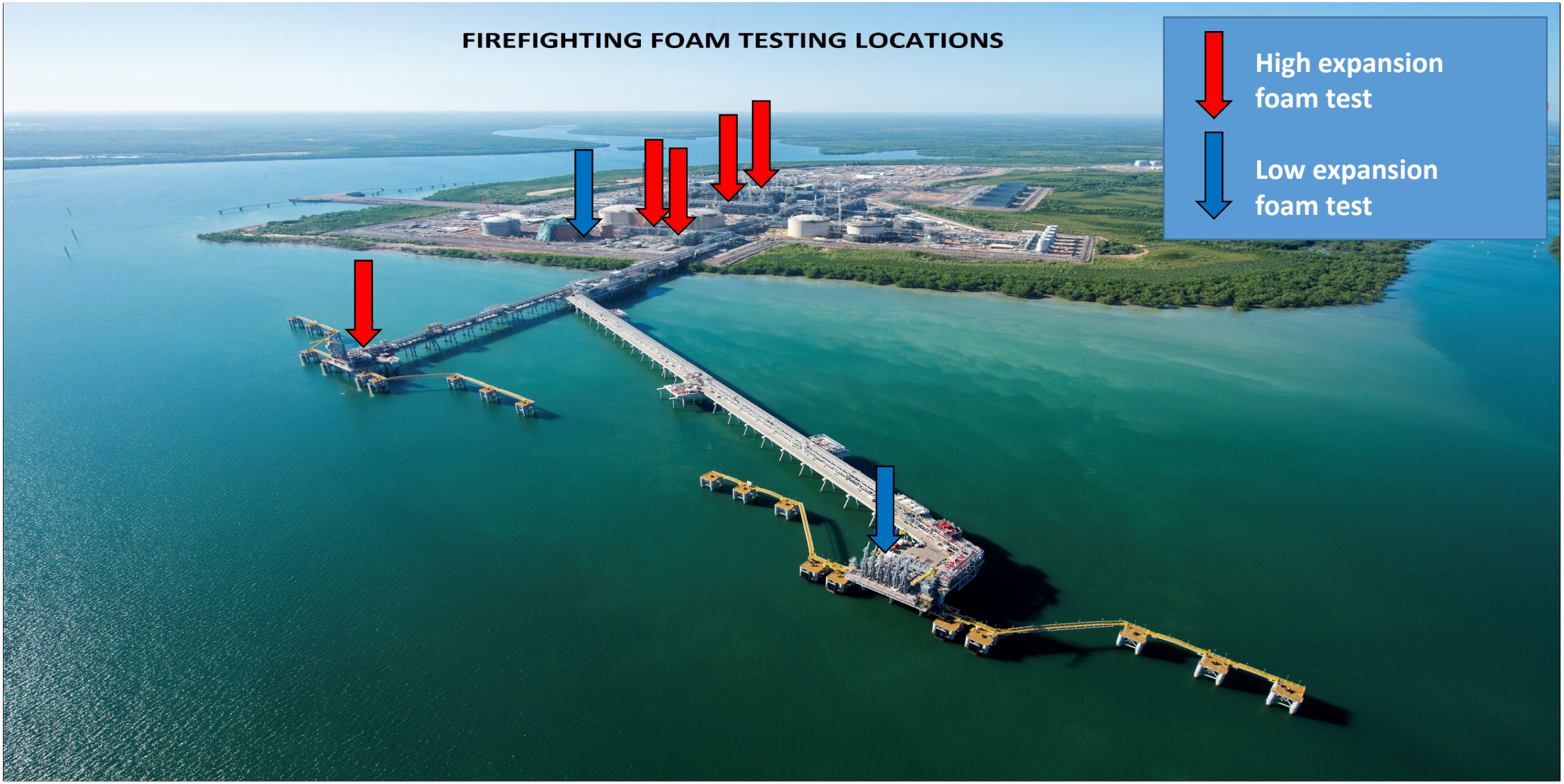
Figure 17: Examples of solid waste container with rainfall cover (as required).

Figure 18: Examples of waste storage – Isotainer for liquid waste (24,000 L capacity).

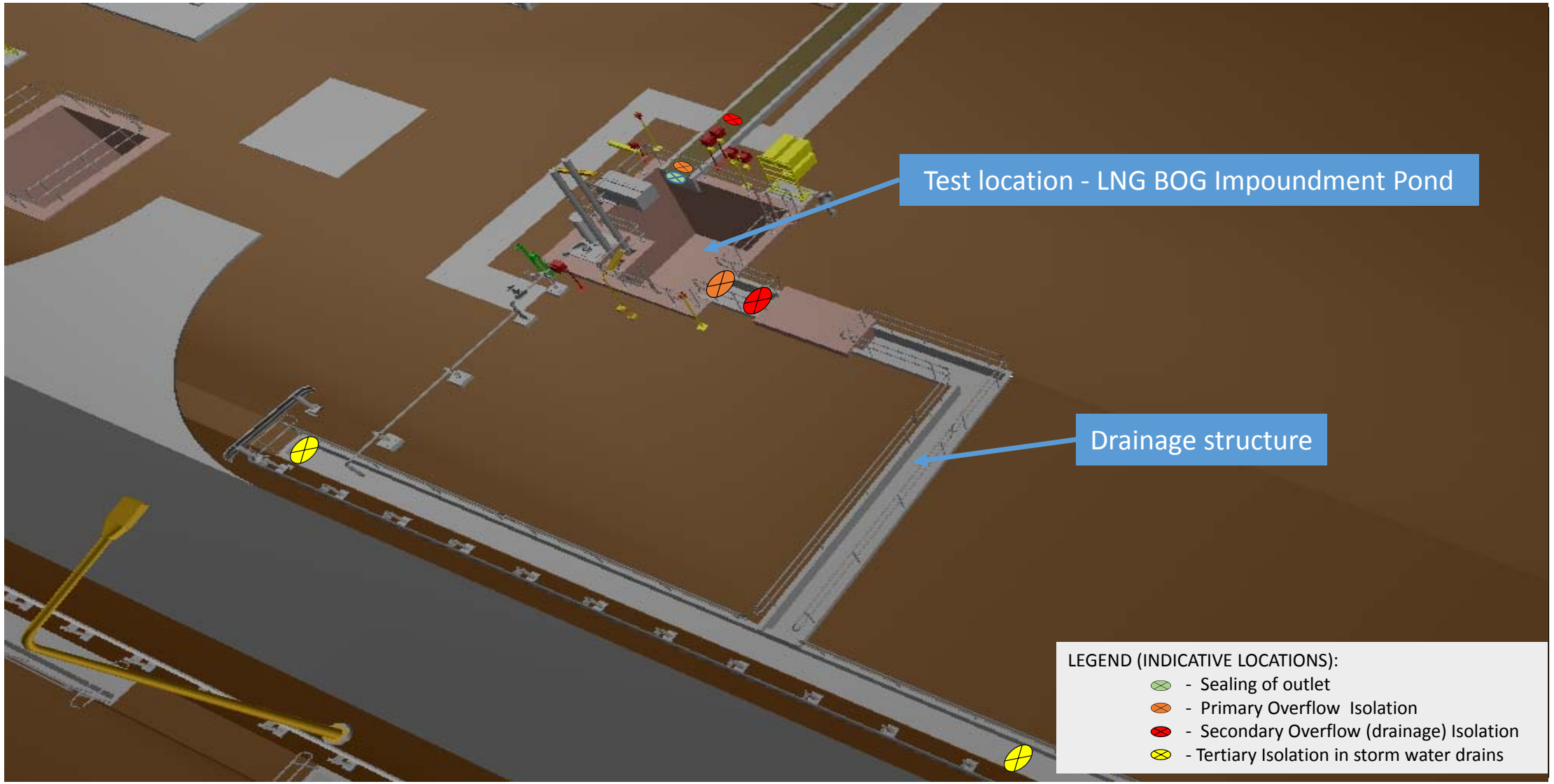
Figure 19: Examples of waste storage – Intermediate bulk container (IBC) for liquid waste (1,000 L capacity).

APPENDIX F: ISOLATION OF DRAINAGE NETWORK

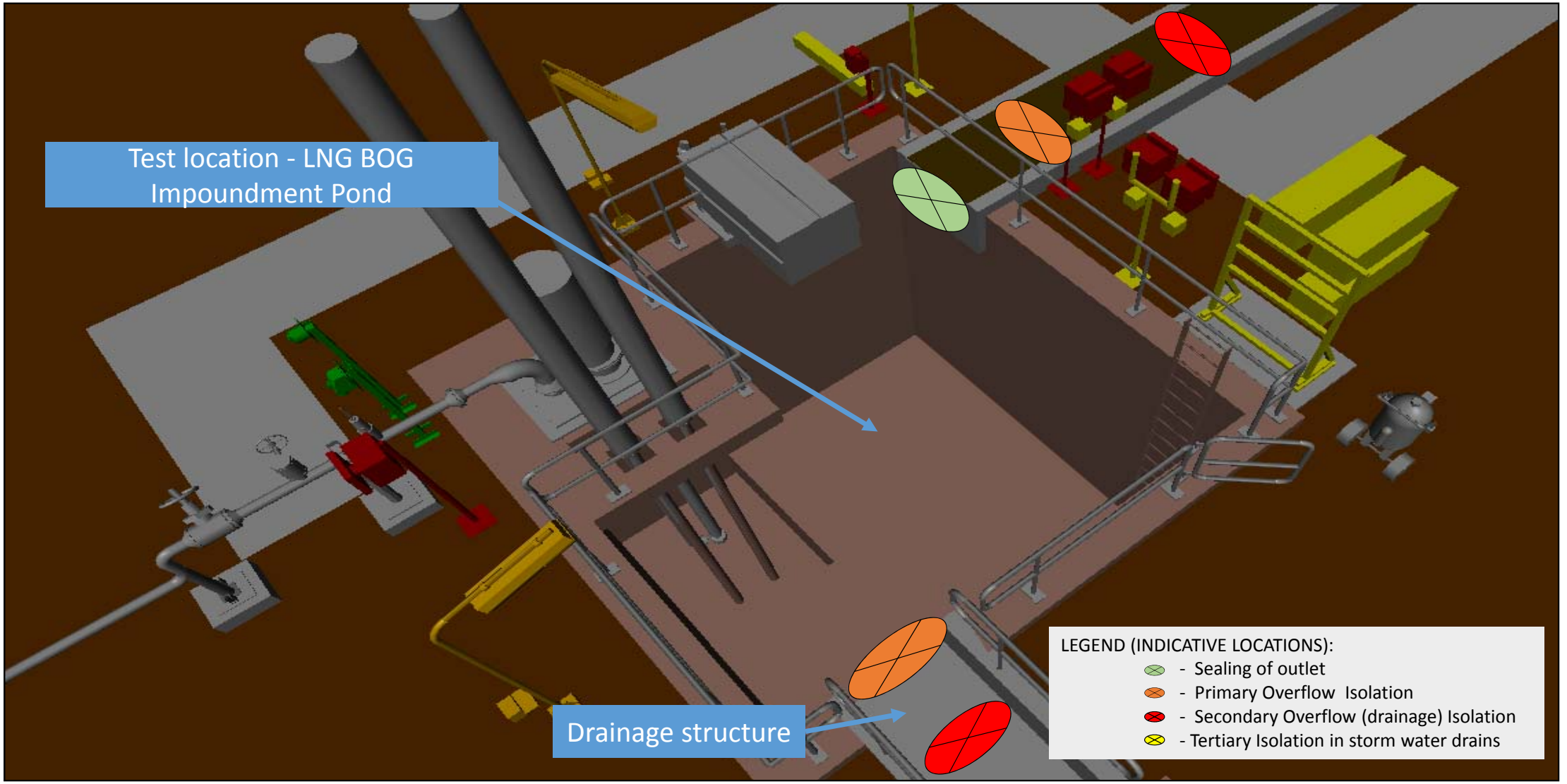
Firefighting Foam Locations and Indicative Isolations Locations



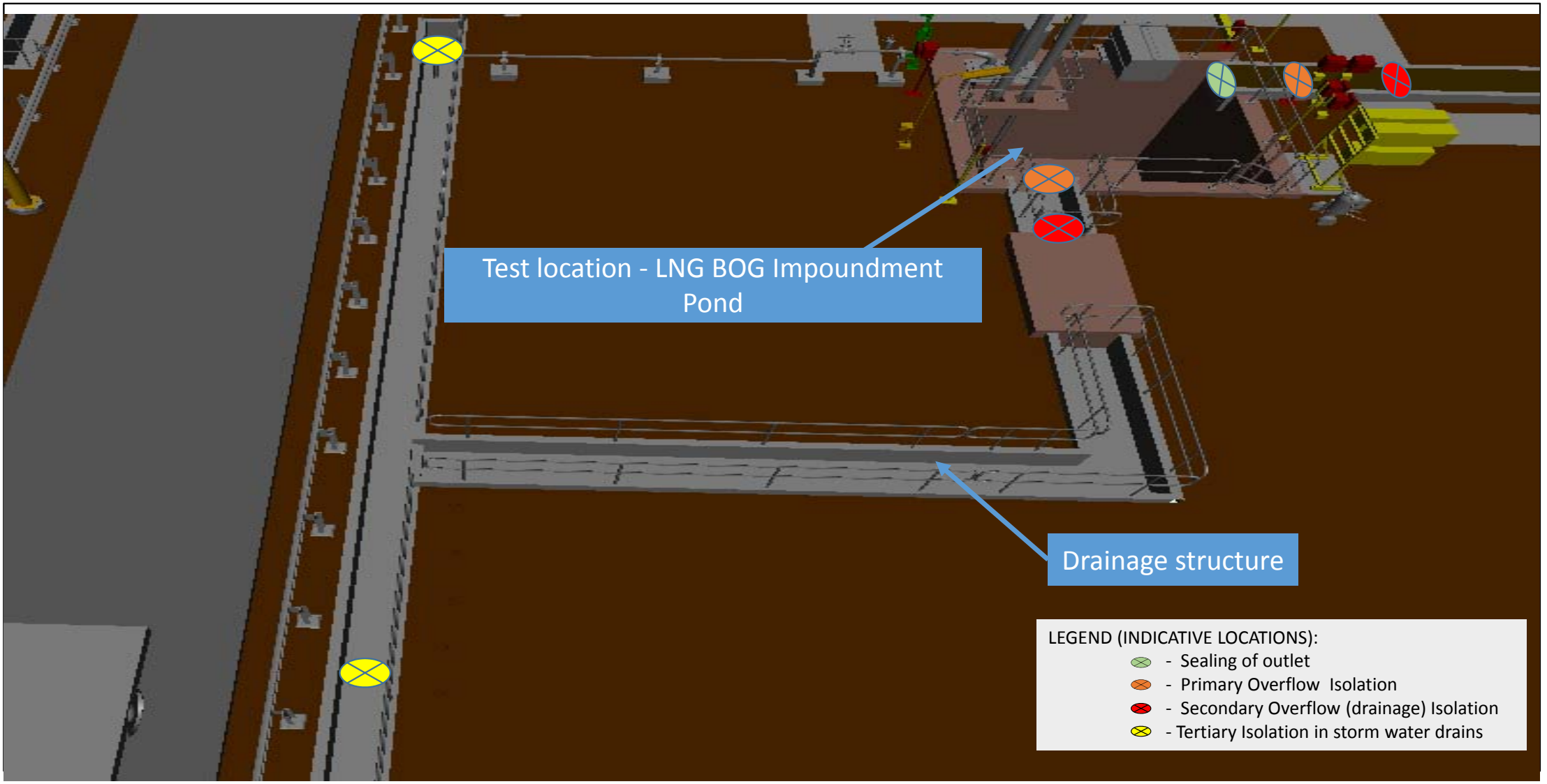
L-790-Y-005 HIGH EXPANSION FOAM
LNG BOG [TYPE-1]



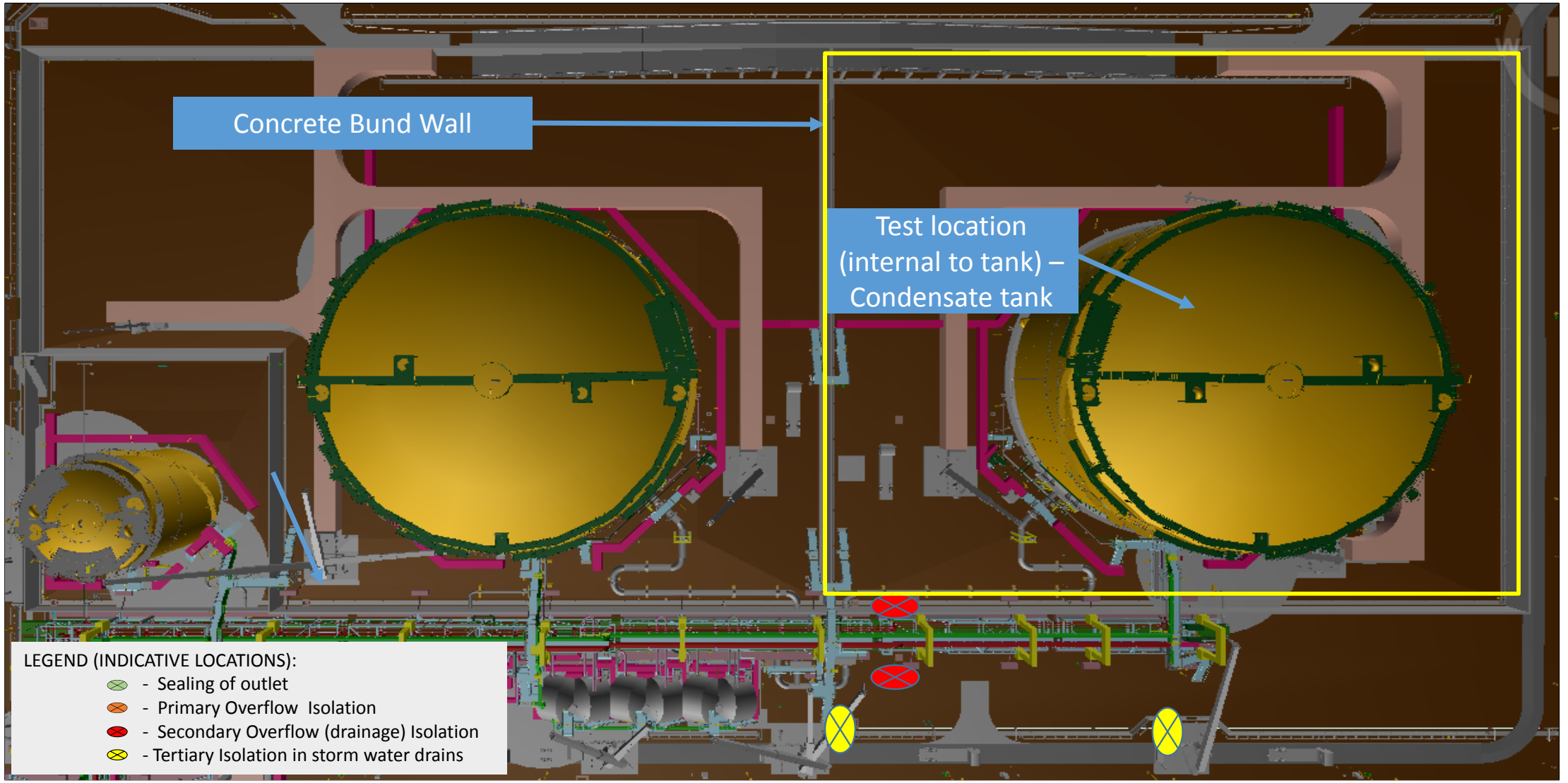
L-790-Y-005 HIGH EXPANSION FOAM
LNG BOG [TYPE-1]



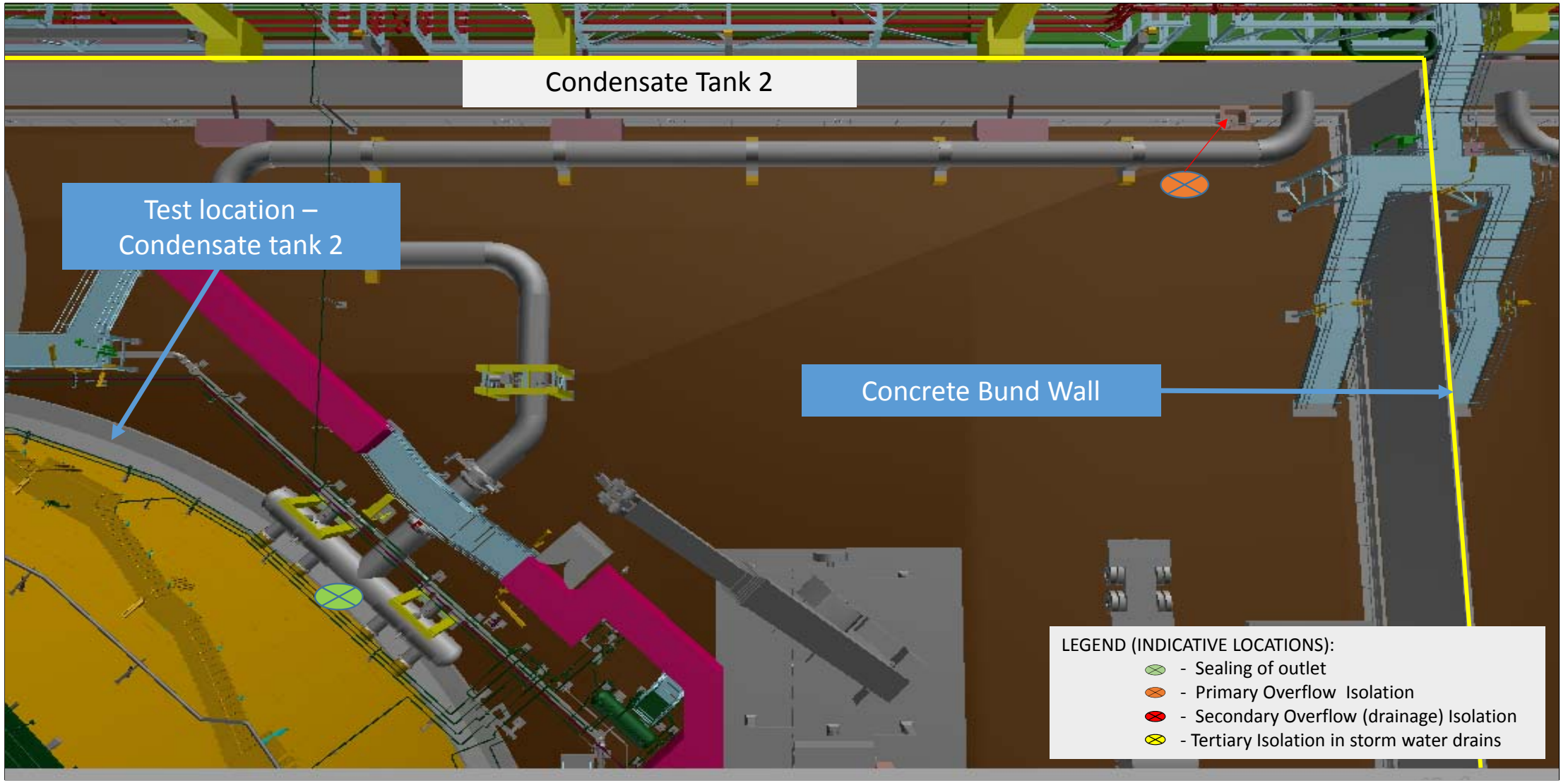
L-790-Y-005 HIGH EXPANSION FOAM
LNG BOG [TYPE-1]



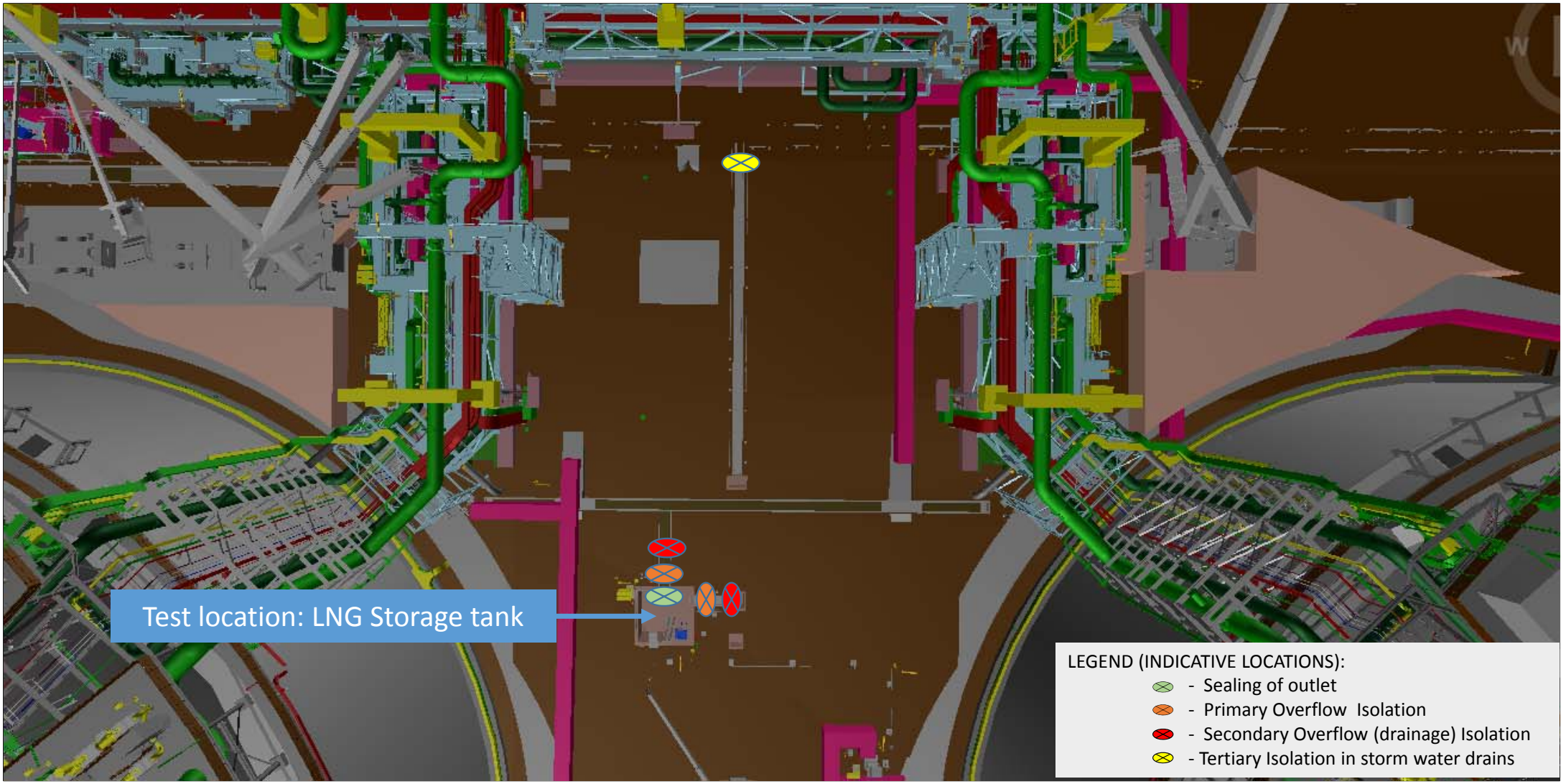
L-790-Y-051 LOW EXPANSION FOAM
CONDENSATE TANK [TYPE 2]



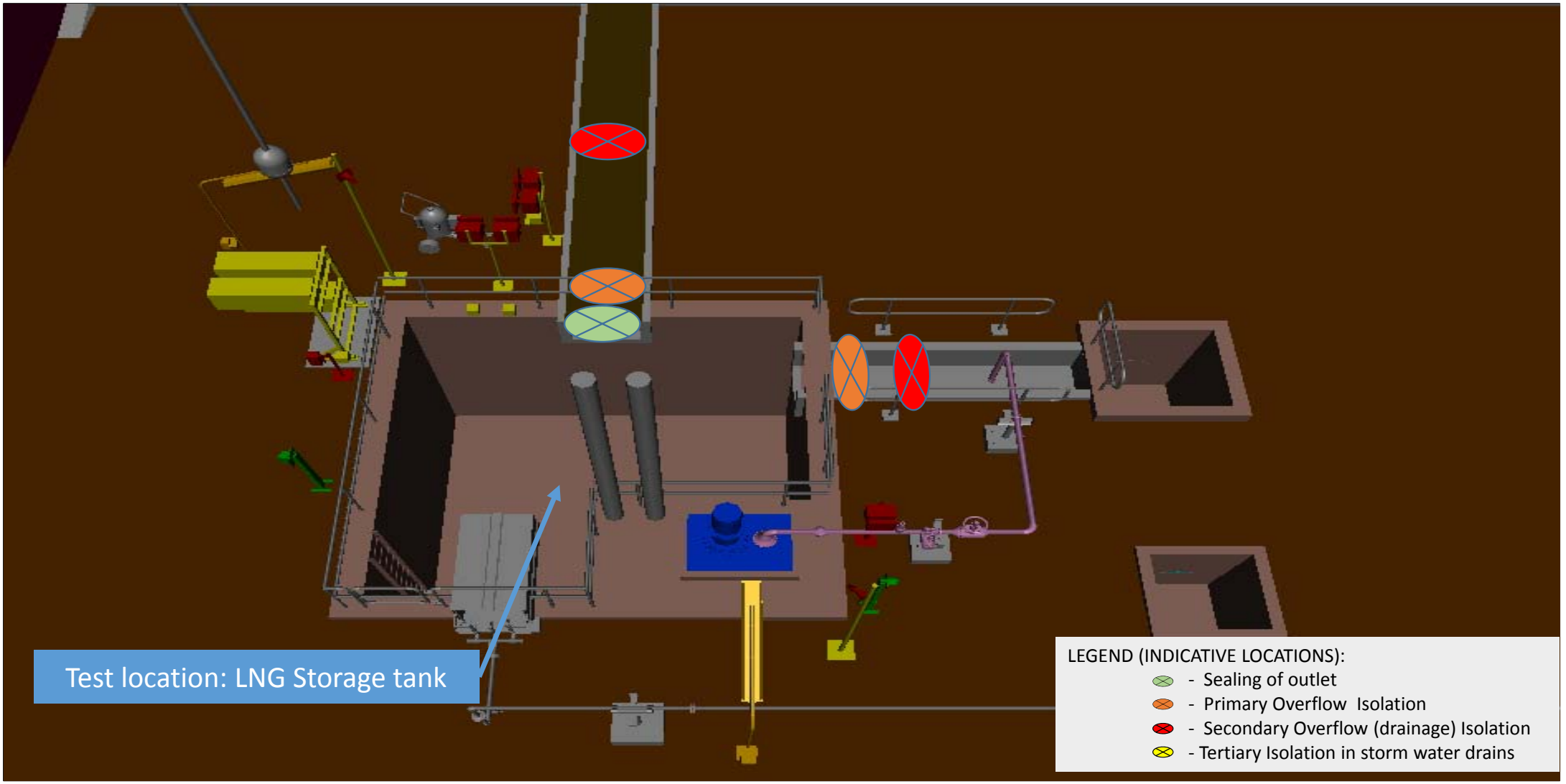
L-790-Y-051 LOW EXPANSION FOAM
CONDENSATE TANK [TYPE 2]



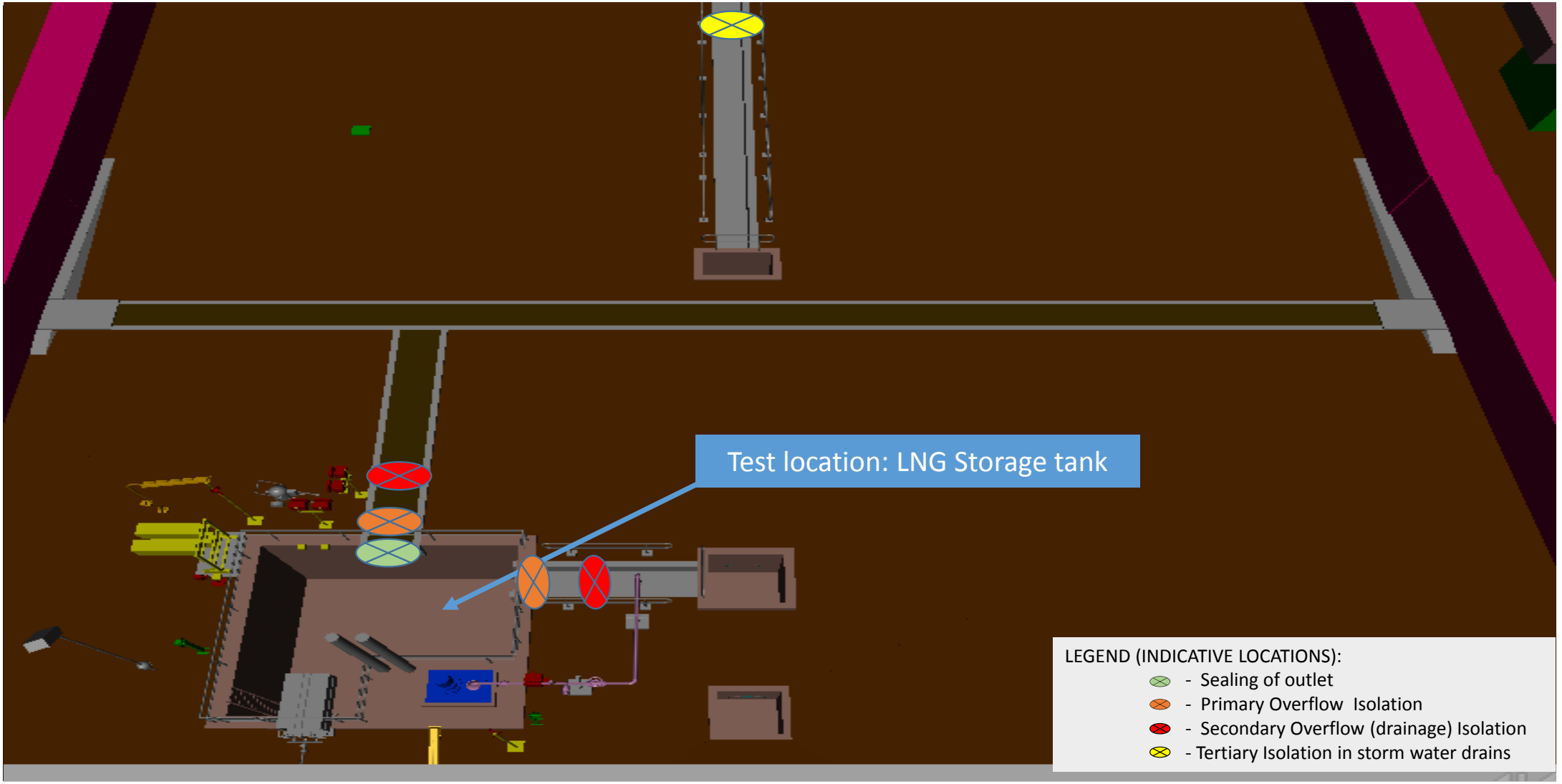
L-790-Y-003 HIGH EXPANSION FOAM
LNG STORAGE TANK [TYPE 1]



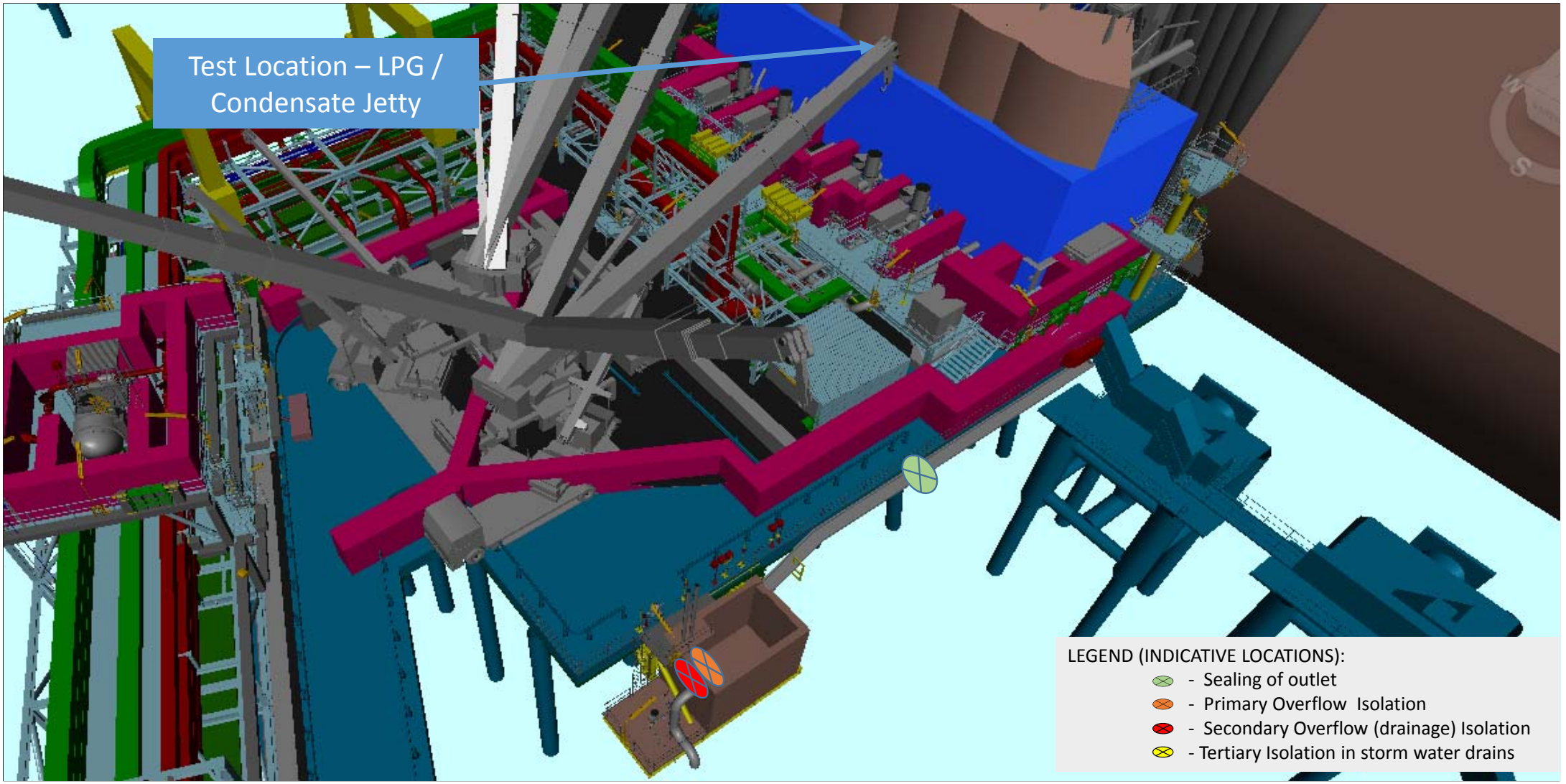
L-790-Y-003 HIGH EXPANSION FOAM
LNG STORAGE TANK [TYPE 1]



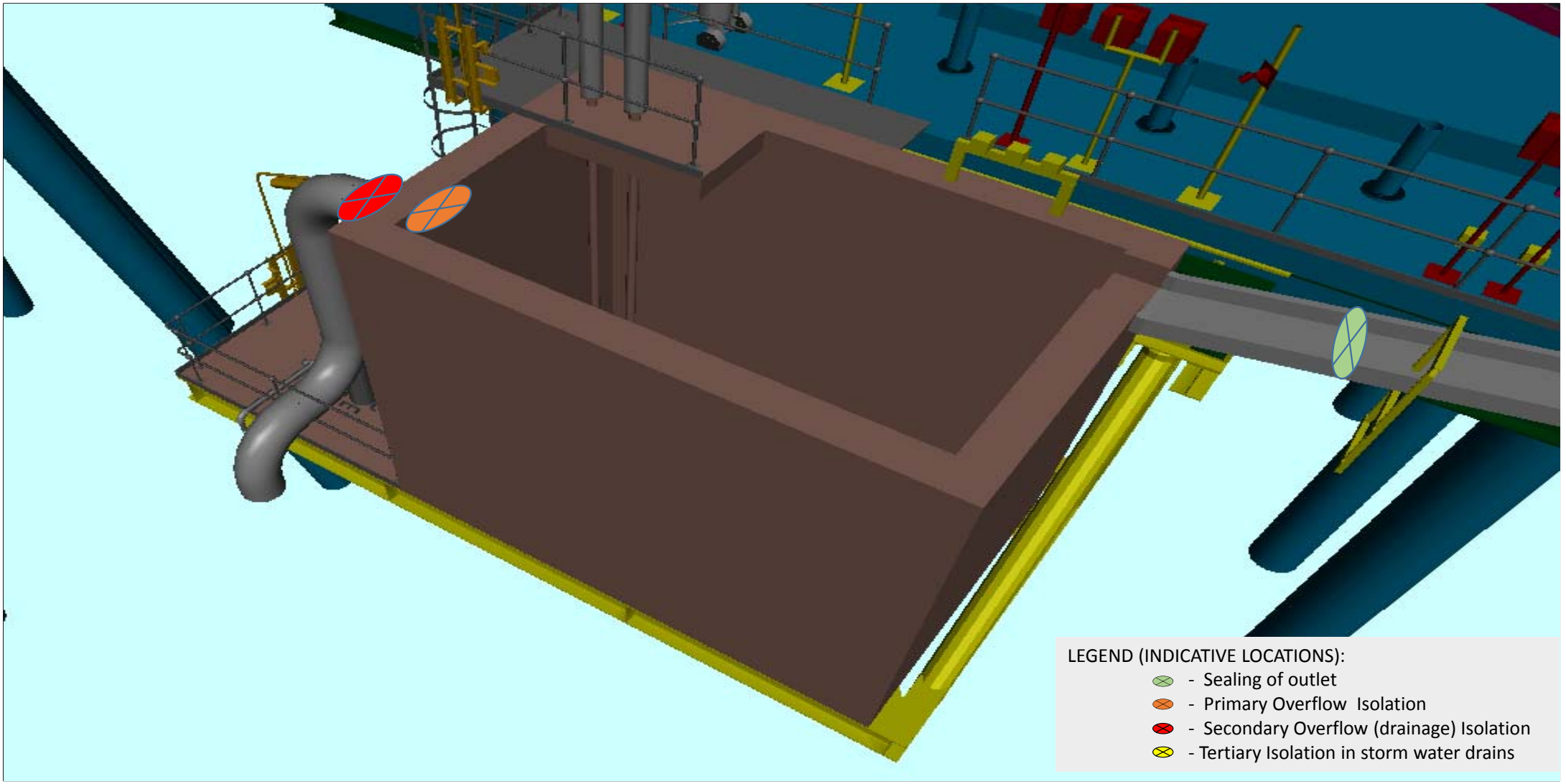
L-790-Y-003 HIGH EXPANSION FOAM
LNG STORAGE TANK [TYPE 1]



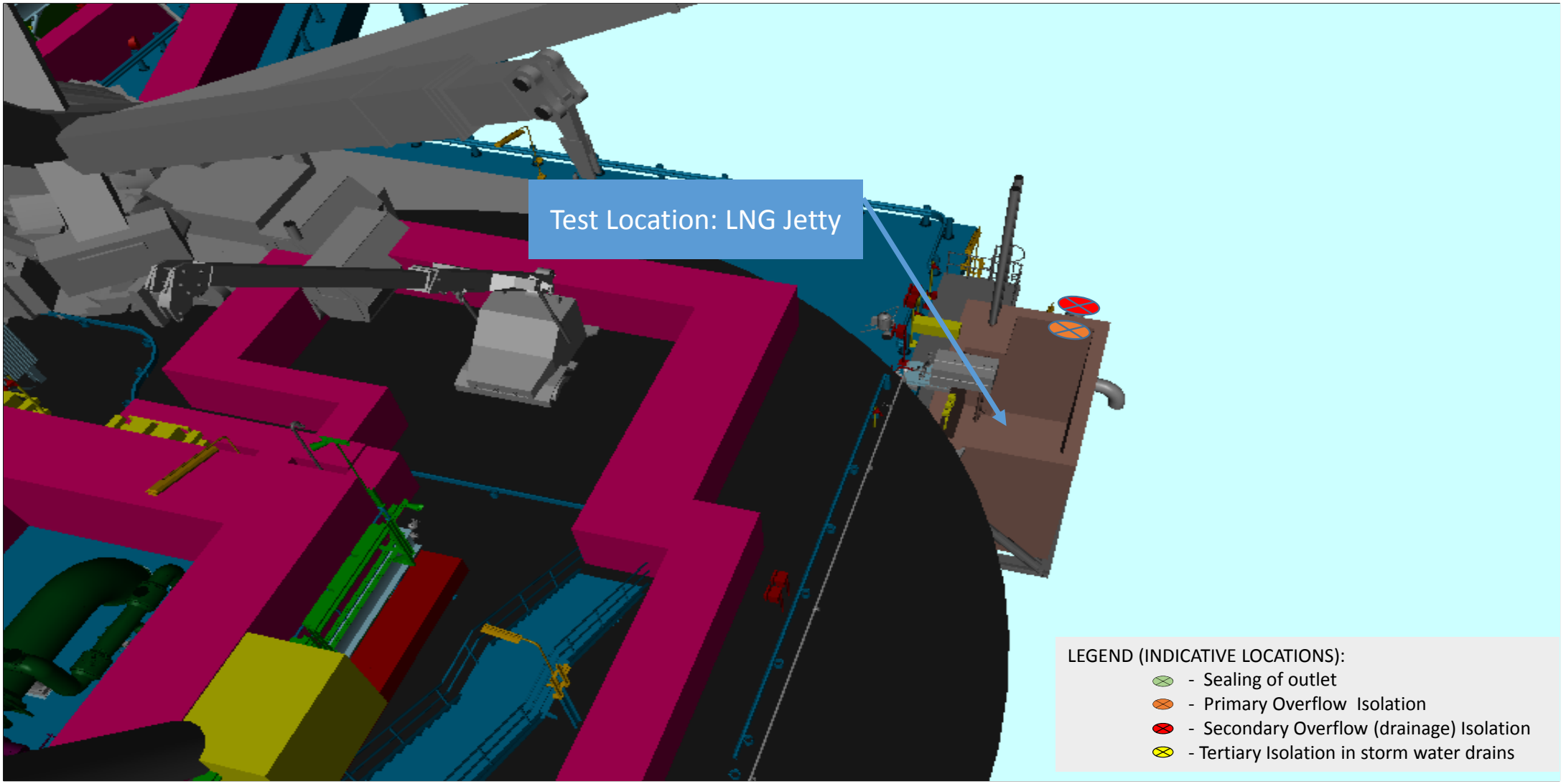
L-790-Y-052 LOW EXPANSION FOAM
LPG / CONDENSATE JETTY [TYPE 4]



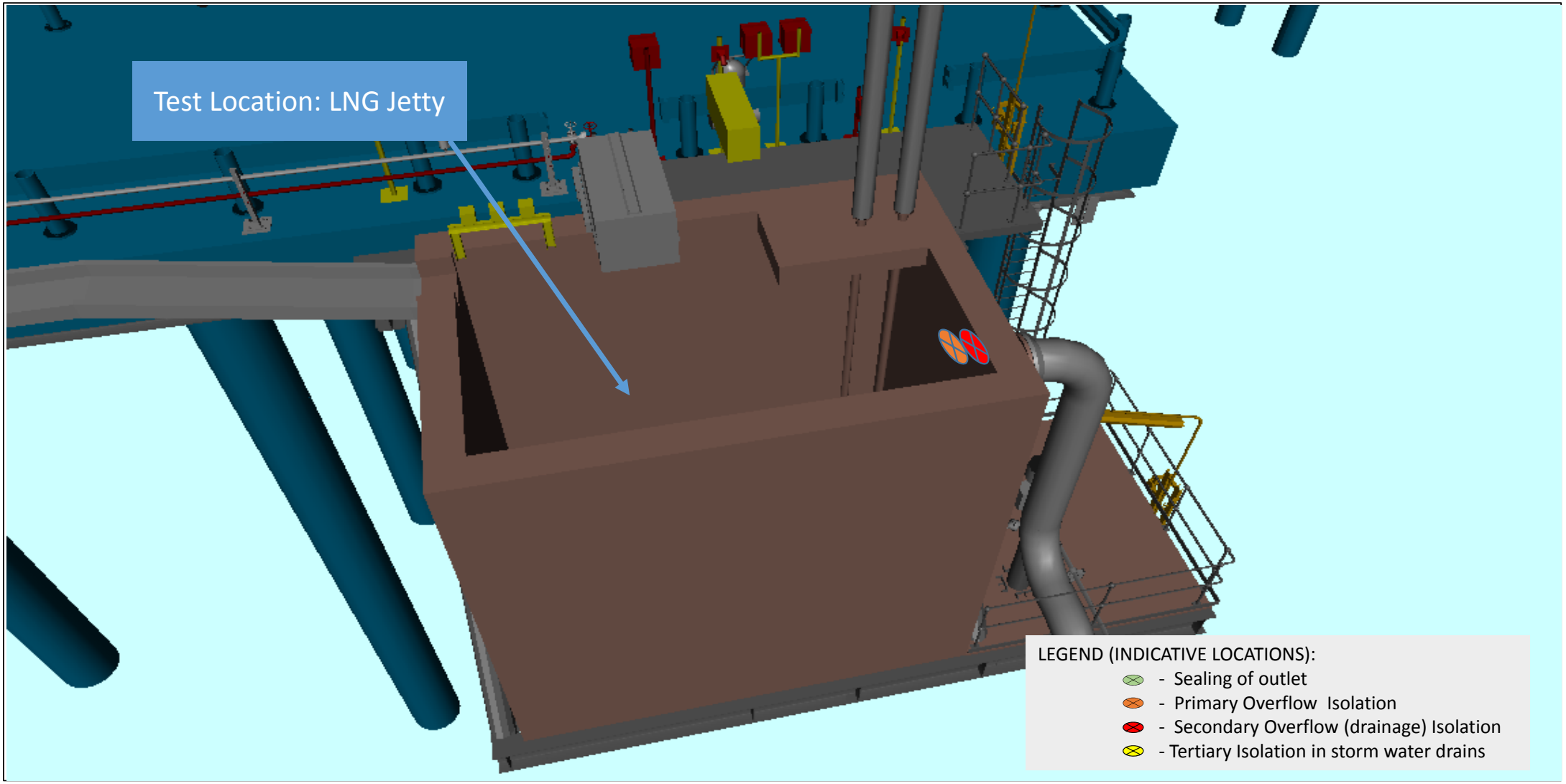
L-790-Y-052 LOW EXPANSION FOAM
LPG / CONDENSATE JETTY [TYPE 4]



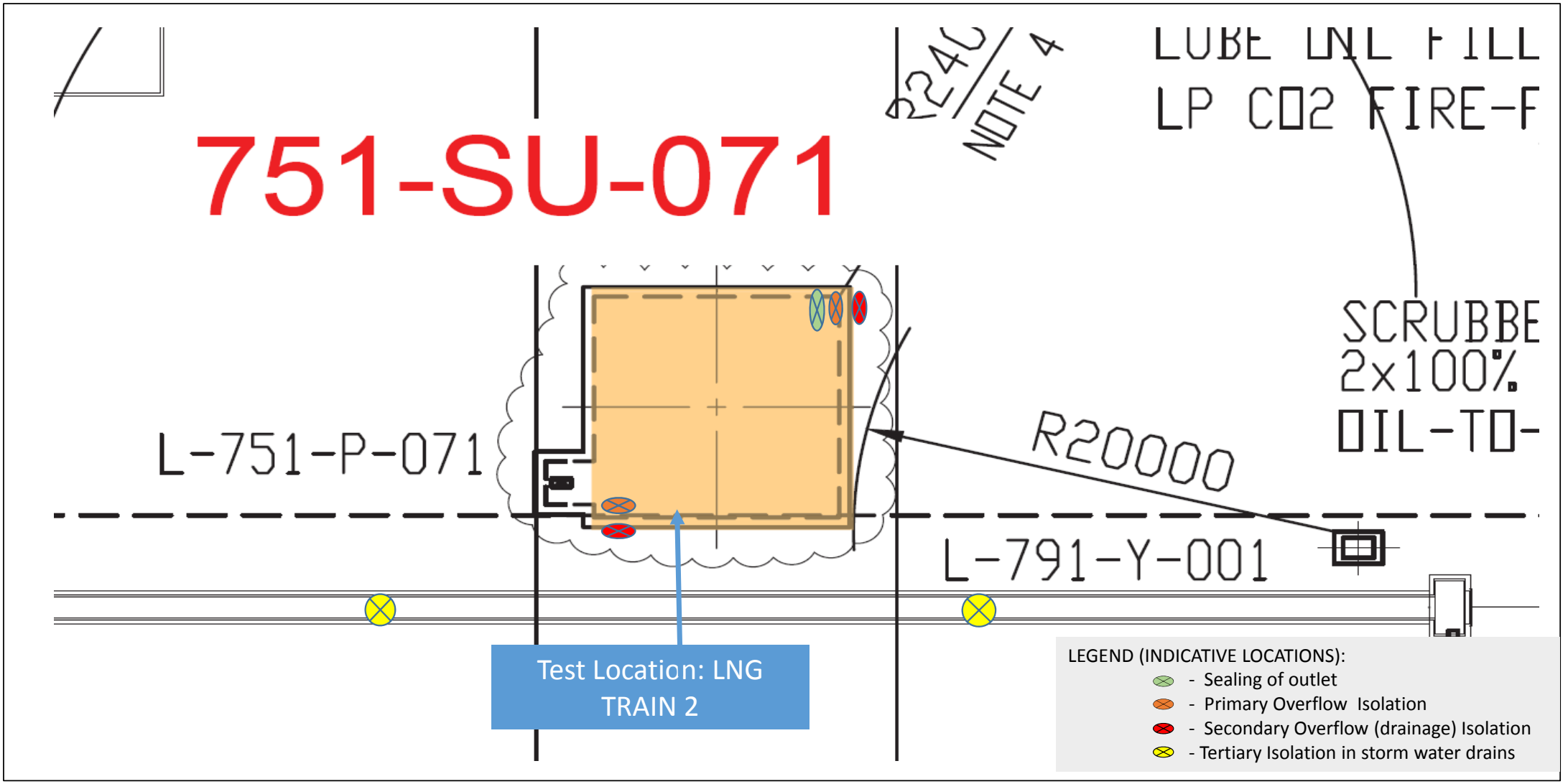
L-790-Y-004 HIGH EXPANSION FOAM
LNG JETTY [TYPE 3]



L-790-Y-004 HIGH EXPANSION FOAM
LNG JETTY [TYPE 3]



L-790-Y-001 HIGH EXPANSION FOAM
LNG TRAIN 1 [TYPE 1]



L-790-Y-001 HIGH EXPANSION FOAM
LNG TRAIN 2 [TYPE 1]