Appendix A. HAZOP Recommendations

Node	Recommendations	Place Used	Status	Noggin Status
1: FSRU gas unloading to ORF inlet	1. Provide FSRU flow measurement to Jemena, and implement alarm at Jemena onshore control centre to indicate deviation between flow set point and FSRU flow measurement.	Causes: 1.1.1	Action no longer applicable, as nitrogen injection facilities are no longer being provided.	In progress
1: FSRU gas unloading to ORF inlet	2. Consider alarm to indicate when nitrogen moves from set flowrate to ratio control.	Causes: 1.1.1	Action no longer applicable, as nitrogen injection facilities are no longer being provided.	Closed
1: FSRU gas unloading to ORF inlet	3. Consider implementing depressurisation of MLA quick disconnection (MLA ESD1) on confirmed fire at ORF.	Causes: 1.1.2	No change.	Closed
1: FSRU gas unloading to ORF inlet	32. Provide ORF pressure indication to FSRU.	Causes: 1.7.2	No change.	In Progress
1: FSRU gas unloading to ORF inlet	33. Develop procedures to allow for pressure balancing across all valves in flow path.	Causes: 1.7.2	No change.	Closed
1: FSRU gas unloading to ORF inlet	34. Indicate insulated gaskets and bolts at SS to CS interface on MLA P&IDs.	Causes: 1.16.1	No change.	In Progress
1: FSRU gas unloading to ORF inlet	35. Assess electrical surge potential and consider mitigation required for MLA. For example, surge diverter around insulating flange.	Causes: 1.21.1	No change.	In Progress
1: FSRU gas unloading to ORF inlet	36. Confirm with Höegh earthing of floating section between insulating flanges to FSRU.	Causes: 1.21.1	No change.	In Progress
1: FSRU gas unloading to ORF inlet	37. Review suitability for SDV-064001/2 and SLV-064007 to be used as block valve for isolation (ability to isolate energy source to actuator).	Causes: 1.23.1	No change.	In Progress
1: FSRU gas unloading to ORF inlet	141. Undertake surge study to ensure that closure time of fast acting ship-shore manifold valves (XV-021005 and XV-021001) does not create surge overpressure issues downstream of the FSRU HIPPS valve.	Causes: 1.3.1	New action.	In Progress.
3. ORF Pipework	40. Consider manual as opposed to automatic shutdown on confirmed gas, or enhanced reliability / confirmed gas set points to reduce spurious trip potential.	Causes: 3.1.2	No change.	Closed
3. ORF Pipework	47. Confirm if fire and gas detection alarms can be forwarded to vessel traffic service.	Causes: 3.1.2	No change.	In Progress
3. ORF Pipework	42. Indicate injection quill and dimensions on P&ID.	Causes: 3.1.3	No change.	In Progress
3. ORF Pipework	43. Confirm optimum flowrate for pigging activities.	Causes: 3.2.1	No change.	In Progress
3. ORF Pipework	41. Confirm closing time of SLV-064007 specified to mitigate surge risk.	Causes: 3.3.2	No change.	In Progress
3. ORF Pipework	44. Include PFP on SLV-064007 bypass up to inlet of LC ball valve.	Causes: 3.9.2	No change.	Closed
3. ORF Pipework	45. Confirm PFP material and coating specification are suitable for marine location.	Causes: 3.13.1	No change.	In Progress
3. ORF Pipework	38. SLV-064007 to be specified as a FC air actuated valve to close on confirmed fire. All other valve functionality indicated on P&ID e.g. position indication, hand switch actuation to be retained, dP interlock. Per Node 1 action, ability to positively isolate valve to allow for use in DBB arrangement e.g. removal of air to solenoid. Valve to be re-tagged as SDV.	Causes: 3.20.1	No change.	In Progress

Node	Recommendations	Place Used	Status	Noggin Status
3. ORF Pipework	39. Confirm required functionality and fail state of SDV-064003. Intention is that valve will close via remote manual actuation only. Assessment of failure state to take into account reliability implications, and fail close status of SLV-064007 with respect to safety and requirement for by-pass line if valve is specified FC.	Causes: 3.20.2	No change.	In Progress
3. ORF Pipework	46. Confirm open path gas detection is the preferred technology for the ORF (taking account of spurious trip potential associated with coal dust and sea spray) and ensure sensors are located in readily accessible areas for cleaning.	Causes: 3.20.3	No change.	In progress
6. Firewater System (Upstream of Pump)	4. Obtain written confirmation from water authority for minimum pressure and flowrate expected for the next 15 years.	Causes: 6.2.1	No change.	Closed
6. Firewater System (Upstream of Pump)	5. Develop procedure for periods of time when less than 100% fire water capacity is available (e.g. due to 5 yearly tank inspection)	Causes: 6.2.1	No change.	In progress
6. Firewater System (Upstream of Pump)	6. Confirm capacity of booster connection meets requirements of local fire authority.	Causes: 6.2.3	No change.	In Progress
6. Firewater System (Upstream of Pump)	7. Indicate valves locked open as required on P&ID. For example VG-1188/1196 on pump suction.	Causes: 6.2.4	Action extends to vendor package valves on firewater pump suction and discharge.	Closed
6. Firewater System (Upstream of Pump)	8. Indicate size of fire water tank overflow on P&ID.	Causes: 6.5.1	No change.	Closed
6. Firewater System (Upstream of Pump)	9. Confirm tank vent and overflow sized for pump discharge scenario.	Causes: 6.8.1	No change.	Closed
6. Firewater System (Upstream of Pump)	10. Confirm materials of construction for drain and overflow lines and indicate on P&ID.	Causes: 6.13.1	No change.	Closed
6. Firewater System (Upstream of Pump)	11. Consider staggering level controller set-points to minimize interference potential.	Causes: 6.17.1	No change.	In Progress
6. Firewater System (Upstream of Pump)	12. Confirm AS 1851 requirements regarding pump testing (frequency of flow testing, and need for return flow to both tanks).	Causes: 6.19.1	No change.	Closed
6. Firewater System (Upstream of Pump)	13. Global: Confirm design includes grounding of metallic structures including fire water tanks.	Causes: 6.21.1	No change.	Closed
7. Firewater System (Downstream of Pump)	14. Confirm fire water pumps are selected to allow for simultaneous operation.	Causes: 7.1.1	No change.	Closed
7. Firewater System (Downstream of Pump)	15. Valve on fire water recycle line (VL-1177) to be locked closed.	Causes: 7.1.2	No change.	Closed
7. Firewater System (Downstream of Pump)	16. Confirm output function of fire water pump overspeed trip.	Causes: 7.1.4	No change.	Closed
7. Firewater System (Downstream of Pump)	17. Confirm with vendor inbuilt firewater pump protections, and acceptability of running pumps for extended period of time with no forward flow.	Causes: 7.3.1	No change.	Closed
7. Firewater System (Downstream of Pump)	18. Confirm firewater pump high temperature trip is compliant with AS 2941.	Causes: 7.3.1	Action is no longer applicable; vendor package does not include high temperature trip.	Closed
7. Firewater System (Downstream of Pump)	19. Consider sprinkler protection within fire water pump house.	Causes: 7.3.3	No change.	In Progress

Node	Recommendations	Place Used	Status	Noggin Status
7. Firewater System (Downstream of Pump)	20. Confirm with Höegh that FSRU fire water system can cover MLA area.	Causes: 7.3.5	No change.	Closed
7. Firewater System (Downstream of Pump)	21. Indicate VF-1217 to be LC on P&ID.	Causes: 7.4.2	No change.	Closed
7. Firewater System (Downstream of Pump)	22. Confirm with Höegh that shore-to-ship connection is only to be made as required.	Causes: 7.4.3	No change.	Closed
7. Firewater System (Downstream of Pump)	23. Consider non return valve in shore-to-ship line.	Causes: 7.4.3	No change.	Closed
7. Firewater System (Downstream of Pump)	24. Confirm discharge pressure of FSRU fire water system	Causes: 7.7.2	No change.	Closed
7. Firewater System (Downstream of Pump)	25. Ensure monitor deluge valve internals (seat) are epoxy coated rather than powder coated.	Causes: 7.7.3	No change.	Closed
7. Firewater System (Downstream of Pump)	26. Confirm requirement for thermal relief protection on firewater system	Causes: 7.7.4	No change.	Closed
7. Firewater System (Downstream of Pump)	31. Include note on P&ID for pressure relief holes on hydrant storz connection caps.	Causes: 7.7.4	No change.	Closed
7. Firewater System (Downstream of Pump)	27. Indicate jockey pump is PD pump (not centrifugal) on P&ID.	Causes: 7.7.5	Action no longer applicable. Vendor package jockey pump is centrifugal.	Closed
7. Firewater System (Downstream of Pump)	28. Confirm with vendor jockey pump integral overpressure protection.	Causes: 7.7.5	No change.	In Progress
7. Firewater System (Downstream of Pump)	29. Provide remote alarm on start-up of diesel fire water pumps.	Causes: 7.8.1	No change.	Completed
7. Firewater System (Downstream of Pump)	30. Consider redundant jockey pump or connection to potable water system when jockey pump out for maintenance, or procedural controls for fire water system during this period.	Causes: 7.8.2	Action no longer applicable. It has been agreed no redundant jockey pump will be provided, and this is reflected in vendor P&ID.	Closed
9. Instrument/Utility Air: Distribution System	88. Ensure overpressure protection is provided in upstream air compressor package.	Causes: 9.1.1	Action is no longer applicable, vendor package details reviewed in Node 8.	Closed
9. Instrument/Utility Air: Distribution System	89. Consider spring return valve on instrument air receiver drain connection.	Causes: 9.8.1	Action is no longer applicable, vendor package reviewed in Node 8 includes auto-drain on the air receiver.	Closed
9. Instrument/Utility Air: Distribution System	90. Confirm dryer package has low temperature protection, and discharge temperature indication to SCADA	Causes: 9.10.1	Action is no longer applicable, vendor package details reviewed in Node 8.	Closed
9. Instrument/Utility Air: Distribution System	92. Consider reducing minimum design temperature for receiver from 0°C (without change in material) to reduce reliance on low temperature instrumented protections and limitation on vessel blowdown rates.	Causes: 9.10.2	Action is no longer applicable, vendor package reviewed in Node 8 includes air receiver with a lower MDMT.	Closed
9. Instrument/Utility Air: Distribution System	91. Confirm requirement for level gauge, and materials of construction given design pressure of instrument air receiver	Causes: 9.16.1	Action is no longer applicable. Vendor package reviewed in Node 8 does not	Closed

Node	Recommendations	Place Used	Status	Noggin Status
			include a level gauge on the air receiver.	
9. Instrument/Utility Air: Distribution System	93. Ensure level transmitter is commissioned separate from instrument air receiver, or specify alternate means of inferring level /absence of free water in instrument air receiver.	Causes: 9.17.1	Action is no longer applicable. Vendor package reviewed in Node 8 does not include a level transmitter on the air receiver.	Closed
9. Instrument/Utility Air: Distribution System	94. Provide pressure control from air receiver PIT only, with alarm on PIT downstream of PCV-054004.	Causes: 9.20.1	Action is no longer applicable, vendor package details reviewed in Node 8.	Closed
9. Instrument/Utility Air: Distribution System	95. Provide by-pass around instrument air receiver to allow for isolation and inspection.	Causes: 9.23.1	No change.	Closed
11. Diesel Fuel Supply	48. Determine potential for diesel storage tank to self-drain towards fire water pump day tanks, and provide additional controls if required.	Causes: 11.1.1	Action no longer applicable, as diesel storage and distribution has been removed from design.	Closed
11. Diesel Fuel Supply	49. Confirm vent and overflow on diesel storage tank and day tanks are designed in accordance with AS 1940 and indicate dimensions on P&ID.	Causes: 11.1.2	Action no longer applicable, as diesel storage and distribution has been removed from design.	Closed
11. Diesel Fuel Supply	50. Provide local level indication on fire water pump day tanks.	Causes: 11.1.4	Action superseded by firewater pump vendor design, which includes level indication.	Closed
11. Diesel Fuel Supply	51. Confirm diesel transfer pump isolation valves are accessible from outside of bunded area. In particular the inlet valve.	Causes: 11.1.5	Action no longer applicable, as diesel storage and distribution has been removed from design.	Closed
11. Diesel Fuel Supply	61. Ensure diesel installation complies with all relevant components of AS 1940. Including requirement for fire extinguishers etc.	Causes: 11.1.5	Action to be addressed in the context of the firewater pump diesel tanks only.	Closed
11. Diesel Fuel Supply	62. Confirm hazardous area requirements for diesel storage area.	Causes: 11.1.5	Action to be addressed in the context of the firewater pump diesel tanks only.	Closed
11. Diesel Fuel Supply	52. Consider alarm on extended running of diesel transfer pump.	Causes: 11.3.1	Action no longer applicable, as diesel storage and distribution has been removed from design.	Closed
11. Diesel Fuel Supply	53. Ensure local start/stop accessible from outside of bunded area.	Causes: 11.3.1	Action no longer applicable, as diesel storage and distribution has been removed from design.	Closed
11. Diesel Fuel Supply	57. Consider additional fill point downstream of diesel transfer pump to allow direct filling of day tanks via truck.	Causes: 11.3.2	Action no longer applicable, as diesel storage and distribution has been removed from design.	Closed

Node	Recommendations	Place Used	Status	Noggin Status
11. Diesel Fuel Supply	58. Confirm that hose fill connection will release within bunded area	Causes: 11.4.1	Action no longer applicable, as diesel storage and distribution has been removed from design.	Closed
11. Diesel Fuel Supply	59. Include note on P&ID for minimum distance between camlock, block valves and NRV.	Causes: 11.4.2	Action no longer applicable, as diesel storage and distribution has been removed from design.	Closed
11. Diesel Fuel Supply	60. Ensure installation complies with all relevant components of AS 1940.	Causes: 11.5.1	Action to be addressed in the context of the firewater pump diesel tanks only.	Closed
11. Diesel Fuel Supply	63. Indicate diesel day tanks are within bunded area.	Causes: 11.5.3	Action no longer applicable, as diesel storage and distribution has been removed from design.	Closed
11. Diesel Fuel Supply	64. Provide overflow on day tanks.	Causes: 11.5.3	Action no longer applicable, as diesel storage and distribution has been removed from design.	Closed
11. Diesel Fuel Supply	65. Ensure diesel day tanks have external local level gauge.	Causes: 11.5.4	Action superseded by vendor design. Action 65 was in the context of day tank filling via a pump from a larger storage tank on site. With local filling via a bowser connection with automatic cut-out, it was agreed in the vendor HAZOP that an external local level gauge is not required.	Closed
11. Diesel Fuel Supply	54. Include storage tank bunded area in CCTV coverage	Causes: 11.6.1	Action no longer applicable, as diesel storage and distribution has been removed from design.	Closed
11. Diesel Fuel Supply	55. Indicate low point / sump in bund with slope to sump for draining on P&ID.	Causes: 11.6.1	Action no longer applicable, as diesel storage and distribution has been removed from design.	Closed
11. Diesel Fuel Supply	66. Ensure low level set point on day tanks include sufficient diesel for 4hrs run time	Causes: 11.6.2	No change.	In progress
11. Diesel Fuel Supply	67. Consider removal of diesel storage tank T-101 with each day tank filled via dedicated fill line. Ensure sufficient capacity in day tanks such that top up not required after each monthly test.	Causes: 11.14.1	Action superseded by present design.	Closed
11. Diesel Fuel Supply	69. Confirm diesel specification for fire water pumps.	Causes: 11.14.2	No change.	In progress

Node	Recommendations	Place Used	Status	Noggin Status
11. Diesel Fuel Supply	68. Confirm means of preventing tank breathing via overflow line during normal operation	Causes: 11.15.1	Action superseded by present design, which does not include an overflow on firewater pump diesel tanks.	Closed
11. Diesel Fuel Supply	70. Confirm with vendor specific control requirements with respect to degradation of diesel, given marine environment.	Causes: 11.15.2	Action no longer applicable, as diesel storage and distribution has been removed from design.	Closed
11. Diesel Fuel Supply	71. Indicate cap on camlock fitting on hose fill line on P&ID.	Causes: 11.15.2	Action no longer applicable, as diesel storage and distribution has been removed from design.	Closed
11. Diesel Fuel Supply	56. Ensure earthing strap at tanker filling, and drain point (note this could be the same point) depending on location.	Causes: 11.21.1	Confirm if action remains relevant for fire water diesel tanks, considering potential for static generation on filling.	Closed
11. Diesel Fuel Supply	72. Ensure valving provided to allow for sight glass cleaning or provide magnetic level reading.	Causes: 11.23.1	Action superseded by vendor design, which does not include a level gauge.	Closed
11. Diesel Fuel Supply	73. Confirm vent access and frequency of change out required.	Causes: 11.24.1	No change.	Closed
11. Diesel Fuel Supply	74. Review size requirement valve on diesel transfer pump inlet (presently 2”, however smaller valve would be advantageous for sampling).	Causes: 11.25.1	No longer applicable, action related to 2" valves on diesel distribution lines, which are no longer in scope.	Closed
12. Potable Water	75. Confirm schedule for safety shower testing.	Causes: 12.2.1	No change.	Closed
12. Potable Water	76. Develop procedure for planned or unplanned loss of water supply.	Causes: 12.3.1	No change.	In progress
12. Potable Water	77. Consider means to detect loss of town water supply (downstream of VF-1137).	Causes: 12.3.1	No change.	In progress
12. Potable Water	78. Consider locking open VF-1137 on town water supply	Causes: 12.3.2	No change.	Closed
12. Potable Water	79. Provide additional back flow prevention / RPZ at Sydney water to AIE interface	Causes: 12.4.1	No change.	Closed
12. Potable Water	80. Consider removal of RPZ on fire water line due to provision of air break in fire water tanks.	Causes: 12.4.2	No change.	Closed
12. Potable Water	81. Provide NRV/RPZ on line to FSRU.	Causes: 12.4.3	No change.	Closed
12. Potable Water	82. Confirm town mains supply pressure is suitable for safety shower requirements	Causes: 12.8.1	No change.	Closed
12. Potable Water	83. Review requirement for insulation of exposed above ground lines to safety showers	Causes: 12.9.1	No change.	Closed
12. Potable Water	84. Update Note 3 on P&ID to specify minimisation of above ground piping to safety showers.	Causes: 12.9.1	No change.	Closed
12. Potable Water	85. Ensure discharge from anti-scald valve to safe location	Causes: 12.9.2	No change.	Closed
12. Potable Water	86. Review requirement for insulating gaskets and bolts at SS to CS interface.	Causes: 12.16.1	No change.	Closed

Node	Recommendations	Place Used	Status	Noggin Status
12. Potable Water	87. Indicate SS to CS interface downstream of RPZ to fire water tanks, and HDPE interface upstream.	Causes: 12.16.1	No change.	Closed
9. Instrument / Utility Air Distribution System	88. Ensure overpressure protection is provided in upstream air compressor package.	Causes: 9.1.1	No change.	In Progress
9. Instrument / Utility Air Distribution System	89. Consider spring return valve on instrument air receiver drain connection.	Causes: 9.8.1	No change.	In Progress
9. Instrument / Utility Air Distribution System	90. Confirm dryer package has low temperature protection, and discharge temperature indication to SCADA	Causes: 9.10.1	No change.	In Progress
9. Instrument / Utility Air Distribution System	91. Confirm requirement for level gauge, and materials of construction given design pressure of instrument air receiver	Causes: 9.16.1	No change.	In Progress
9. Instrument / Utility Air Distribution System	92. Consider reducing minimum design temperature for receiver from 0°C (without change in material) to reduce reliance on low temperature instrumented protections and limitation on vessel blowdown rates.	Causes: 9.10.2	No change.	In Progress
9. Instrument / Utility Air Distribution System	93. Ensure level transmitter is commissioned separate from instrument air receiver, or specify alternate means of inferring level /absence of free water in instrument air receiver.	Causes: 9.17.1	No change.	In Progress
9. Instrument / Utility Air Distribution System	94. Provide pressure control from air receiver PIT only, with alarm on PIT downstream of PCV-054004.	Causes: 9.20.1	No change.	In Progress
8. Instrument / Utility Air Compressor & Dryer Vendor Package	95. Vendor action: Provide by-pass around instrument air receiver to allow for isolation and inspection.	Causes: 8.23.1, 9.23.1	Action Moved from Node 9 to Node 8	In Progress
4a. Odourant Storage & Injection	96. Provide alarm to indicate when neither odourant systems are inhibited or both pumps are running.	Causes: 4a.1.1	New action	In Progress
4a. Odourant Storage & Injection	97. Confirm requirements and provision for odourant level monitoring at Kembla Grange.	Causes: 4a.1.2	New action	In Progress
4a. Odourant Storage & Injection	98. Vendor action: Confirm required set point of instrument air supply.	Causes: 4a.3.1	New action	In Progress
4a. Odourant Storage & Injection	99. Determine set point and provide alarm on load cell to indicate SBC changeover.	Causes: 4a.3.3	New action	In Progress
4a. Odourant Storage & Injection	100. Vendor action: Consider provision of a pressure transmitter with low pressure alarm on nitrogen supply, or nitrogen pressure alarms in YZ package to allow sufficient time for nitrogen bottle changeover (minimum 3 hours).	Causes: 4a.3.4	New action	In Progress
4a. Odourant Storage & Injection	101. Provide NRV close to injection point upstream of DBB isolation to prevent vapour displacing odourant.	Causes: 4a.4.1	New action	In Progress
4a. Odourant Storage & Injection	102. Provide an alarm to indicate when SOV-001 and SOV-002 are out of position.	Causes: 4a.1.3	New action	In Progress
4a. Odourant Storage & Injection	103. Power to odourant site package to be via site UPS.	Causes: 4a.3.5	New action	In Progress
4a. Odourant Storage & Injection	104. Vendor action: Determine minimum flow logic on loss of gas flowrate signal to the odourant package.	Causes: 4a.3.6	New action	In Progress
4a. Odourant Storage & Injection	105. Vendor action: Provide PSV downstream of PCV-1115.	Causes: 4a.7.2	New action	In Progress
4a. Odourant Storage & Injection	106. Determine requirements for thermal pressure protection on injection line considering potential volume of blocked inventory tubing length.	Causes: 4a.9.1	New action	In Progress
4a. Odourant Storage & Injection	107. Confirm inspection and maintenance regime for container, including for integral bunding.	Causes: 4a.17.1	New action	In Progress
4a. Odourant Storage & Injection	108. Vendor action: Investigate air gap for bunding component.	Causes: 4a.17.1	New action	In Progress

Node	Recommendations	Place Used	Status	Noggin Status
4a. Odourant Storage & Injection	109. Confirm available forklift will have required reach for SBC changeout.	Causes: 4a.25.1	New action	In Progress
4a. Odourant Storage & Injection	110. Confirm requirement for forklift SBC changeover to be undertaken within bunded area.	Causes: 4a.27.1	New action	In Progress
4a. Odourant Storage & Injection	111. Develop procedures to manage spill of odourant internal and external to container.	Causes: 4a.27.1	New action	In Progress
4b. Odourant Package Activated Carbon Scrubber Systems	112. Develop an operating routine for confirming operation of vent system.	Causes: 4b.2.3	New action	In Progress
4b. Odourant Package Activated Carbon Scrubber Systems	113. Include flowrate checking in regular servicing of system.	Causes: 4b.2.3	New action	In Progress
4b. Odourant Package Activated Carbon Scrubber Systems	114. Provide alarm on fan motor to indicate fan not running.	Causes: 4b.3.1	New action	In Progress
4b. Odourant Package Activated Carbon Scrubber Systems	115. Develop procedure for accessing container when fan is not running, including requirement for doors to remain open.	Causes: 4b.3.1	New action	In Progress
4b. Odourant Package Activated Carbon Scrubber Systems	116. Develop checking routine for activated carbon filters.	Causes: 4b.14.1	New action	In Progress
4b. Odourant Package Activated Carbon Scrubber Systems	117. Confirm systems that should remain energised on ESD, consider shutdown of YZ system only.	Causes: 4b.21.1	New action	In Progress
8. Instrument / Utility Air Compressor & Dryer Vendor Package	118. Provide an alarm to indicate when two compressors are running and loaded to notify operator.	Causes: 8.1.2	New action	In Progress
8. Instrument / Utility Air Compressor & Dryer Vendor Package	119. Vendor action: Provide tie-in point for hire compressor.	Causes: 8.3.1	New action	In Progress
8. Instrument / Utility Air Compressor & Dryer Vendor Package	120. Vendor action: Consider alarm on dew point sensor.	Causes: 8.10.2	New action	In Progress
8. Instrument / Utility Air Compressor & Dryer Vendor Package	121. Vendor action: Consider NRV upstream of instrument air receiver.	Causes: 8.8.1	New action	In Progress
8. Instrument / Utility Air Compressor & Dryer Vendor Package	122. Vendor action: Consider running all drain connections to a common tundish.	Causes: 8.4.2	New action	In Progress
8. Instrument / Utility Air Compressor & Dryer Vendor Package	123. Provide high dP alarm and consider high dP trip for pre and post filters.	Causes: 8.7.2	New action	In Progress
8. Instrument / Utility Air Compressor & Dryer Vendor Package	124. Vendor action: Relocate dew point sensor to instrument air receiver.	Causes: 8.20.2	New action	In Progress
13. Drain system	125. Confirm discharge elevation is above highest astronomical tide level.	Causes: 13.2.1	New action	In Progress

Node	Recommendations	Place Used	Status	Noggin Status
13. Drain system	126. Develop procedures for routine inspection and maintenance of ecoceptors and baffle boxes. Also include means of determining level of silt deposition and requirements for replacement of baffle box skimmer/sponge.	Causes: 13.1.1	New action	In Progress
13. Drain system	127. Assess requirement to provide coarse screen for overflow pipes.	Causes: 13.2.5	New action	In Progress
13. Drain system	128. Consider additional provisions for oil skimming at southern pond.	Causes: 13.5.1	New action	In Progress
13. Drain system	129. Develop suitable procedures for management of sediment, noting potential contaminants.	Causes: 13.14.2	New action	In Progress
7. Firewater System (Downstream of Pump)	130. Per AS 2941 requirement, provide overspeed trip on fire water pumps.	Causes: 7.1.4	New action	In Progress
7. Firewater System (Downstream of Pump)	131. For diesel tank level tank transmitters, provide low level alarm at a level that ensures required running duration.	Causes: 7.2.3	New action	In Progress
7. Firewater System (Downstream of Pump)	132. Consider locking open valve on diesel supply to fire pump engine.	Causes: 7.2.3	New action	In Progress
7. Firewater System (Downstream of Pump)	133. Provide the battery fault and charger failure alarm in SCADA.	Causes: 7.2.5	New action	In Progress
7. Firewater System (Downstream of Pump)	134. Indicate temperature alarms on fire water heat exchanger and engine and provide engine temperature alarms in SCADA.	Causes: 7.2.1	New action	In Progress
7. Firewater System (Downstream of Pump)	135. Include in maintenance procedures requirement for manual operation of fire water pumps during jockey pump maintenance.	Causes: 7.8.2	New action	In Progress
11. Diesel Fuel Supply	136. Provide spill kit in fire water pump house.	Causes: 11.6.2	New action	In Progress
11. Diesel Fuel Supply	137. Confirm ability to inspect interstitial space in tank walls to determine leak from inner wall.	Causes: 11.6.2	New action	In Progress
11. Diesel Fuel Supply	138. Develop procedures for checking double walled tank for internal leaks.	Causes: 11.6.2	New action	In Progress
11. Diesel Fuel Supply	139. Confirm access requirements e.g. step up, for tank filling.	Causes: 11.24.2	New action	In Progress
11. Diesel Fuel Supply	140. Indicate fill point connection type on diesel tank.	Causes: 11.27.1	New action	In Progress

Appendix B. HAZOP Minutes

Node: 1. FSRU gas unloading to ORF inlet (HP Manifold XV's to XV-064001/2)

Design Conditions/Parameters: Fluid: High pressure export gas
Max / Normal Operating Pressure: 12MPa / 8 - 10MPa
Max / Normal Operating Temperature: 65degC / 8degC
Flowrate: 50-500MMscfd

Drawing / Reference: MB601.61; PKGT-EMC-BTH-PIP-PID-0001; GAS-554-DW-PD-001

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
1. High Flow	1. Failure of FSRU flow controller	~~1. Impact on odourant and nitrogen ratio resulting in off-spec gas~~	~~1. Nitrogen set flowrate based on gas nomination, but will revert to ratio control if gas flow increases.~~	~~1. Provide FSRU flow measurement to Jemena, and implement alarm at Jemena onshore control centre to indicate deviation between flow set point and FSRU flow measurement.~~	~~Kevin Bourke~~	~~15-Feb-23~~	POST HAZOP NOTE: Per PKGT-AIE-PMT-CON-CHRQ-0013 [3] provision for nitrogen injection at Cringilla is no longer being undertaken. FSRU flow controller failure will impact odourant injection rate only.
		2. Commercial impacts	2. Odourant injection runs continuously on ratio control.	~~2. Consider alarm to indicate when nitrogen moves from set flowrate to ratio control.~~	~~Kevin Bourke~~	~~15-Feb-23~~	Action 2 no longer relevant, per above.
			3. Analysers at KGMS to confirm gas is on spec.				
	2. Loss of containment in wharf pipework (upstream of SDV-064001/2)	1. Release of gas, fire / explosion and potential fatality	1. Confirmed fire or gas detection initiates customer ESD + isolation (FSRU HP Manifold ESDVs, SDV-064003 or 7, and MLA isolation valves). Note this does not depressure MLA.	3. Consider implementing depressurisation of MLA quick disconnection (MLA ESD1) on confirmed fire at ORF.	David Miller	30-Sep-22	1. Review requirement for automatic blowdown of wharf pipework (Recommendation from FEED HAZOP). Reviewed in FSS and confirmed no blowdown required premised on small isolatable inventory.
			2. Fire exposure protection (via fire water system)				
			3. Isolation / shutdown of FSRU regas system				
			4. NRV downstream of MLA (safeguard if release is from MLA).				
	3. Line break	1. Loss of containment	1. Low pressure protection on FSRU set at 46bar				1. Reference: EGP Reversal DD HAZOP
		2. FSRU would not have enough heat to vapourise LNG resulting in cryogenic liquid being sent in to pipeline.	2. 2 x XV valves used to isolate the pipeline				2. Pressure rate of change alarm required on PIT-064004 (Recommendation from EGP Reversal DD HAZOP). Note agreed that this is to be implemented.
			3. 2oo3 low temperature trip (TE-RCG-0011/12/13) on HP Export Header, and individual low temperature trip on each train				
			4. Low temperature trip on seawater outlet				

Node: 1. FSRU gas unloading to ORF inlet (HP Manifold XV's to XV-064001/2)

Design Conditions/Parameters: Fluid: High pressure export gas

Max / Normal Operating Pressure: 12MPa / 8 - 10MPa

Max / Normal Operating Temperature: 65degC / 8degC

Flowrate: 50-500MMscfd

Drawing / Reference: MB601.61; PKGT-EMC-BTH-PIP-PID-0001; GAS-554-DW-PD-001

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
	4. High flow from booster pumps	1. Reaching capacity of the vaporization	1. 27TI1115B with LL trip (will trip individual vapourisation train)				1. Reference: Samsung Regasification System HAZOP Node 3
		2. No liquid entrainment expected, but low temperature to gas send-out	2. 27TI1021B with LL trip (will trip individual vapourisation train)				
		3. Damage on the gas send-out side	3. 54TI1120B with LL trip (will trip individual vapourisation train)				
			4. 2oo3 low temperature trip (TE-RCG-0011/12/13) on HP Export Header, and individual low temperature trip on each train				
			5. Low temperature trip on seawater outlet				
			6. Dedicated boosted pumps per vapourisation train limits the impact of single pump / train deviation				
	5. MLA out of position	1. Potential rupture leading to LOC of gas, fire / explosion and potential fatality	1. Mooring system designed for site conditions with ongoing mooring line load monitoring and maintenance.				
			2. Position switch on MLA with pre alarm, ESD 1 (Isolation + blowdown), ESD 2 (Disconnection) functionality. ESD 1 & 2 on one MLA will trigger the same on the other MLA.				
	6. MLA blowdown valves spuriously open	1. Continuous discharge from MLA vent	1. Blowdown valves are interlocked with MLA ESD valves.				
			2. Position indication on blowdown valves.				
			3. MLA vents are elevated at safe location				
2. Low Flow	1. No issues identified						

Node: 1. FSRU gas unloading to ORF inlet (HP Manifold XV's to XV-064001/2)

Design Conditions/Parameters: Fluid: High pressure export gas

Max / Normal Operating Pressure: 12MPa / 8 - 10MPa

Max / Normal Operating Temperature: 65degC / 8degC

Flowrate: 50-500MMscfd

Drawing / Reference: MB601.61; PKGT-EMC-BTH-PIP-PID-0001; GAS-554-DW-PD-001

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
3. No Flow	1. Spurious closure of valve up to and including SDV-064001/2	1. Surge leading to potential overpressure of MLA or FSRU	~~1. Specification of valve closure time based on surge studies (Doc no TBC).~~				
			1. ESD initiated when actuated valves are out of position. For example when normally open valve is "not open" and there is no alternate flow path, maximising the time available for the HIPPS valve to close to prevent/minimise surge.				
			2. ASME B31.3 allows for pressure surges up to 33% above design pressure.	141. Undertake surge study to ensure that closure time of fast acting ship-shore manifold valves (XV-021005 and XV- 021001) does not create surge overpressure issues downstream of the FSRU HIPPS valve.	Bjorn Haukedal	30-Jun-24	
4. Reverse Flow	1. Vent line open in error	1. Excessive gas to vent resulting in environmental incident	1. SOPs				
			2. Visual / audible detection of vent discharging.				
			3. Maintenance				
			4. Gas detection				
	2. Ignition at vent	1. Thermal radiation levels and potential fatality	1. Jemena standard design. Minimum vent height 3m above grade.				
	3. NRV or SDV-064001/2 by-pass valve open when required to be closed	1. Inability to fully isolate system on LOC.	1. Ball valves on each by-pass are specified as locked closed. Plug valves are normally closed.				
			2. By-pass lines minimised to the extent practicable.				
	4. Large bore valve open in error with high downstream and low upstream pressure.	1. Surge leading to potential overpressure of MLA or FSRU	1. Differential pressure inhibit on actuated valves.				
		2. Damage to valve itself.	2. Slow opening valves will limit the impact of pressure surge.				
5. High Level / Overflow	1. Not applicable						
6. Low Level / Empty	1. Not applicable						

Node: 1. FSRU gas unloading to ORF inlet (HP Manifold XV's to XV-064001/2)

Design Conditions/Parameters: Fluid: High pressure export gas

Max / Normal Operating Pressure: 12MPa / 8 - 10MPa

Max / Normal Operating Temperature: 65degC / 8degC

Flowrate: 50-500MMscfd

Drawing / Reference: MB601.61; PKGT-EMC-BTH-PIP-PID-0001; GAS-554-DW-PD-001

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
7. High Pressure	1. During start-up the line from the FSRU is depressured, this is pressurised from the EGP	1. Surge	1. Commissioning procedure and manual filling/pressurisation				1. Reference: EGP Reversal DD HAZOP
			2. Interlocks to prevent opening of valves against high dP, pressurisation via small bore bypass lines				
	2. Following shutdown, FSRU pressure may be higher than pipeline pressure	1. Inability to open valves without balancing pressure.		32. Provide ORF pressure indication to FSRU.	Kevin Bourke	15-Feb-23	
				33. Develop procedures to allow for pressure balancing across all valves in flow path.	David Miller	14-Oct-22	
	3. Valve closure in ORF, booster pump design pressure is 17Mpa	1. Overpressure of MLA / ORF pipework leading to LOC, potential fire and fatality	1. The FSRU has a SIL3 rated HIPPS system set at 12 MPag. This stops flow to the MLAs, it does not send an ESD1 to shore				1. Reference: EGP Reversal DD HAZOP
			2. PSD from high pressure trip on FSRU				2. C&E requires inputs from the MLA. Any ESD signal on the jetty should be transmitted first to the FSRU with a 2 second delay (Recommendation from EGP Reversal DD HAZOP)
			3. An ESD signal from ORF (including valve discrepancy) will initiate a FSRU PSD + closure of FSRU HP Manifold ESD valves. One set of ship to shore link fibre is dedicated to the ESD signals				3. Note FSRU design pressure is lower than pipeline design pressure, therefore pressure issues will manifest on FSRU and have been addressed in FSRU Regasification System HAZOP.
8. Low Pressure	1. Low grid pressure. Refer to previous hazard regarding line break.						1. Reference: Samsung Regasification System HAZOP Node 3
9. High Temperature	1. No issues identified associated with shut-in and heat up to ambient temperatures						
10. Low Temperature	1. Loss of heating medium on FSRU	1. Low temperature (-130 degC) in wharf pipework / pipeline leading to brittle failure, LOC, potential fire and fatality	1. Low temperature / pressure alarm and shutdown on FSRU heating medium system (depending on vessel selection)				
			2. Low temperature alarm and shutdown on FSRU gas system				

Node: 1. FSRU gas unloading to ORF inlet (HP Manifold XV's to XV-064001/2)

Design Conditions/Parameters: Fluid: High pressure export gas
Max / Normal Operating Pressure: 12MPa / 8 - 10MPa
Max / Normal Operating Temperature: 65degC / 8degC
Flowrate: 50-500MMscfd

Drawing / Reference: MB601.61; PKGT-EMC-BTH-PIP-PID-0001; GAS-554-DW-PD-001

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
	2. Rapid depressurisation due to maintenance activities	1. Low temperature in wharf pipework / pipeline leading to brittle failure, LOC, potential fire and fatality	1. Vent sizing (50mm) not sufficiently large to cause low temperature issues 2. Vent is low temperature CS				1. Based on blowdown volume and time, freezing of vent valves not considered credible.
11. Phase Change	1. Liquid carry over from regasification. Refer previous hazard regarding high flow.						1. Reference: EGP Reversal DD HAZOP
12. Mixing	1. No issues identified						
13. Reaction	1. No issues identified						
14. Concentration / Composition	1. Off-spec LNG	1. Off-spec gas to pipeline	1. Gas analysis on FSRU ~~2. Nitrogen injection / correction at Cringilla~~ 3. Management of cargo quality to FSRU				Per PKGT-AIE-PMT-CON-CHRQ-0013 [3] provision for nitrogen injection at Cringilla is no longer being undertaken.
	2. Failure of GC on FSRU	1. Off-spec gas to pipeline	1. Redundant GC on FSRU ~~2. Specification tolerances allow for conservatism in rate of nitrogen injection~~				Per PKGT-AIE-PMT-CON-CHRQ-0013 [3] provision for nitrogen injection at Cringilla is no longer being undertaken.
15. Contamination / Impurities	1. No issues identified - gas assumed is clean, sweet and dry						
16. Materials Of Construction	1. SS to CS material spec break at FSRU to MLA interface	1. Potential for galvanic corrosion		34. Indicate insulated gaskets and bolts at SS to CS interface on MLA P&IDs.	Kevin Bourke	1-Dec-22	
17. First Start-Up / Commissioning	1. Insufficient drying following pipeline hydro testing	1. Potential hydrate formation leading to pipeline blockage or damage	1. Following hydro testing the pipeline is dewatered and dried to a dew point of -20degC				1. Intention is for pipeline to be air filled and running purge with gas from KGMS vented at pig launcher. To be undertaken prior to FSRU arriving at berth. MLA to be commissioned once FSRU is at berth. POST HAZOP NOTE: Venting may no longer be at pig launcher, as a permanent launcher is removed from the design.
	2. Debris during construction	1. Blockage	1. In-line commissioning strainers provided downstream of MLAs				1. Reference: EGP Reversal DD HAZOP

Node: 1. FSRU gas unloading to ORF inlet (HP Manifold XV's to XV-064001/2)

Design Conditions/Parameters: Fluid: High pressure export gas

Max / Normal Operating Pressure: 12MPa / 8 - 10MPa

Max / Normal Operating Temperature: 65degC / 8degC

Flowrate: 50-500MMscfd

Drawing / Reference: MB601.61; PKGT-EMC-BTH-PIP-PID-0001; GAS-554-DW-PD-001

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
18. Start-Up /Partial Start-Up	1. Refer previous hazards regarding balancing of pressure around valves.						1. Start-up / shutdown procedures to be developed and update P&IDs if required
19. Shutdown	1. No additional issues identified						1. Start-up / shutdown procedures to be developed and update P&IDs if required
20. Control & Instrumentation	1. Failure of dedicated ESD ship-to-shore link	1. Inability for safety systems to communicate	1. Initiate ESD on loss of communication MLA will shut on delay.				
			2. Ability to implement alternate communication e.g. electric connection				
	2. Failure of ship-to-shore modbus link	1. Loss of information sharing between FSRU and shore and potential loss of onshore process functionality	1. System will "fail last" on loss of communications				
			2. Ability to implement alternate communication e.g. voice communication				
21. Electrical / Ignition	1. Lightning strike	1. Breakdown (crack) of insulating flange resulting in loss of galvanic separation	1. Earthing systems provided on both sides of insulating flange	35. Assess electrical surge potential and consider mitigation required for MLA. For example, surge diverter around insulating flange.	Kevin Bourke	15-Feb-23	
				36. Confirm with Höegh earthing of floating section between insulating flanges to FSRU.	David Miller	31-Oct-22	
22. Utilities / Services	1. No issues identified - MLA nitrogen purging can be provided via N3 or N11						POST HAZOP NOTE. Per PKGT-AIE-PMT-CON-CHRQ-0012 [2] fixed nitrogen facility on site no longer provided. Purging would be via local bottle connection.
23. Maintenance - Testing / Isolation Requirements	1. Double block and bleed isolation between MLA and pipeline required SDV for block	1. Actuated valve can spuriously open if not isolated correctly.		37. Review suitability for SDV-064001/2 and SLV-064007 to be used as block valve for isolation (ability to isolate energy source to actuator).	Andrew Petch	31-Oct-22	1. Jemena do not typically use actuated valves for isolation.
24. Access	1. No issues identified						1. MLA position monitoring sensors located on primary arm and are accessible via mobile platform. Local control panel is located at grade.
25. Sampling	1. No issues identified						

Node: 1. FSRU gas unloading to ORF inlet (HP Manifold XV's to XV-064001/2)

Design Conditions/Parameters: Fluid: High pressure export gas

Max / Normal Operating Pressure: 12MPa / 8 - 10MPa

Max / Normal Operating Temperature: 65degC / 8degC

Flowrate: 50-500MMscfd

Drawing / Reference: MB601.61; PKGT-EMC-BTH-PIP-PID-0001; GAS-554-DW-PD-001

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
26. Miscellaneous	1. The FSRU and the PKP are both protected by CP systems	1. Touch potential	1. AG piping in the station is isolated from the PKP by an MIJ				1. Reference: EGP Reversal DD HAZOP (guideword: isolation)
							2. Confirm Electrical isolation of the MLA's from the FSRU is included in the MLA connection (Recommendation from EGP Reversal DD HAZOP)
27. General Comments	1. No issues identified						

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Node: 3. ORF pipework (XV-064001/2 to PKP)

Design Conditions/Parameters: Fluid: High pressure export gas
Max / Normal Operating Pressure: 12MPa / 8 - 10MPa
Max / Normal Operating Temperature: 65degC / 8degC
Flowrate: 50-500MMscfd

Drawing / Reference: GAS-554-DW-PD-001; GAS-554-DW-PD-002_RL

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
1. High Flow	1. Refer hazards identified in Node 1.						
	2. Loss of containment in wharf pipework (downstream of SDV-064001/2)	1. Release of gas, fire / explosion and potential fatality	1. Confirmed fire or gas detection initiates customer ESD + isolation (FSRU HP Manifold ESDVs, SDV-064003 or 7, and MLA isolation valves). Note this does not depressure MLA.	40. Consider manual as opposed to automatic shutdown on confirmed gas, or enhanced reliability / confirmed gas set points to reduce spurious trip potential.	Alex Lovell	30-Jul-22	1. Automated function on confirmed gas may have reliability issues due to spurious detection, beam blockage etc.
			2. Fire exposure protection (via fire water system)	47. Confirm if fire and gas detection alarms can be forwarded to vessel traffic service.	Kevin Bourke	30-Nov-22	
			3. Isolation / shutdown of FSRU regas system				
	3. Vortex induced vibration	1. Failure of odourant injection quill	1. Injection point casing (80mm) sized based on wake frequency calculation	42. Indicate injection quill and dimensions on P&ID.	Andrew Petch	30-Oct-22	
2. Low Flow	1. Design flowrates not appropriate for pigging activities	1. Inability to launch pigs using gas from FSRU or poor quality data / monitoring	1. Confirmed by Jemena that design operating flowrates (50-500MMscfd) are suitable for launching pigs.	43. Confirm optimum flowrate for pigging activities.	Andrew Petch	31-Oct-22	
3. No Flow	1. Refer hazards identified in Node 1.						
	2. Spurious closure of valve up to and including SLV-064007 as per Node 1.			41. Confirm closing time of SLV-064007 specified to mitigate surge risk.	Andrew Petch	31-Oct-22	
4. Reverse Flow	1. Refer hazards identified in Node 1.						
	2. Low pressure in AIE pipeline	1. Reverse flow from EGP - no significant consequence					1. Review requirement for check valves at EGP tie-in (Recommendation from FEED HAZOP)
							2. Review requirement for pressure protection on FSRU from high pressures from EGP or nitrogen injection depending on the pressure rating of the chosen vessel (Recommendation from FEED HAZOP)
5. High Level / Overflow	1. Not applicable						
6. Low Level / Empty	1. Not applicable						
7. High Pressure	1. Refer hazards identified in Node 1.						
8. Low Pressure	1. Refer hazards identified in Node 1.						

Node: 3. ORF pipework (XV-064001/2 to PKP)

Design Conditions/Parameters: Fluid: High pressure export gas

Max / Normal Operating Pressure: 12MPa / 8 - 10MPa

Max / Normal Operating Temperature: 65degC / 8degC

Flowrate: 50-500MMscfd

Drawing / Reference: GAS-554-DW-PD-001; GAS-554-DW-PD-002_RL

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
9. High Temperature	1. No issues identified associated with shut-in and heat up to ambient temperatures						
	2. External fire impingement	1. Potential escalation of fire event	1. Buried pipeline	44. Include PFP on SLV-064007 bypass up to inlet of LC ball valve.	Andrew Petch	30-Oct-22	1. Suitable material and/or PFP being assessed by Jemena. POST HAZOP Note: Facility design no longer includes permanent pig launcher, but will include above ground ESD valves.
			2. PFP on above ground sections of piping up to inlet of SLV-064007 and outlet of pig launcher ball valve, with welded connection on PKP side of valves				
			3. ESD on confirmed fire to isolate inventory				
			4. All above ground valves are fire safe				
10. Low Temperature	1. Refer hazards identified in Node 1.						
11. Phase Change	1. No issues identified						
12. Mixing	1. No issues identified						
13. Reaction	1. PFP insulation on above ground sections of piping	1. Potential for corrosion underneath PFP	1. Pipeline pigging will give indication of pipeline thinning (only applicable to pigged section)	45. Confirm PFP material and coating specification are suitable for marine location.	Andrew Petch	31-Oct-22	
14. Concentration / Composition	1. Incorrect odourant dosing rate	1. Over/under dosing of odourant resulting in excessive reporting of gas leaks from public or failure to detect leaks	1. Flow rate measurement on odourant injection pumps withhold last dosing rate on failure				
			2. Sulphur analysers at KGMS				
15. Contamination / Impurities	1. No issues identified						
16. Materials Of Construction	1. No issues identified						
17. First Start-Up / Commissioning	1. No issues identified						
18. Start-Up /Partial Start-Up	1. No issues identified						
19. Shutdown	1. No issues identified						

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Node: 3. ORF pipework (XV-064001/2 to PKP)

Design Conditions/Parameters: Fluid: High pressure export gas
Max / Normal Operating Pressure: 12MPa / 8 - 10MPa
Max / Normal Operating Temperature: 65degC / 8degC
Flowrate: 50-500MMscfd

Drawing / Reference: GAS-554-DW-PD-001; GAS-554-DW-PD-002_RL

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
20. Control & Instrumentation	1. SLV-064007 presently shown as FL hydraulically actuated valve	1. Closure of this valve is assumed in FSS recommendation that ORF blowdown is not required.		38. SLV-064007 to be specified as a FC air actuated valve to close on confirmed fire. All other valve functionality indicated on P&ID e.g. position indication, hand switch actuation to be retained, dP interlock. Per Node 1 action, ability to positively isolate valve to allow for use in DBB arrangement e.g. removal of air to solenoid. Valve to be re-tagged as SDV.	Andrew Petch	31-Oct-22	
	2. SLV-064007 is not located at facility boundary	1. Pipeline inventory within site boundary unable to be isolated from remaining lateral inventory. Will impact Sch. 15 inventory calculations and potential MHF designation of ORF.	1. SDV-064003 located as boundary isolation valve.	39. Confirm required functionality and fail state of SDV-064003. Intention is that valve will close via remote manual actuation only. Assessment of failure state to take into account reliability implications and fail close status of SLV-064007 with respect to safety and requirement for by-pass line if valve is specified FC.	Kevin Bourke	30-Oct-22	
	3. Use of open path gas detection	1. Potential spurious actuation by coal dust or salt spray	1. Multiple detectors covering each area	46. Confirm open path gas detection is the preferred technology for the ORF (taking account of spurious trip potential associated with coal dust and sea spray) and ensure sensors are located in readily accessible areas for cleaning.	Kevin Bourke	15-Feb-23	
21. Electrical / Ignition	1. Lightning strike	1. Breakdown (crack) of insulating flange resulting in loss of galvanic separation	1. Surge diverter around MIJ				
22. Utilities / Services	1. No issues identified						
23. Maintenance - Testing / Isolation Requirements	1. No issues identified						
24. Access	1. No issues identified						
25. Sampling	1. No issues identified						
26. Miscellaneous	1. No issues identified						
27. General Comments	1. No issues identified						

Node: 4a. Odourant storage and Injection

Design Conditions/Parameters: Fluid: Spotleak1005

Max / Normal Operating Pressure: Max Pressure is variable depending on air supply pressure

Drawing / Reference: PKGT-ICE-ORF-PRO-PID-0001; PKGT-ICE-ORF-PRO-PID-0002 ; GAS-554-DW-PD-002

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
1. High Flow	1. Two odourant pump systems concurrently online	1. Over odourise gas leading to accelerated depletion of inventory with financial implications..	1. Control system will indicate if pump systems are online or inhibited	96. Provide alarm to indicate when neither odourant systems are inhibited or both pumps are running.	Kevin Bourke	15-Jul-23	
		2. Increased reporting of leakages					
	2. YZ control failure	1. Over odourise gas leading to accelerated depletion of inventory with financial implications..	1. Signal to indicate over pumping feeds into common YZ fault alarm (XA-001A/B) which will initiate manual changeover of odourant system	97. Confirm requirements and provision for odourant level monitoring at Kembla Grange.	Andrew Petch	15-Jul-23	
		2. Increased reporting of leakages	2. Depleting odourant storage more rapidly than anticipated				
			3. Gas analysers at Kembla Grange may detect excessive odourisation				
	3. SOV-001 and SOV-002 simultaneously open	1. Both SBCs concurrently online, with potential that standby SBC content is depleted at time of changeover	1. SBCs on load cells with remote weight indication	102. Provide an alarm to indicate when SOV-001 and SOV-002 are out of position.	Kevin Bourke	15-Jul-23	
			2. Position indication on SOV-001 and SOV-002				
			3. Control system does not allow for both SBCs to be specified as online				
	4. Leak of nitrogen within container	1. Potential asphyxiation due to low oxygen atmosphere	1. Nitrogen bottles and PSV located external to container				
			2. Ventilation system with minimum 20 air changes per hour				
2. Low Flow	1. YZ control failure	1. Under-odourisation of gas resulting in minimum specification requirements not being met	1. Signal to indicate under pumping feeds into common YZ fault alarm (XA-001A/B) which will imitate manual changeover of odourant system				
			2. Gas analyser at Kembla Grange may detect under-odourisation				
3. No Flow	1. Blocked discharge on odourant pump system, or at injection point	1. Failure to odourise gas resulting in minimum specification requirements not being met	1. Air supply pressure set point can be specified such that system cannot	98. Vendor action: Confirm required set point of instrument air supply.	David Miller	15-Jul-23	

Node: 4a. Odourant storage and Injection

Design Conditions/Parameters: Fluid: Spotleak1005

Max / Normal Operating Pressure: Max Pressure is variable depending on air supply pressure

Drawing / Reference: PKGT-ICE-ORF-PRO-PID-0001; PKGT-ICE-ORF-PRO-PID-0002 ; GAS-554-DW-PD-002

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
		2. Potential to overpressurise system	be overpressurised on blocked discharge				
	2. Loss of instrument air supply	1. Inability to run odourant injection pump	1. Facility shutdown on site wide loss of air supply 2. Common alarm on unit if pump is not running e.g. due to local loss of air supply				
	3. Empty SBC	1. Failure to odourise gas resulting in minimum specification requirements not being met	1. SBCs on load cells with remote weight indication	99. Determine set point and provide alarm on load cell to indicate SBC changeover.	Kevin Bourke	15-Jul-23	
	4. Depletion of nitrogen supply	1. Loss of blanket gas in SBC and loss of NPSH to odourant pump	1. Pressure transmitters in YZ system will indicate loss of nitrogen pressure 2. PI-1001 and PI-1002 on nitrogen supply with weekly operator checks	100. Vendor action: Consider provision of a pressure transmitter with low pressure alarm on nitrogen supply, or nitrogen pressure alarms in YZ package to allow sufficient time for nitrogen bottle changeover (minimum 3 hours).	David Miller	15-Jul-23	1. Discussed and agreed that FI-1003 not practicable to be implemented. Intention was to indicate loss of nitrogen supply which can be achieved through pressure transmitter.
	5. Loss of power to SOV-001/002 / valve out of position	1. Failure to odourise gas resulting in minimum specification requirements not being met	1. Position indication on supply valves with incorrect position alarm	103. Power to odourant site package to be via site UPS.	Kevin Bourke	15-Mar-23	1. Refer to Action 102 for valve out of position.
	6. Loss of gas flowrate signal to odourant dosing package	1. Failure to odourise gas resulting in minimum specification requirements not being met	1. Ability to inject odourant at specified flowrate on loss of gas flowrate signal	104. Vendor action: Determine minimum flow logic on loss of gas flowrate signal to the odourant package.	David Miller	15-Jul-23	1. Implementation of a set flowrate may result in odourant injection when gas is not flowing.
4. Reverse Flow	1. Odourant pump system offline	1. Reverse flow of natural gas through injection line 2. Loss of odourant from supply line following shutdown	1. Dual check valves within the pump system prevent overpressurisation / damage to dosing unit	101. Provide NRV close to injection point (upstream of DBB isolation) to prevent vapour displacing odourant.	Lars Aarekol	15-Mar-23	1. Typical industry practice is to include NRV close to injection point.
5. High Level / Overflow	1. Incorrect valve line-up e.g. V3 left open	1. Overfill of expansion tank	1. System design limits pressure in expansion tank to SBC pressure whilst some residual vapour is in tank. Failure of expansion tank or lifting of PSVs is not credible in this scenario 2. If expansion tank becomes liquid filled, high pressure PSV will relieve on thermal expansion. Relief is internal to shipping container and				

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Node: 4a. Odourant storage and Injection

Design Conditions/Parameters: Fluid: Spotleak1005

Max / Normal Operating Pressure: Max Pressure is variable depending on air supply pressure

Drawing / Reference: PKGT-ICE-ORF-PRO-PID-0001; PKGT-ICE-ORF-PRO-PID-0002 ; GAS-554-DW-PD-002

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
			vapours will be discharged by scrubbing system.				
			3. Dosing system pressure transmitters will indicate abnormal operating mode				
6. Low Level / Empty	1. Refer to No Flow due to SBC depletion						
7. High Pressure	1. Pressure control valve failure on nitrogen supply	1. Overpressure and failure of SBC	1. 3 stages of pressure reduction on nitrogen supply with PSVs downstream of each regulator				
		2. Potential to damage dosing package solenoid valves	2. Dosing package will shutdown on high pressure				
	2. Pressure control valve failure on air supply	1. Potential for pressure downstream of odourant pump in excess of downstream odourant injection design pressure (may require concurrent blockage of injection line)		105. Vendor action: Provide PSV on air supply downstream of PCV-1115.	David Miller	15-Jul-23	
8. Low Pressure	1. Refer to No Flow due to nitrogen or air pressure loss						
9. High Temperature	1. Thermal gain on blocked in liquid inventory	1. Potential overpressurisation of tubing (e.g. between dosing system outlet and injection point DBB)		106. Determine requirements for thermal pressure protection on injection line considering potential volume of blocked inventory tubing length.	Lars Aarekol	15-Jul-23	1. No provision of thermal relief PSV increase the potential for fugitive release of odourant.
10. Low Temperature	1. No issues identified						
11. Phase Change	1. No issues identified						
12. Mixing	1. No issues identified						
13. Reaction	1. No issues identified						
14. Concentration / Composition	1. Incorrect odourant product supplied	1. No significant issues identified, note not considered credible that a non-odourant product could be supplied in error.					
15. Change in Composition / Concentration	1. No issues identified						

Node: 4a. Odourant storage and Injection

Design Conditions/Parameters: Fluid: Spotleak1005

Max / Normal Operating Pressure: Max Pressure is variable depending on air supply pressure

Drawing / Reference: PKGT-ICE-ORF-PRO-PID-0001; PKGT-ICE-ORF-PRO-PID-0002 ; GAS-554-DW-PD-002

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
16. Contamination / Impurities	1. Potential particulate matter in odourant system	1. Damage to dosing pump	1. Quality control of odourant with certificate of analysis				
			2. Bulk odourant filter in dosing package upstream of pump				
17. Materials Of Construction	1. Operation in marine environment	1. Potential for corrosion of system components	1. System components are either stainless steel, powder coated or hot dipped galvanised carbon steel	107. Confirm inspection and maintenance regime for container, including for integral bunding.	Steele Johnson	15-Aug-23	
			2. Dosing package is enclosed within dangerous goods container	108. Vendor action: Investigate air gap for bunding component.	David Miller	15-Jul-23	
18. First Start-Up / Commissioning	1. No issues identified; commissioning is undertaken using kerosene to minimise potential for odourant release due to system leaks						
19. Start-Up /Partial Start-Up	1. No issues identified						
20. Shutdown	1. No issues identified						
21. Control & Instrumentation	1. No issues identified						
22. Electrical / Ignition	1. No issues identified, internal of container is Zone 1 Hazardous Area. All items are EXIA or EXD rated specified for use in Zone 1.						
23. Utilities / Services	1. No issues identified						
24. Maintenance - Testing / Isolation Requirements	1. No issues identified						
25. Access	1. Requirement for forklift access to container for SBC changeout		1. 3D model for container layout being developed and will be subjected to layout review	109. Confirm available forklift will have required reach for SBC changeout.	Steele Johnson	15-Aug-23	
26. Sampling	1. Not applicable						
27. Miscellaneous	1. Changeout of SBCs via forklift	1. Potential for LoC external to bunded container leading to significant odour issues	1. Top entry SBC limits leak potential	110. Confirm requirement for forklift SBC changeover to be undertaken within bunded area.	Alex Lovell	15-Mar-23	1. Provision of bunding will not mitigate odour issues, and may increase persistence of issue.
				111. Develop procedures to manage spill of odourant internal and external to container.	Steele Johnson	15-Aug-23	
28. General Comments	1. No issues identified						

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Node: 4b. Odourant Package Activated Carbon Scrubber System
Design Conditions/Parameters: Fluid: Spotleak1005
Drawing / Reference: PKGT-ICE-ORF-PRO-PID-0003

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
1. High Flow	1. Not credible, fixed speed fan appropriately sized for application.						
2. Low Flow	1. Blockage of activated carbon	1. Inability to maintain specified 20 air changes per hour	1. Margin provided in air change rate (15 air changes per hour required, 20 provided)				
			2. Periodic changeout of filters				
	2. Degradation of fan	1. Inability to maintain specified 20 air changes per hour	1. Ongoing inspection and maintenance				
			2. Margin provided in air change rate (15 air changes per hour required, 20 provided)				
	3. Blockage of duct inlet	1. Inability to maintain specified 20 air changes per hour	1. Margin provided in air change rate (15 air changes per hour required, 20 provided)	112. Develop an operations routine check for confirming operation of vent system.	Steele Johnson	15-Aug-23	
			2. Blockages can be detected through operator rounds	113. Include flowrate checking in regular servicing of system.	Steele Johnson	15-Aug-23	
3. No Flow	1. Fan turned off or fan failure	1. Insufficient air changes in container and potential for fugitive odour releases	1. Motor running status on fan	114. Provide alarm on fan motor to indicate fan not running.	Kevin Bourke	15-Jul-23	1. Note, confirmed that odourant injection can continue on loss of fan system, no requirement for standby fan.
				115. Develop procedure for accessing container when fan is not running, including requirement for doors to remain open.	Steele Johnson	15-Aug-23	
4. Reverse Flow	1. Rain ingress to vent	1. Potential blockage	1. Sleeve at the vent discharge point to prevent water ingress				
			2. Continuous operation of fans				
5. High Level / Overflow	1. No issues identified						
6. Low Level / Empty	1. No issues identified						
7. High Pressure	1. No issues identified						
8. Low Pressure	1. No issues identified						
9. High Temperature	1. No issues identified						
10. Low Temperature	1. No issues identified						
11. Phase Change	1. No issues identified						
12. Mixing	1. No issues identified						

Node: 4b. Odourant Package Activated Carbon Scrubber System

Design Conditions/Parameters: Fluid: Spotleak1005

Drawing / Reference: PKGT-ICE-ORF-PRO-PID-0003

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
13. Reaction	1. Exothermic reaction between activated carbon and liquid odourant	1. Potential for combustion	1. Air inlet is from above liquid levels in container, preventing liquid from entering activated carbon system 2. Adequate airflow to provide cooling for small exothermic reactions between odourant and activated carbon				
14. Concentration / Composition	1. Depletion of activated carbon over time	1. Potential for odour breakthrough	1. 3 activated carbon filters in series with sampling point downstream of second filter	116. Develop checking routine for activated carbon filters.	Steele Johnson	15-Aug-23	
15. Change in Composition / Concentration	1. No additional issues identified						
16. Contamination / Impurities	1. Presence of coal dust in area	1. Blockage of pores in activated carbon reducing absorption efficiency	1. Changeout of carbon filters when breakthrough is detected				1. Air inlet filtration discussed and rejected.
17. Materials Of Construction	1. Refer to node 4a regarding marine environment. Carbon filters are stainless steel and exhaust fan is powder coated.						
18. First Start-Up / Commissioning	1. No issues identified						
19. Start-Up /Partial Start-Up	1. No issues identified						
20. Shutdown	1. No issues identified						
21. Control & Instrumentation	1. C&E presently show de-energisation of container on ESD	1. Loss of ventilation to shipping container due to fan shutdown. Note, fan is EX rated		117. Confirm systems that should remain energised on ESD, consider shutdown of YZ system only.	Kevin Bourke	15-Jul-23	
22. Electrical / Ignition	1. No issues identified						
23. Utilities / Services	1. No issues identified						
24. Maintenance - Testing / Isolation Requirements	1. No issues identified						
25. Access	1. Access requirement for filter changeout		1. 3D model for container layout being developed and will be subjected to layout review				
26. Sampling	1. Sampling as discussed. Sampling provisions provided.						

Node: 4b. Odourant Package Activated Carbon Scrubber System

Design Conditions/Parameters: Fluid: Spotleak1005

Drawing / Reference: PKGT-ICE-ORF-PRO-PID-0003

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
27. Miscellaneous	1. Disposal of activated carbon	1. Potential OHS exposure	1. Complete canister replacement as opposed to media replacement				
		2. Incorrect disposal of saturated canister	2. Use of registered waste contractor for disposal in accordance with local regulation requirements				
28. General Comments	1. No issues identified						

Node: 6. Fire water system (Upstream of Pump)

Design Conditions/Parameters: Fluid: Fire water

Normal Operating Pressure: Ambient

Normal Operating Temperature: Ambient

2x 50% fire water tanks each with 1537m^3 capacity. Supplied via town mains. Fire water tanks supply 3x 50% diesel fire water pumps and jockey pump.

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0009

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
1. High Flow	1. No issues identified						
2. Low Flow	1. Fire water tanks supplied via 4" town mains connection	1. Excessive time to fill tanks (in particular should town mains pressure reduce in the future).	1. Emptying of tanks occurs infrequently. Not anticipated ORF will remain operational within days of major fire/release event.	4. Obtain written confirmation from water authority for minimum pressure and flowrate expected for the next 15 years.	Alex Lovell	30-May-22	1. Current design to fill tanks to 50% capacity (both tanks) within 24 hours.
				5. Develop procedure for periods of time when less than 100% fire water capacity is available (e.g. due to 5 yearly tank inspection)	Alex Lovell	30-Jun-23	
	2. Degradation of tank liner	1. Blockage in tank outlet (pump suction)	1. Two tanks				
			2. Monthly pump testing				
	3. Booster assembly sized for open yard requirement (4x 10L/s connection)	1. Booster has capacity for hydrant flow but not monitor flow. May not comply with requirements of local fire authority.		6. Confirm capacity of booster connection meets requirements of local fire authority.	Alex Lovell	30-Oct-23	
	4. Valves in tank outlet are partially closed when required to be open	1. Insufficient flow to fire water system	1. Duty / standby pumping arrangement	7. Indicate valves locked open as required on P&ID. For example VG-1188/1196 on pump suction.	Alex Lovell	30-Jul-22	VENDOR HAZOP NOTE: Action extends to gates valves on fire water pump suction and discharge lines.
			2. Valves on pump suction are lockable by chain and padlock				
3. No Flow	1. Valves in tank outlet are fully closed when required to be open	1. Insufficient flow to fire water system	1. Duty / standby pumping arrangement				
	2. LCV-086002/3 fails closed	1. Inability to fill fire water tank	1. 2x 50% tanks with individual LCV and a balance line				

Node: 6. Fire water system (Upstream of Pump)

Design Conditions/Parameters: Fluid: Fire water

Normal Operating Pressure: Ambient

Normal Operating Temperature: Ambient

2x 50% fire water tanks each with 1537m³ capacity. Supplied via town mains. Fire water tanks supply 3x 50% diesel fire water pumps and jockey pump.

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0009

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
	3. Loss of feed water supply e.g. rupture of mains	1. Inability to fill fire water tank	1. Emptying of tanks occurs infrequently. Not anticipated ORF will remain operational within days of major fire/release event. Note 4 hours fire water supply is based on tank capacity and not dependent on in-flow.				1. Alternate sources of fire water including point for trucked in supply and/or sea water supply considered by workshop team and was rejected.
4. Reverse Flow	1. Reverse flow from fire water fill line into potable water system	1. Contamination of potable water	1. Backflow prevention device (double check valve). Registered and certified by Sydney water annually.				
			2. Tank fill point from top with air gap to prevent siphoning of tank				
5. High Level / Overflow	1. LCV-086002/3 fails open	1. Potential overfill of tanks leading to overflow and spill to grade	1. Dedicated overflow to drain with air gap for visual inspection	8. Indicate size of fire water tank overflow on P&ID.	Alex Lovell	30-Juy-22	
			2. Level transmitter with high level alarm, both acting independently				
			3. Selection of radar level transmitter for high reliability				
			4. External level gauge				
6. Low Level / Empty	1. Tank leak	1. Fire water to grade	1. Level control with continual top up				1. Radar level transmitter should be located such that there is a clear measurement path.
		2. Insufficient fire water capacity for requirements	2. Level transmitter with low level alarm				
			3. 5-yearly preventative maintenance				
7. High Pressure	1. Blocked atmospheric vent on tank	1. Potential overpressure leading to tank damage	1. Alternate relief path via overflow line				
8. Low Pressure	1. Blocked atmospheric vent on tank	1. Vacuum generated if tank/ pump is discharging	1. Alternate relief path via overflow line	9. Confirm tank vent and overflow sized for pump discharge scenario.	Alex Lovell	30-Jul-22	
9. High Temperature	1. No issues identified						
10. Low Temperature	1. No issues identified - freezing not considered credible						
11. Phase Change	1. No issues identified						

Node: 6. Fire water system (Upstream of Pump)

Design Conditions/Parameters: Fluid: Fire water

Normal Operating Pressure: Ambient

Normal Operating Temperature: Ambient

2x 50% fire water tanks each with 1537m³ capacity. Supplied via town mains. Fire water tanks supply 3x 50% diesel fire water pumps and jockey pump.

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0009

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
12. Mixing	1. No issues identified						
13. Reaction	1. Corrosion of tank	1. Increased potential for leaks and blockages etc	1. Materials of construction - galvanised lined tank and galvanised fire water pipework 2. 5-yearly preventative maintenance	10. Confirm materials of construction for drain and overflow lines and indicate on P&ID.	Alex Lovell	30-Jul-22	1. Note tank vendor to provide recommendations for additional corrosion protection. For example, sacrificial anodes
14. Concentration / Composition	1. Hard town mains water supply	1. Potential for calcium build-up/scale	1. 6-monthly and 5-yearly preventative maintenance as required by AS 1851				
15. Contamination / Impurities	1. Stagnation of water in tanks	1. Microbial growth in tanks leading to blockage	1. 6-monthly and 5-yearly preventative maintenance as required by AS 1851				
16. Materials Of Construction	1. Refer to Reactions.						
17. First Start-Up / Commissioning	1. Level controllers programmed with same set-points.	1. Interference between independent level controllers.		11. Consider staggering level controller set-points to minimize interference potential.	Kevin Bourke	15-Feb-23	
	2. First fill of tanks	1. Tank settlement leading to stress on pipework and potential leaks	1. Civil design accounts for tank settlement				
18. Start-Up /Partial Start-Up	1. No issues identified						
19. Shutdown	1. Fire water pump recycle returns to T-103 only	1. Inability to test fire water pumps when T-103 out of service 2. Water ingress to T-103 during maintenance	1. Flow test only required annually	12. Confirm AS 1851 requirements regarding pump testing (frequency of flow testing, and need for return flow to both tanks).	Alex Lovell	30-Jul-22	
20. Control & Instrumentation	1. Jockey pump operation off a single pressure switch with high and low set points	1. Excessive starting of pump if band between high and low set points is too narrow leading to pump early wear out	1. Accumulator downstream of jockey pump 2. Multiple set points available on pressure switch allowing for a wider band if cycling occurs				
21. Electrical / Ignition	1. Lightning strike	1. Damage to fire water system and associated equipment		13. Global: Confirm design includes grounding of metallic structures including fire water tanks.	Alex Lovell	30-Jul-22	
22. Utilities / Services	1. No issues identified - level control valves are hydraulically operated.						

Node: 6. Fire water system (Upstream of Pump)

Design Conditions/Parameters: Fluid: Fire water

Normal Operating Pressure: Ambient

Normal Operating Temperature: Ambient

2x 50% fire water tanks each with 1537m^3 capacity. Supplied via town mains. Fire water tanks supply 3x 50% diesel fire water pumps and jockey pump.

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0009

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
23. Maintenance - Testing / Isolation Requirements	1. Refer previous hazards regarding preventative maintenance.						
24. Access	1. Requirement to access tank roof for maintenance (tank entry, level transmitter and atmospheric vent).	1. Working at height	1. Handrails provided where required				
25. Sampling	1. Not applicable						
26. Miscellaneous	1. No issues identified						
27. General Comments	1. No issues identified						

Node: 7. Fire water system (Downstream of Pump)

Design Conditions/Parameters: Fluid: Fire water

Normal Operating Pressure: 750-850 kPag

Normal Operating Temperature: Ambient

Fire water tanks supply 3x 50% diesel fire water pumps and jockey pump. Jockey pump maintains pressure in ring main between 750-850 kPag. When pressure drops below 700 kPag first fire water pump will start.

Worst case fire water demand based on operation of 2 tower mounted fire water monitors.

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0009; PKGT-LOG-ORF-PRO-PAIA-0010

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
1. High Flow	1. Simultaneous operation of fire water pumps	1. Excessive fire water flow leading to reduced coverage duration	1. Delayed start of second pump to limit simultaneous operation. Noting P-102 lead pump.	14. Confirm fire water pumps are selected to allow for simultaneous operation.	Alex Lovell	30-Nov-22	
		2. Potential damage to pumps					
	2. Recycle valve to fire water tank left open	1. Insufficient water flowing into ring main in scenario requiring fire water monitors.		15. Valve on fire water recycle line (VL-1177) to be locked closed.	Alex Lovell	30-Jul-22	
	3. Breach in line (in particular UG HDPE section)	1. Insufficient water flowing into ring main.	1. Two fire water pumps				
			2. Ability to isolate sections of ring main				
			3. Early detection may be indicated my pressure indicator downstream of jockey pump				

Node: 7. Fire water system (Downstream of Pump)

Design Conditions/Parameters: Fluid: Fire water

Normal Operating Pressure: 750-850 kPag

Normal Operating Temperature: Ambient

Fire water tanks supply 3x 50% diesel fire water pumps and jockey pump. Jockey pump maintains pressure in ring main between 750-850 kPag. When pressure drops below 700 kPag first fire water pump will start.

Worst case fire water demand based on operation of 2 tower mounted fire water monitors.

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0009; PKGT-LOG-ORF-PRO-PAIA-0010

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
	4. Pump over speed (governor failure) e.g. due to flammable gas ingress into motor air intake	1. Damage to pump and /or equipment	1. over speed trip	16. Confirm output function of fire water pump overspeed trip.	Alex Lovell	30-Nov-22	
			2. Monthly pump testing	130. Per AS 2941 requirement, provide overspeed trip on fire water pumps.	David Miller	15-Jul-23	
			3. 3 x 50% pumps				
	5. Excessive flow through pump water cooled heat exchanger	1. No significant impacts					
2. Low Flow	1. Blockage of strainer to pump water cooled heat exchanger	1. Overheating leading to engine damage	1. Routine maintenance of inlet strainer	134. Indicate temperature alarms on fire water heat exchanger and engine and provide engine temperature alarms in SCADA.	Kevin Bourke	15-Jul-23	
			2. Requirement for periodic running of fire water pumps with visual indication of fire water flow				
			3. Manual bypass around heat exchanger actuating valve				
			4. High temperature alarm on local fire pump control panel send as common fault alarm				
			5. Engine temperature alarm				
	2. Pressure switch failure	1. Pump does not run when required	1. Redundant pressure switches per fire water pump				
			2. Redundancy with 3x50% pumps				
	3. Blocked diesel supply or empty diesel tank	1. Pump does not run when required	1. Redundancy with 3x50% pumps	131. For diesel tank level tank transmitters, provide low level alarm at a level that ensures required running duration.	Kevin Bourke	15-Jul-23	
			2. Level transmitter on diesel tanks	132. Consider locking open valve on diesel supply to fire pump engine.	Steele Johnson	15-Aug-23	
	4. Mechanical issue with fire water pump	1. Pump does not run when required	1. Redundancy with 3x50% pumps				
			2. Routine maintenance and regular starting of pumps as per AS 1851				

Node: 7. Fire water system (Downstream of Pump)

Design Conditions/Parameters: Fluid: Fire water

Normal Operating Pressure: 750-850 kPag

Normal Operating Temperature: Ambient

Fire water tanks supply 3x 50% diesel fire water pumps and jockey pump. Jockey pump maintains pressure in ring main between 750-850 kPag. When pressure drops below 700 kPag first fire water pump will start.

Worst case fire water demand based on operation of 2 tower mounted fire water monitors.

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0009; PKGT-LOG-ORF-PRO-PAIA-0010

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
	5. Failure of battery required for fire water pump starting	1. Pump does not run when required	1. Redundancy with 3x50% pumps	133. Provide the battery fault and charger failure alarm in SCADA.	Kevin Bourke	15-Jul-23	
No Flow	1. Pump starts with no fire water demand	1. Pumping against blocked discharge leading to pump damage (seals)	1. SCADA system will indicate that pump is running. However, it may take up to 2 hours to manually stop the pump(s).	17. Confirm with vendor inbuilt firewater pump protections, and acceptability of running pumps for extended period of time with no forward flow.	Alex Lovell	30-Jul-22	VENDOR HAZOP NOTE: Action 18 no longer applicable., high temperature trip not provided.
			2. In blocked in scenario, jacket cooler will still be operational	18. Confirm firewater pump high temperature trip is compliant with AS 2941.	Alex Lovell	30-Jul-22	
	2. Manual valve closed in error	1. Insufficient or no water flowing into ring main.					1. Refer HAZOP action #7 in previous node to indicate in fire water flow path as LO.
	3. Actuated valve on engine cooling water line fails to open	1. Loss of engine cooling resulting in potential overheating /damage of engine. As per low flow.	1. 3 x 50% pumps	19. Consider sprinkler protection within fire water pump house.	Alex Lovell	16-Jan-23	1. Modbus connection requested in order to allow for analysis of common fault.
			2. High temperature alarm on local fire pump control panel send as common fault alarm				
			3. Smoke detection in fire water pump house				
	4. Pump failure	1. Insufficient or no water flowing into ring main.	1. 3 x 50% pumps				
			2. Monthly pump testing				
	5. Failure of solenoid on monitor deluge valve	1. No water to fire monitor	1. Periodic testing of deluge valve actuation	20. Confirm with Höegh that FSRU fire water system can cover MLA area.	David Miller	15-Nov-22	
			2. Manual release provided (however unlikely to be accessed during fire scenario)				
			3. Two towers				
			4. Fire hydrants				
			5. Failure state of solenoid is to actuate deluge valve				

Node: 7. Fire water system (Downstream of Pump)

Design Conditions/Parameters: Fluid: Fire water

Normal Operating Pressure: 750-850 kPag

Normal Operating Temperature: Ambient

Fire water tanks supply 3x 50% diesel fire water pumps and jockey pump. Jockey pump maintains pressure in ring main between 750-850 kPag. When pressure drops below 700 kPag first fire water pump will start.

Worst case fire water demand based on operation of 2 tower mounted fire water monitors.

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0009; PKGT-LOG-ORF-PRO-PAIA-0010

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
4. Reverse Flow	1. Failure of check valve on fire water pump discharge	1. Recirculation of fire water limiting forward flow into ring main	1. 5-yearly preventative maintenance on check valve 2. FM approved UL listed components specified				
	2. Failure of check valve on fire water booster assembly discharge	1. Recirculation of fire water limiting forward flow into ring main	1. 5-yearly preventative maintenance on check valve 2. FM approved UL listed components specified ~~3. VF-1217 is normally closed~~	21. Indicate VF-1217 to be LC on P&ID.	Alex Lovell	30-Jul-22	
	3. Flow of seawater into (onshore) freshwater fire water system via shore-to-ship connection	1. Potential corrosion in onshore fire water system	1. Normally closed valve in line	22. Confirm with Höegh that shore-to-ship connection is only to be made as required.	David Miller	1-Aug-22	Confirmed with Höegh that shore-to-ship connection is only to be made as required.
			2. Check valve on shore to ship connection and check valves downstream of each fire water pump	23. Consider non return valve in shore-to-ship line.	David Miller	1-Aug-22	Considered non return valve in shore-to-ship line if there is no requirement to send fire water from ship to shore. OTE - move to safeguard.
5. High Level / Overflow	1. Not applicable						
6. Low Level / Empty	1. Not applicable						
7. High Pressure	1. Elevation difference between hydrant / hose reel and monitors	1. Hydrant discharge pressure will be higher than monitor discharge	1. Discharge pressure at the hydrants is within allowances of AS 2419. Maximum allowable is 1200 kPag. 2. Hose reel flow rate is within capacity of jockey pump				
	2. Discharge pressure of FSRU fire water system unknown	1. Potential to overpressure onshore fire water systems via shore-to-ship connection		24. Confirm discharge pressure of FSRU fire water system	David Miller	1-Aug-22	
	3. Riser to monitor drained downstream of deluge valve	1. Potential water hammer on monitor activation 2. Damage to deluge valve coating due to pressure surges	1. Opening time of the deluge valve (adjustable to be set during commissioning)	25. Ensure monitor deluge valve internals (seat) are epoxy coated rather than powder coated.	Alex Lovell	30-Jul-22	

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Node: 7. Fire water system (Downstream of Pump)

Design Conditions/Parameters: Fluid: Fire water

Normal Operating Pressure: 750-850 kPag

Normal Operating Temperature: Ambient

Fire water tanks supply 3x 50% diesel fire water pumps and jockey pump. Jockey pump maintains pressure in ring main between 750-850 kPag. When pressure drops below 700 kPag first fire water pump will start.

Worst case fire water demand based on operation of 2 tower mounted fire water monitors.

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0009; PKGT-LOG-ORF-PRO-PAIA-0010

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
	4. Thermal gain in system	1. Liquid expansion leading to system overpressure	1. Majority of system is underground	26. Confirm requirement for thermal relief protection on firewater system	Alex Lovell	30-Nov-22	
				31. Include note on P&ID for pressure relief holes on hydrant storz connection caps.	Alex Lovell	30-Aug-22	
	5. Failure of jockey pump pressure control	1. Potential to overpressure fire water system due to continual operation of PD pump		27. Indicate jockey pump is PD pump (not centrifugal) on P&ID.	Alex Lovell	30-Nov-22	
				28. Confirm with vendor jockey pump integral overpressure protection.	Alex Lovell	16-Jan-23	
8. Low Pressure	1. Failure of jockey pump	1. Loss of system pressure leading to fire water pump starting with no demand. Refer to pumps running with no flow.	1. Remote monitoring of switchgear will indicate pump failure 2. Maintenance of jockey pump as per AS 1851 requirements	29. Provide remote alarm on start-up of diesel fire water pumps.	Kevin Bourke	15-Feb-23	
	2. Jockey pump out for maintenance	1. Potential operation of fire water pumps due to loss of system pressure	1. Procedural control to disable auto-start of fire water pump engines when jockey pump maintenance is being undertaken, with personnel on standby for manual starting of fire water pumps	30. Consider redundant jockey pump or connection to potable water system when jockey pump out for maintenance, or procedural controls for fire water system during this period.	Alex Lovell	30-Sep-22	VENDOR HAZOP NOTE: Action 30 has been addressed and no redundant fire water jockey pump to be provided.
				135. Include in maintenance procedures requirement for manual operation of fire water pumps during jockey pump maintenance.	Steele Johnson	15-Aug-23	
	3. Refer Node 6 regarding requirement to LO valves on pump suction.						
9. High Temperature	1. No additional issues identified						
10. Low Temperature	1. No issues identified						
11. Phase Change	1. No issues identified						
12. Mixing	1. No issues identified						
13. Reaction	1. No issues identified						

Node: 7. Fire water system (Downstream of Pump)

Design Conditions/Parameters: Fluid: Fire water

Normal Operating Pressure: 750-850 kPag

Normal Operating Temperature: Ambient

Fire water tanks supply 3x 50% diesel fire water pumps and jockey pump. Jockey pump maintains pressure in ring main between 750-850 kPag. When pressure drops below 700 kPag first fire water pump will start.

Worst case fire water demand based on operation of 2 tower mounted fire water monitors.

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0009; PKGT-LOG-ORF-PRO-PAIA-0010

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
14. Concentration / Composition	1. Refer to previous hazard regarding seawater ingress to system.						
15. Contamination / Impurities	1. Refer blockage of water cooler heat exchanger.						
16. Materials Of Construction	1. No additional issues identified						
17. First Start-Up / Commissioning	1. No issues identified						
18. Start-Up /Partial Start-Up	1. No issues identified						
19. Shutdown	1. Refer previous hazard regarding requirement to shut fire water pumps on false start.						
	2. Low point drain connection to ring main provided.						
20. Control & Instrumentation	1. Calibration error or drift on flow transmitter on test line	1. Incorrect pump performance indication	1. With multiple fire pumps, consistent drift in pump curves will indicate issues with flow transmitter				
21. Electrical / Ignition	1. No issues identified						
22. Utilities / Services	1. No issues identified						
23. Maintenance - Testing / Isolation Requirements	1. No issues identified, isolation valves and removable spools on pump suction and discharge.						
24. Access	1. No issues identified						
25. Sampling	1. No issues identified						
26. Miscellaneous	1. No issues identified						
27. General Comments	1. No issues identified						

Node: 8. Instrument/Utility Air: Air Compressor & Dryer Vendor Package

Design Conditions/Parameters: Fluid: Instrument Air

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0004; PKGT-LOG-ORF-PRO-PAIA-0006; PKGT-LOG-ORF-PRO-PAIA-0012; E12201-PID-001 Sheet 1 & 2

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
1. High Flow	1. Two compressors running simultaneously	1. Overpressure air receiver or compressor horizontal air receiver	1. PSVs sized for blocked flow (2 compressors flowing on instrument air receiver, 1 compressor flowing on individual air receiver) 2. Pressure control on instrument air receiver, and on each individual compressor				1. Compressors are fixed speed.
	2. Drain valve fails open	1. Loss of instrument air pressure	1. Pressure control on instrument air receiver will bring second compressor online if pressure in inadequate	118. Provide an alarm to indicate when two compressors are running and loaded to notify operator.	Kevin Bourke	15-Jul-23	
	3. Excessive use of plant air	1. Insufficient instrument air	1. Pressure regulator will prevent use of plant air below 500 kPag				
2. Low Flow	1. Blockage of inlet air filter	1. Reduced capacity of compressor	1. Pressure control on instrument air receiver will bring second compressor online if pressure in inadequate 2. Refer action for alarm on both compressors loaded which will indicate degradation of system performance				
3. No Flow	1. Failure of compressor packages	1. Loss of instrument and plant air	1. Air actuated valves will fail to safe position 2. Low pressure alarm downstream of air receiver 3. Air receiver sized to actuate all valves from low pressure set point	119. Vendor action: Provide tie-in point for hire compressor.	David Miller	15-Jul-23	1. Depending on compressor failure mode, refrigerator packages may not be available in this mode of operation.
	2. Refrigeration package continues to run with no flow through compressor	1. Potential to ice up refrigeration unit	1. Refrigeration circuit set point at 3 degC with sensor located in close proximity to chilling circuit				
	3. Valve closure	1. Partial or total loss of air supply	1. All valves in the line-up are manual, removing potential for spurious closure				
4. Reverse Flow	1. Flow from loaded to unloaded compressor or compressor shuts down	1. Loss of system pressure	1. NRV in each compressor package				

Node: 8. Instrument/Utility Air: Air Compressor & Dryer Vendor Package

Design Conditions/Parameters: Fluid: Instrument Air

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0004; PKGT-LOG-ORF-PRO-PAIA-0006; PKGT-LOG-ORF-PRO-PAIA-0012; E12201-PID-001 Sheet 1 & 2

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
	2. Simultaneous opening of multiple auto drains in system	1. Potential for condensate to flow from higher pressure to lower pressure drain point	1. NRV on all drain connections	122. Vendor action: Consider running all drain connections to a common tundish.	David Miller	15-Jul-23	
5. High Level / Overflow	1. Accumulation of water in air receiver	1. Liquid carryover into instrument air	1. Pneumatically actuated auto drain on instrument air receiver				
			2. 3 degC dew point specification limits potential for water in instrument air receiver and dew point sensor to indicate when specification is not met				
	2. Accumulation of water in horizontal air receiver	1. Short cycling and load-unload cycles compared to usual operation	1. Solenoid auto drain				
		2. Excessive load on dryer pre-filters and refrigeration and dryer post filters	2. Horizontal air receiver can be manually drained				
			3. Will be detected via poor dew point performance				
6. Low Level / Empty	1. Loss of oil from system over time or due to leaks	1. Overheating of compressor leading to compressor damage	1. Operator and maintenance routines and weekly checks of oil levels				1. Common fault alarm on each compressor package to site control master system. Alarm can be interrogated.
			2. TI-001 with high temperature alarm and trip on compressor discharge				
7. High Pressure	1. Refer to High Flow						
	2. Blockage of pre or post filters	1. Potential damage to filter leading to loss of filtration capabilities	1. Duty and standby filters allowing for online maintenance	123. Provide high dP alarm and consider high dP trip for pre and post filters.	Kevin Bourke	15-Jul-23	
		2. High pressure drop leading to lower instrument air pressure	2. Local dP indication for each filter				
			3. Differential pressure transmitter across each filter set				
8. Low Pressure	1. Air leaks from system	1. Insufficient pressure in air receiver	1. Low pressure alarm on air receiver with control to compressor to increase output	121. Vendor action: Consider NRV upstream of instrument air receiver.	David Miller	15-Jul-23	
9. High Temperature	1. Failure of refrigeration circuit temperature control	1. Hot gas bypass excessively open, resulting in high dew point air	1. Dew point sensor at instrument air receiver				1. Refer action for alarm on dew point sensor.
	2. Failure of compressor cooling fan	1. High screw discharge temperature leading to high air and oil temperature	1. TI-001 with high temperature alarm and trip on compressor discharge				

Node: 8. Instrument/Utility Air: Air Compressor & Dryer Vendor Package

Design Conditions/Parameters: Fluid: Instrument Air

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0004; PKGT-LOG-ORF-PRO-PAIA-0006; PKGT-LOG-ORF-PRO-PAIA-0012; E12201-PID-001 Sheet 1 & 2

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
10. Low Temperature	1. Depressuring instrument air receiver	1. Low temperature due to excessive depressuring rate	1. Change in instrument air receiver material specification from previous (with MDMT of -10degC as opposed to 0degC)				
	2. Failure of refrigeration circuit temperature control	1. Hot gas bypass excessively closed, resulting in freezing of drain lines	1. Dew point sensor at instrument air receiver	120. Vendor action: Consider alarm on dew point sensor.	David Miller	15-Jul-23	
11. Phase Change	1. Failure of refrigerant dryer	1. Moisture carryover to instrument air receiver with high dew point IA	1. Liquid drop out in instrument air receiver 2. Dew point sensor at instrument air receiver				
12. Mixing	1. No issues identified						
13. Reaction	1. No issues identified						
14. Concentration / Composition	1. No issues identified						
15. Contamination / Impurities	1. Degradation or failure of oil separator element	1. Oil contamination from instrument air compressors with oil discharged from drains, or damage to instruments	1. Routine maintenance 2. Pre-filters and post-filters with differential pressure measurement 3. Oil-water separator on outlet of condensate line				
	2. Salt water spray ingress to instrument air compressors	1. Damage to compressor internals, salt will absorb into oil, not considered to be a significant issue					
16. Materials Of Construction	1. Operation in marine environment	1. Potential for accelerated corrosion	1. Critical components upgraded with surface protection to meet the requirements and reliability for a salty environment				
17. First Start-Up / Commissioning	1. No issues identified						
18. Start-Up /Partial Start-Up	1. No issues identified						
19. Shutdown	1. No issues identified, note on system trip, local restart will be required						
20. Control & Instrumentation	1. Sequence control failure or failure of pressure control loop from instrument air receiver	1. Potential loss of instrument air	1. Air compressors revert automatically to local control in the absence of sequence control				
	2. Dew point sensor on line to instrument air receiver	1. Instrument instability with pressure swings		124. Vendor action: Relocate dew point sensor to instrument air receiver.	David Miller	15-Jul-23	

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Node: 8. Instrument/Utility Air: Air Compressor & Dryer Vendor Package

Design Conditions/Parameters: Fluid: Instrument Air

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0004; PKGT-LOG-ORF-PRO-PAIA-0006; PKGT-LOG-ORF-PRO-PAIA-0012; E12201-PID-001 Sheet 1 & 2

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
21. Electrical / Ignition	1. No issues identified						
22. Utilities / Services	1. No issues identified						
23. Maintenance - Testing / Isolation Requirements	1. Inability for internal inspection of instrument air receiver with ORF in operation, and inability to maintain instrument air receiver PSV			95. Vendor action: Provide by-pass around instrument air receiver to allow for isolation and inspection.	Alex Lovell	30-Jun-22	
24. Access	1. No issues identified						
25. Sampling	1. No issues identified, periodic oil sampling per Original Equipment Manufacturer standard design						
26. Miscellaneous	1. No issues identified						
27. General Comments	1. No issues identified						

Node: 9. Instrument/Utility Air: Distribution System (Due to change in vendor package boundary, relevant detail amalgamated into Node 8.)

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0006_RL; PKGT-LOG-ORF-PRO-PAIA-0012

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
1. High Flow	~~1. Two compressors running simultaneously~~	~~1. Overpressure air receiver~~		88. Ensure overpressure protection is provided in upstream air compressor package.	Alex Lovell	16-Jan-23	NOTE: Superseded by Vendor HAZOP Node 8. Action 88 is no longer applicable, as Node 8 has reviewed the vendor package.
	~~2. Excessive use of plant air~~	~~1. Insufficient instrument air~~	~~1. Pressure regulator will prevent use of plant air below 500 kPag~~				NOTE: Superseded by Vendor HAZOP Node 8.
2. Low Flow	1. No issues identified						
3. No Flow	~~1. Failure of compressor packages~~	~~1. Loss of instrument and plant air~~	~~1. Air actuated valves will fail to safe position~~				NOTE: Superseded by Vendor HAZOP Node 8.
			~~2. Low pressure alarm on air receiver~~				
			~~3. Air receiver sized to actuate all valves from low pressure set point~~				
			~~4. Tie-in point provided for hire compressor~~				
	~~2. PCV-054004 fails closed~~	~~1. Loss of instrument and plant air~~	~~1. Air actuated valves will fail to safe position~~				NOTE: Superseded by Vendor HAZOP Node 8.
			~~2. Low pressure alarm downstream~~				
			~~3. Provision of by-pass around PCV~~				
4. Reverse Flow	1. No issues identified						
5. High Level / Overflow	~~1. Accumulation of water in air receiver~~	~~1. Liquid carryover into instrument air~~	~~1. Local level gauge and transmitter with high level alarm, and ability to manually drain water~~				NOTE: Superseded by Vendor HAZOP Node 8.
6. Low Level / Empty	1. No issues identified						
7. High Pressure	1. No additional issues identified						
8. Low Pressure	~~1. Drain valve left open on air receiver~~	~~1. Insufficient pressure in air receiver~~	~~1. Low pressure alarm on air receiver with control to compressor to increase output~~	89. Consider spring return valve on instrument air receiver drain connection.	Alex Lovell	30-Jun-22	NOTE: Superseded by Vendor HAZOP Node 8. Action 89 is no longer applicable, as the air receiver now has an auto-drain.
	~~2. Air leaks from system~~	~~1. Insufficient pressure in air receiver~~	~~1. Low pressure alarm on air receiver with control to compressor to increase output~~				NOTE: Superseded by Vendor HAZOP Node 8.
9. High Temperature	1. No issues identified						

Node: 9. Instrument/Utility Air: Distribution System (Due to change in vendor package boundary, relevant detail amalgamated into Node 8.)

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0006_RL; PKGT-LOG-ORF-PRO-PAIA-0012

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
10. Low Temperature	~~1. Failure of refrigerant dryer temperature control~~	~~1. instrument air receiver below design temperature resulting in potential failure~~		90. Confirm dryer package has low temperature protection, and discharge temperature indication to SCADA	Alex Lovell	16-Jan-23	NOTE: Superseded by Vendor HAZOP Node 8. Action 90 is no longer applicable, as package has been reviewed in Node 8.
	~~2. Depressuring instrument air receiver~~	~~1. Low temperature due to excessive depressuring rate~~	~~1. RO on vent line~~	92. Consider reducing minimum design temperature for receiver from 0°C (without change in material) to reduce reliance on low temperature instrumented protections and limitation on vessel blowdown rates.	Alex Lovell	30-Jun-22	NOTE: Superseded by Vendor HAZOP Node 8. Action 92 has been addressed, and MDMT of the air receiver has been lowered.
11. Phase Change	~~1. Failure of refrigerant dryer~~	~~1. Moisture carryover to instrument air receiver with high dew point IA~~	~~1. Liquid drop out in instrument air receiver~~				NOTE: Superseded by Vendor HAZOP Node 8.
12. Mixing	1. No issues identified						
13. Reaction	1. No issues identified						
14. Concentration / Composition	1. No additional issues identified						
15. Contamination / Impurities	~~1. Oil contamination from instrument air compressors~~	~~1. No impact within this node~~					NOTE: Superseded by Vendor HAZOP Node 8.
	~~2. Saltwater spray ingress to instrument air compressors~~	~~1. No impact within this node~~					NOTE: Superseded by Vendor HAZOP Node 8.
16. Materials Of Construction	~~1. P&ID indicates gauge glass on instrument air receiver~~			91. Confirm requirement for level gauge, and materials of construction given design pressure of instrument air receiver	Alex Lovell	30-Jun-22	NOTE: Superseded by Vendor HAZOP Node 8. Action 91 is no longer applicable. There is no level gauge on the air receiver.
17. First Start-Up / Commissioning	~~1. Level transmitter cannot be commissioned with instrument air receiver due to absence of liquid in system~~			93. Ensure level transmitter is commissioned separate from instrument air receiver, or specify alternate means of inferring level /absence of free water in instrument air receiver.	Alex Lovell	30-Jun-22	NOTE: Superseded by Vendor HAZOP Node 8. Action no longer relevant – there is no longer a level transmitter on the instrument air receiver.
18. Start-Up /Partial Start-Up	1. No additional issues identified						
19. Shutdown	1. Refer hazards regarding depressuring instrument air receiver						
20. Control & Instrumentation	~~1. PIT upstream and downstream of PCV-054004 indicated as providing signal to compressor package~~	~~1. Potential for control system fighting~~		94. Provide pressure control from air receiver PIT only, with alarm on PIT downstream of PCV-054004.	Alex Lovell	30-Jun-22	NOTE: Superseded by Vendor HAZOP Node 8. Action 94 is no longer applicable, as package has been reviewed in Node 8.
21. Electrical / Ignition	1. No issues identified						
22. Utilities / Services	1. No issues identified						
23. Maintenance - Testing / Isolation Requirements	~~1. Inability for internal inspection of instrument air receiver with ORF in operation~~			95. Provide by-pass around instrument air receiver to allow for isolation and inspection.	Alex Lovell	30-Jun-22	NOTE: Superseded by Vendor HAZOP Node 8. Action has been moved to Node 8.
24. Access	1. No issues identified						

Node: 9. Instrument/Utility Air: Distribution System (Due to change in vendor package boundary, relevant detail amalgamated into Node 8.)

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0006_RL; PKGT-LOG-ORF-PRO-PAIA-0012

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
25. Sampling	1. No issues identified						
26. Miscellaneous	1. No issues identified						
27. General Comments	1. No issues identified						

Node: 11. Diesel Fuel Supply

Design Conditions/Parameters: Fluid: Diesel

Max / Operating Pressure: 1MPag / TBC pending pump selection

Max / Operating Temperature: 65degC / Ambient

470 litre diesel storage tank dedicated to each firewater pump. Tanks are double walled, with local filling, level indication, and an atmospheric vent. 2 penetrations in the bottom of the tank (outlet and drain line), with tank sitting over drip tray.

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0008

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
1. High Flow	~~1. Valve to day tank left open~~	~~1. Potential overfill of day tank leading to overflow~~	~~1. Local level indication on diesel storage tank~~	48. Determine potential for diesel storage tank to self-drain towards fire water pump day tanks, and provide additional controls if required.	Alex Lovell	30-Jun-22	POST HAZOP NOTE: Action no longer relevant, as there is no longer diesel storage and distribution at site.
			~~2. High level alarm at SCADA with ability to remotely stop pump~~				
	~~2. Excessive filling rate to diesel storage tank~~	~~1. Potential overpressure of tank~~	~~1. Vent and overflow provide overpressure relief path~~	49. Confirm vent and overflow on diesel storage tank and day tanks are designed in accordance with AS 1940 and indicate dimensions on P&ID.	Alex Lovell	30-Jun-22	POST HAZOP NOTE: Action no longer relevant, as there is no longer diesel storage and distribution at site.
	3. Excessive filling rate to fire water pump day tanks	1. Potential overpressure of tank	1. Vent and open connection for filling provide overpressure relief path				
		2. Insufficient time to stop filling when high level indication of tank is reached	2. Bowser connection is used which will automatically stop flow when tank is full				
	~~4. PSV-086001 spuriously opens~~	~~1. Excessive recycle resulting in insufficient forward flow~~	~~1. Day tank filling is a local, manual operation. Slow increase in level will provide indication of issue.~~	50. Provide local level indication on fire water pump day tanks.	Alex Lovell	30-Jun-22	POST HAZOP NOTE: Cause is no longer applicable, however noted the action to provide local level indication on firewater pump day tanks has been implemented.
	~~5. Pump seal failure~~	~~1. Loss of containment of diesel, environmental incident and potential fire~~	~~1. Pump located in bunded area~~	51. Confirm diesel transfer pump isolation valves are accessible from outside of bunded area. In particular the inlet valve.	Alex Lovell	30-Jun-22	POST HAZOP NOTE: Cause is no longer applicable as diesel storage and pump removed from scope. Action 51 is no longer applicable. Actions 61 & 62 are to be addressed in the context of the firewater pump tanks.
			~~2. Local operation of pump will allow for detection of seal failure~~	61. Ensure diesel installation complies with all relevant components of AS 1940. Including requirement for fire extinguishers etc.	Alex Lovell	30-Jun-22	

Node: 11. Diesel Fuel Supply

Design Conditions/Parameters: Fluid: Diesel

Max / Operating Pressure: 1MPag / TBC pending pump selection

Max / Operating Temperature: 65degC / Ambient

470 litre diesel storage tank dedicated to each firewater pump. Tanks are double walled, with local filling, level indication, and an atmospheric vent. 2 penetrations in the bottom of the tank (outlet and drain line), with tank sitting over drip tray.

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0008

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
			~~3. Site ignition controls, noting storage tank is located in a non-hazardous area~~ ~~4. Manual call point in utilities area~~	62. Confirm hazardous area requirements for diesel storage area.	Alex Lovell	30-Jun-22	
2. Low Flow	1. No issues identified						
3. No Flow	~~1. Operator fails to stop diesel transfer pump following filling of day tank~~	~~1. Pumps to continue to run with no flow leading to pump damage (seals) and potential LOC~~	~~1. Remote stop however unlikely remote operator would be running against blocked discharge~~	52. Consider alarm on extended running of diesel transfer pump.	Kevin Bourke	20-Jan-23	POST HAZOP NOTE: Cause is no longer applicable as diesel storage and pump removed from scope. Actions 52 and 53 are no longer applicable.
				53. Ensure local start/stop accessible from outside of bunded area.	Alex Lovell	30-Jun-22	
	~~2. Diesel transfer pump failure~~	~~1. Inability to fill day tanks~~	~~1. Day tanks are filled infrequently allowing time for pump replacement or repair~~	57. Consider additional fill point downstream of diesel transfer pump to allow direct filling of day tanks via truck.	David Miller	30-Jun-22	POST HAZOP NOTE: Cause is no longer applicable as diesel storage and pump removed from scope. Action 57 is no longer applicable.
	3. Refer Node 7 for fire water pump failure to run due to closure of valves from diesel tank						
4. Reverse Flow	~~1. Siphoning of diesel storage tank fill line~~	~~1. Loss of containment of diesel, environmental incident and potential fire~~	~~1. NRV in fill line~~ ~~2. Two manual valves~~	58. Confirm that hose fill connection will release within bunded area	Alex Lovell	30-Jun-22	POST HAZOP NOTE: Cause is no longer applicable as diesel storage and pump removed from scope. Action 58 is no longer applicable.
	~~2. Disconnection of transfer hose~~	~~1. Loss of containment of diesel from upstream of manual block valve, or upstream of NRV if valves are not closed prior to disconnection~~		59. Include note on P&ID for minimum distance between camlock, block valves and NRV.	Alex Lovell	30-Jun-22	POST HAZOP NOTE: Cause is no longer applicable as diesel storage and pump removed from scope. Action 59 is no longer applicable.
	~~3. Reverse flow diesel day tanks to diesel storage tank~~	~~1. Insufficient storage in day tanks for required fire water pump operation duration~~	~~1. NRV downstream of transfer pump~~				POST HAZOP NOTE: Cause is no longer applicable as diesel storage and pump removed from scope.
5. High Level / Overflow	~~1. Truck driver error~~	~~1. Loss of containment of diesel, environmental incident and potential fire~~	~~1. Local level gauge (visible from truck filling point)~~ ~~2. Local level indication on diesel storage tank (visible from truck filling point)~~ ~~3. Dedicated overflow to grade~~	60. Ensure installation complies with all relevant components of AS 1940.	Alex Lovell	30-Jun-22	POST HAZOP NOTE: Cause is no longer applicable as diesel storage and pump removed from scope. Action 60 to be addressed in the context of the firewater pump diesel tanks.

Node: 11. Diesel Fuel Supply

Design Conditions/Parameters: Fluid: Diesel

Max / Operating Pressure: 1MPag / TBC pending pump selection

Max / Operating Temperature: 65degC / Ambient

470 litre diesel storage tank dedicated to each firewater pump. Tanks are double walled, with local filling, level indication, and an atmospheric vent. 2 penetrations in the bottom of the tank (outlet and drain line), with tank sitting over drip tray.

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0008

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
			~~4. High level alarm at SCADA. Local operator will be present with comms with control room~~ ~~5. Normal fill level is below total tank capacity (95%)~~				
	~~2. Spurious reading on level indicator~~	~~1. Loss of containment of diesel, environmental incident and potential fire~~	~~1. Local level gauge (visible from truck filling point)~~ ~~2. Dedicated overflow to grade~~				POST HAZOP NOTE: Cause is no longer applicable as diesel storage and pump removed from scope.
	~~3. Operator error~~	~~1. Potential overfill of day tank leading to overflow~~	~~1. Local level indication on diesel storage tank~~ ~~2. High level alarm at SCADA with ability to remotely stop pump~~	63. Indicate diesel day tanks are within bunded area. 64. Provide overflow on day tanks.	Alex Lovell Alex Lovell	30-Jun-22 30-Jun-22	POST HAZOP NOTE: Cause is no longer applicable as diesel storage and pump removed from scope. Actions 63 and 64 are no longer applicable.
	4. Spurious reading on level indicator (day tank)	1. Loss of containment of diesel, environmental incident and potential fire	1. Local filling of diesel tanks 2. Bowser connection is used which will automatically stop flow when tank is full 3. Operator trigger on bowser 4. Drip tray under diesel tank	65. Ensure diesel day tanks have external local level gauge.	Alex Lovell	30-Jun-22	VENDOR HAZOP NOTE. Action 65 was in the context of day tank filling via a pump from a larger storage tank on site. With local filling via a bowser connection with automatic cut-out, it was agreed in the vendor HAZOP that an external local level gauge is not required.
6. Low Level / Empty	~~1. Leak from storage tank and associated equipment~~	~~1. Loss of containment of diesel, environmental incident and potential fire~~	~~1. Storage tank and bund located in bunded area~~ ~~2. Low level alarm~~ ~~3. Local level gauge~~	54. Include storage tank bunded area in CCTV coverage 55. Indicate low point / sump in bund with slope to sump for draining on P&ID.	Alex Lovell Alex Lovell	30-Jun-22 30-Jun-22	POST HAZOP NOTE: Cause is no longer applicable as diesel storage and pump removed from scope. Actions 54 and 55 are no longer applicable.

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Node: 11. Diesel Fuel Supply

Design Conditions/Parameters: Fluid: Diesel

Max / Operating Pressure: 1MPag / TBC pending pump selection

Max / Operating Temperature: 65degC / Ambient

470 litre diesel storage tank dedicated to each firewater pump. Tanks are double walled, with local filling, level indication, and an atmospheric vent. 2 penetrations in the bottom of the tank (outlet and drain line), with tank sitting over drip tray.

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0008

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
	2. Leak from day tank	1. Loss of containment of diesel, environmental incident and potential fire	1. Low level alarm. Refer Action 50.	66. Ensure low level set point on day tanks include sufficient diesel for 4hrs run time	Kevin Bourke	30-Oct-22	
		2. Insufficient storage in day tanks for required fire water pump operation duration	2. Double walled tank (however, tank outlet and drain are from bottom of tank)	136. Provide spill kit in fire water pump house.	Steele Johnson	15-Aug-23	
			3. Routine tank maintenance	137. Confirm ability to inspect interstitial space in tank walls to determine leak from inner wall.	David Miller	15-Jul-23	
				138. Develop procedures for checking double walled tank for internal leaks.	Steele Johnson	15-Aug-23	
	3. Failure to undertake top up of diesel tanks	1. Insufficient storage in day tanks for required fire water pump operation duration	1. Low level alarm. Refer Action 50.				
7. High Pressure	1. Solar gain on shut in liquid line	1. Overpressure leading to flange leaks. Not considered credible as LO path between diesel tank and fire water pump engine.					
	2. Blocked tank vent when filling	1. Overpressure of tank. Not considered credible as tank is locally filled via open nozzle.					
8. Low Pressure	1. Blocked tank vent when discharging	1. Vacuum in tank leading to damage	1. 3 x 50% fire pumps (redundancy)				
		2. Potential inadequate diesel flow					
9. High Temperature	1. Diesel storage exposed to solar radiation	1. Accelerated degradation of diesel and excessive vapour discharge via vent	1. Tank are located under a roof				
10. Low Temperature	1. No issues identified						
11. Phase Change	1. No issues identified						
12. Mixing	1. No additional issues identified						
13. Reaction	1. No additional issues identified						

Node: 11. Diesel Fuel Supply

Design Conditions/Parameters: Fluid: Diesel

Max / Operating Pressure: 1MPag / TBC pending pump selection

Max / Operating Temperature: 65degC / Ambient

470 litre diesel storage tank dedicated to each firewater pump. Tanks are double walled, with local filling, level indication, and an atmospheric vent. 2 penetrations in the bottom of the tank (outlet and drain line), with tank sitting over drip tray.

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0008

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
14. Concentration / Composition	1. Degradation of diesel fuel over time	1. Inability to run diesel engines or blockage	1. Monthly pump testing will result in turnover of diesel storage 2. Annual visual check of diesel fuel as part of certification	67. Consider removal of diesel storage tank T-101 with each day tank filled via dedicated fill line. Ensure sufficient capacity in day tanks such that top up not required after each monthly test.	David Miller	30-Jul-22	VENDOR HAZOP NOTE::Original recording was in the context of a large diesel storage on site. Whilst the cause remains relevant, the issue is significantly reduced through use of smaller diesel storages. Action 67 has been implemented, and is no longer relevant in the context of the present design.
	2. Incorrect diesel (fire water pump vendor typically do not recommend bio diesel or bio diesel blend)	1. Potential damage to fire water pumps		69. Confirm diesel specification for fire water pumps.	Alex Lovell	16-Jan-23	
15. Contamination / Impurities	1. Water ingress to storage tank	1. Acceleration degradation and/or microbial contamination of diesel	1. Desiccant breather on storage tank vent	68. Confirm means of preventing tank breathing via overflow line during normal operation	Alex Lovell	30-Jun-22	POST HAZOP NOTE: Firewater tanks do not have an overflow line. Action 68 is no longer applicable.
	~~2. Saltwater spray ingress to storage tank~~	~~1. Potential degradation of diesel~~		70. Confirm with vendor specific control requirements with respect to degradation of diesel, given marine environment.	Alex Lovell	16-Jan-23	POST HAZOP NOTE: Cause related to the site diesel storage tank, which has been removed from scope. Firewater day tanks are not considered to be vulnerable to salt water sprays. Actions 70 & 71 are no longer applicable.
				71. Indicate cap on camlock fitting on hose fill line on P&ID.	Alex Lovell	30-Jun-22	
16. Materials Of Construction	1. No issues identified						
17. First Start-Up / Commissioning	1. No issues identified						
18. Start-Up /Partial Start-Up	1. No issues identified						
19. Shutdown	1. No additional issues identified						
20. Control & Instrumentation	1. No additional issues identified						
21. Electrical / Ignition	1. P&ID does not presently indicate earthing connections for trucks involved in diesel tank filling, or bund pump-out	1. Potential for un-earthed vehicle to provide an ignition source		56. Ensure earthing strap at tanker filling, and drain point (note this could be the same point) depending on location.	Alex Lovell	30-Jun-22	VENDOR HAZOP NOTE: Confirm if action remains relevant for fire water diesel tanks, considering potential for static generation on filling.
	2. Top filling of diesel tanks	1. Potential for static generation	1. Anti-static chemical (STADIS) added to diesel by suppliers				
22. Utilities / Services	1. No issues identified						

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Node: 11. Diesel Fuel Supply

Design Conditions/Parameters: Fluid: Diesel

Max / Operating Pressure: 1MPag / TBC pending pump selection

Max / Operating Temperature: 65degC / Ambient

470 litre diesel storage tank dedicated to each firewater pump. Tanks are double walled, with local filling, level indication, and an atmospheric vent. 2 penetrations in the bottom of the tank (outlet and drain line), with tank sitting over drip tray.

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0008

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
23. Maintenance - Testing / Isolation Requirements	~~1. Potential requirement to clean level gauge sight glass~~			72. Ensure valving provided to allow for sight glass cleaning or provide magnetic level reading.	Alex Lovell	30-Jun-22	POST VENDOR HAZOP NOTE: Agreed that due to change in filling, level gauge no longer required on firewater diesel tanks. Action 72 no longer applicable.
24. Access	1. Requirement to change desiccant in tank vents			73. Confirm vent access and frequency of change out required.	Alex Lovell	30-Jun-22	
	2. Height of fill connection on diesel tank (~1.6m above grade)	1. Difficulty manually filling tank		139. Confirm access requirements e.g. step up, for tank filling.	David Miller	15-Jul-23	
25. Sampling	1. No issues identified - drain valves on storage tank and pump suction allow for sampling ~~however valves are 2"~~			74. Review size requirement valve on diesel transfer pump inlet (presently 2", however smaller valve would be advantageous for sampling).	Alex Lovell	30-Jun-22	POST VENDOR HAZOP NOTE: Action related to drain valves on the diesel storage, which has since been removed. Drain valves on the firewater pump tanks are ~ ½", and are considered appropriate for sampling. Action 74 no longer applicable.
26. Miscellaneous	1. No issues identified						
27. General Comments	1. No issues identified			140. Indicate fill point connection type on diesel tank.	David Miller	15-Jul-23	

Node: 12. Potable Water

Design Conditions/Parameters: Fluid: Potable water

Max / Operating Pressure: TBC to be advised by water authority

Max / Operating Temperature: Ambient

Flowrate: As supplied by water authority

HDPE below ground, SS above ground.

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0011

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
1. High Flow	1. No issues identified						
2. Low Flow	1. Potential blockages in safety showers through infrequent use	1. Insufficient flow to safety shower		75. Confirm schedule for safety shower testing.	Alex Lovell	30-Mar-23	
3. No Flow	1. Town water supply unavailable	1. Inability to use safety showers on site and loss of amenities	1. Not normally manned site with infrequent chemical deliveries	76. Develop procedure for planned or unplanned loss of water supply.	Alex Lovell	30-Mar-23	
				77. Consider means to detect loss of town water supply (downstream of VF-1137).	Kevin Bourke	30-Oct-22	

Node: 12. Potable Water

Design Conditions/Parameters: Fluid: Potable water
Max / Operating Pressure: TBC to be advised by water authority
Max / Operating Temperature: Ambient
Flowrate: As supplied by water authority
HDPE below ground, SS above ground.

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0011

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
	2. Manual valve closed	1. Inability to use safety showers on site and loss of amenities	1. Flow path to critical users (safety showers) are locked open	78. Consider locking open VF-1137 on town water supply	Alex Lovell	30-Sep-22	
4. Reverse Flow	1. Reverse flow from water system to town water	1. Contamination of town water supply		79. Provide additional back flow prevention / RPZ at Sydney water to AIE interface	Alex Lovell	30-Jun-22	
	2. Reverse flow from fire water to potable water system covered in Node 6.			80. Consider removal of RPZ on fire water line due to provision of air break in fire water tanks.	Alex Lovell	30-Jun-22	
	3. Flow from FSRU into potable water system	1. Potential contamination due to incorrect connection on FSRU e.g. grey water system		81. Provide NRV/RPZ on line to FSRU.	Alex Lovell	30-Jun-22	
5. High Level / Overflow	1. Not applicable						
6. Low Level / Empty	1. Not applicable						
7. High Pressure	1. No issues identified						
8. Low Pressure	1. Low town mains pressure	1. Insufficient flow to safety shower		82. Confirm town mains supply pressure is suitable for safety shower requirements	David Miller	30-Oct-22	
		2. PSH may not indicate activation of safety shower					
	2. Damage to safety shower head (corrosion)	1. PSH may not indicate activation of safety shower	1. Regular testing of safety showers				
9. High Temperature	1. Solar gain on shut in liquid line	1. Potential hot water discharge from safety showers	1. Lines run underground to extent practical	83. Review requirement for insulation of exposed above ground lines to safety showers	Alex Lovell	30-Jun-22	
			2. Anti-scald valve on safety showers	84. Update Note 3 on P&ID to specify minimisation of above ground piping to safety showers.	Alex Lovell	30-Jun-22	
	2. Discharge from anti scald valve	1. Potential burns to persons in area		85. Ensure discharge from anti-scald valve to safe location	Alex Lovell	30-Jun-22	
10. Low Temperature	1. No issues identified						
11. Phase Change	1. No issues identified						
12. Mixing	1. No issues identified						
13. Reaction	1. No issues identified						
14. Concentration / Composition	1. No issues identified						

Node: 12. Potable Water

Design Conditions/Parameters: Fluid: Potable water

Max / Operating Pressure: TBC to be advised by water authority

Max / Operating Temperature: Ambient

Flowrate: As supplied by water authority

HDPE below ground, SS above ground.

Drawing / Reference: PKGT-LOG-ORF-PRO-PAIA-0011

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
15. Contamination / Impurities	1. Refer previous hazards regarding reverse flow from FSRU						
16. Materials Of Construction	1. SS to CS interface	1. Galvanic corrosion		86. Review requirement for insulating gaskets and bolts at SS to CS interface.	Alex Lovell	30-Jun-22	
				87. Indicate SS to CS interface downstream of RPZ to fire water tanks, and HDPE interface upstream.	Alex Lovell	30-Jun-22	
17. First Start-Up / Commissioning	1. No issues identified						
18. Start-Up /Partial Start-Up	1. No issues identified						
19. Shutdown	1. No issues identified						
20. Control & Instrumentation	1. No additional issues identified						1. Recommendation #76 raised regarding indicating loss of water supply.
21. Electrical / Ignition	1. No issues identified						
22. Utilities / Services	1. No issues identified						
23. Maintenance - Testing / Isolation Requirements	1. No issues identified						
24. Access	1. No issues identified						
25. Sampling	1. No issues identified						
26. Miscellaneous	1. No issues identified						
27. General Comments	1. No issues identified						

Node: 13. Drain System

Design Conditions/Parameters: Fluid: Oily Water

Drawing / Reference: PKGT-LOG-ORF-CIV-DGA-1002-0004; PKGT-LOG-ORF-CIV-DGA-1002-0005; PKGT-LOG-ORF-CIV-DGA-1002-0006; PKGT-LOG-ORF-CIV-DGA-1002-0007; PKGT-LOG-ORF-CIV-DGA-1002-0008

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
1. High Flow	1. System demand rate exceeds design capacity from either severe weather event or firewater system testing	1. Localised flooding onsite 2. Potential discharge of off-spec water from site	1. System designed to accommodate peak storm conditions 2. Housekeeping to ensure spilled oils are cleaned up in a timely manner 3. Firewater monitoring testing within the capacity of the system	126. Develop procedures for routine inspection and maintenance of Ecoceptors and baffle boxes. Also include means of determining level of silt deposition and requirements for replacement of baffle box skimmer/sponge.	Steele Johnson	15-Aug-23	1. It is not expected that firewater will be contained when both monitors are discharging in an emergency event.
2. Low Flow	1. High tide	1. Insufficient relative height difference between discharge point and tide level. Potential reverse flow into baffle box of settlement ponds with potential for localised flooding	1. Specification of discharge elevation with consideration of extreme high tide levels	125. Confirm discharge elevation is above highest astronomical tide level.	Lars Aarekol	15-Jul-23	
	2. Partial blockage within drain system	1. Localised flooding onsite 2. Potential discharge of off-spec water from site	1. Limited free material onsite with hard stand surface 2. Localised inspection points to enable maintenance and cleaning 3. Removable grating over trench drain				
	3. Blockage within baffle box	1. Localised flooding onsite 2. Potential discharge of off-spec water from site	1. Removal hatches on baffle boxes allow for removal of accumulated material				
	4. Blockage of gully pit	1. Carryover of particulate matter into ponds	1. Removable cover on gully pit chamber allows for removal of accumulated material				
	5. Blockage of pond overflows e.g. plastic bag	1. Overflow of pond, potential discharge of off-spec water	1. Large diameter of overflow pipework limits potential for blockage 2. Regular inspection regime of ponds	127. Assess requirement to provide coarse screen for overflow pipes.	David Miller	15-Jul-23	
3. No Flow	1. Malicious activity blocking discharge at northern or southern end of drainage system	1. Localised flooding onsite 2. Potential discharge of off-spec water from site	1. Two separate discharge points on southern pond, either point can be used to discharge from both ponds 2. Ability to pump water over top of revetment 3. Northern discharge point is at height relative to water level and is in secure location				1. Northern drainage discharge point is believed to be within the perimeter of CCTV coverage.

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Node: 13. Drain System

Design Conditions/Parameters: Fluid: Oily Water

Drawing / Reference: PKGT-LOG-ORF-CIV-DGA-1002-0004; PKGT-LOG-ORF-CIV-DGA-1002-0005; PKGT-LOG-ORF-CIV-DGA-1002-0006; PKGT-LOG-ORF-CIV-DGA-1002-0007; PKGT-LOG-ORF-CIV-DGA-1002-0008

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
4. Reverse Flow	1. Refer High Tide						
	2. Localised flooding on coal terminal flows onto site	1. Insufficient water treatment capability for potential pollutants from coal terminal leading to discharge off-spec water	1. Coordinated response between site and coal terminal for incidents that involve localised flooding				
			2. Adjacent coal terminal site is subjected to environmental discharge conditions license, and has similar obligations for management of water run off emanating from site				
5. High Level / Overflow	1. Spill of hydraulic oil / seal oil at gangway / MLAs / air compressor	1. Oil enters drainage system, potential for discharge from site	1. Integral bunding of hydraulic units may contain a portion of the spill	128. Consider additional provisions for oil skimming at southern pond.	David Miller	15-Jul-23	
			2. Ecoceptors between potential oil spill locations and trough drain, hydrocarbon capacity 1200L				
			3. Skimmer on baffle box				
			4. Ability to skim oil transferred to settlement ponds				
	2. Failure to maintain Ecoceptors	1. Accumulation of oil beyond design capacity leading to loss of separation performance and excessive discharge of oil to baffle box or ponds	1. Routine inspection and maintenance of Ecoceptors				
		2. Build-up of silt in Ecoceptors leading to solids carryover					
	3. Failure to maintain baffle box skimmer	1. Accumulation of oil in baffle box leading to discharge	1. Routine inspection and maintenance				
6. Low Level / Empty	1. Failure of pond liner	1. Potential contamination of surrounding land and failure to discharge via specified discharge point	1. Two ponds with the ability to isolate either pond for maintenance				
			2. Routine inspection and maintenance of ponds				
7. High Pressure	1. No causes identified						
8. Low Pressure	1. No causes identified						
9. High Temperature	1. No causes identified						
10. Low Temperature	1. No causes identified						
11. Phase Change	1. No causes identified						

Node: 13. Drain System

Design Conditions/Parameters: Fluid: Oily Water

Drawing / Reference: PKGT-LOG-ORF-CIV-DGA-1002-0004; PKGT-LOG-ORF-CIV-DGA-1002-0005; PKGT-LOG-ORF-CIV-DGA-1002-0006; PKGT-LOG-ORF-CIV-DGA-1002-0007; PKGT-LOG-ORF-CIV-DGA-1002-0008

Guideword	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility	End Date	Comments
12. Mixing	1. High flow rate into pond	1. Potential for insufficient settlement of solids leading to off-spec discharge	1. Ability to dose pond to aid flocculation				
			2. Routine testing of water to confirm discharge spec is being met				
13. Reaction	1. No causes identified						
14. Concentration / Composition	1. Discharge of firefighting foam onsite	1. Potential to enter drainage system, impacting ability to separate oil and water	1. Use of foam onsite restricted to the extent practicable, only portable extinguishers used				
	2. Removal of sediment from baffle boxes, Ecoceptors or ponds	1. Personnel exposure to contaminants of concern e.g. heavy metals or potential toxins (legacy issue due to previous site usage)	1. Use of qualified contractors for removal of sediment and disposal at an appropriate location, following testing	129. Develop suitable procedures for management of sediment, noting potential contaminants.	Steele Johnson	15-Aug-23	
		2. Potential inappropriate disposal of sediment					
15. Contamination / Impurities	1. Refer Concentration / Composition						
16. Materials Of Construction	1. No causes identified						
17. First Start-Up / Commissioning	1. No causes identified						
18. Start-Up /Partial Start-Up	1. No causes identified						
19. Shutdown	1. No causes identified						
20. Control & Instrumentation	1. No causes identified						
21. Electrical / Ignition	1. No causes identified						
22. Utilities / Services	1. No causes identified						
23. Maintenance - Testing / Isolation Requirements	1. Refer maintenance of pond liners.						
	2. Baffle box elements can be maintained online.						
24. Access	1. No causes identified						
25. Sampling	1. No additional causes						
26. Miscellaneous	1. No additional causes						
27. General Comments	1. Note: The galleon deck drain system does not discharge any water into the shore based systems directly or indirectly and has not been considered as part of this review.						

Appendix C. HAZOP Guidewords

GUIDEWORDS

- High Flow
- Low Flow
- No Flow
- Reverse Flow
- High Level / Overflow
- Low Level / Empty

- High Pressure
- Low Pressure
- High Temperature
- Low Temperature
- Phase Change
- Mixing
- Reaction
- Concentration / Composition
- Contamination / Impurities
- Materials of Construction
- First Start-Up / Commissioning
- Start-Up / Partial Start-Up
- Shutdown
- Control and Instrumentation
- Electrical / Ignition
- Utilities / Services
- Maintenance - Testing / Isolation Requirements
- Access
- Sampling
- Miscellaneous
- General Comments

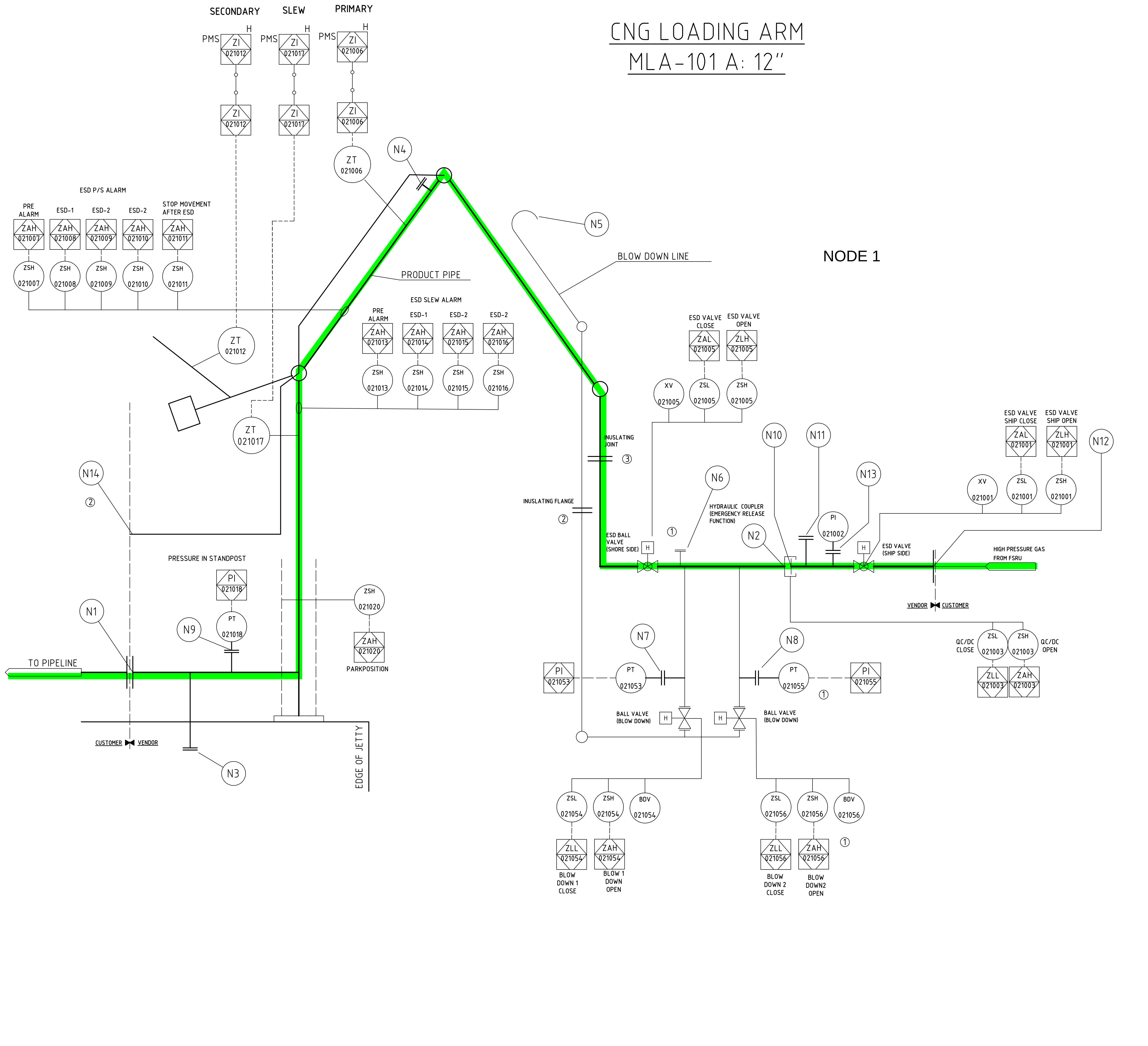
Overview Guidewords

- Emergency Response
- Emergency Shutdown
- Leaks / Ruptures
- Fire / Explosion Protection
- Hazardous Substances
- Environmental / Noise
- Operability / Reliability / Simplicity
- Meets Basis / Requirement Of Design
- Relief Requirements
- Safety Systems – Showers, Buttons
- Compatibility Of Materials / Chemicals
- Human Factors
- Miscellaneous

Appendix D. HAZOP Master P&IDs (Initial Studies)


INERT GAS DRY AIR PLANT
NITROGEN GENERATOR ROOM
ENGINE ROOM
PORT
STBD
DETAIL OF MANIFOLD SPILL TRAY
NOZZLE FOR CARGO JETTISON
GENERAL END CONNECTION FOR PURGING/SAMPLING/DRAIN (ONLY LIQUID LINE)
GENERAL END CONNECTION FOR PURGING/SAMPLING/DRAIN (EXCEPT LIQUID LINE)
NODE 1
LNG FEED HEADER
EMPTY VENT
CARGO VAPOUR
SPRAY MAIN
CARGO LIQUID
SUCTION DRUM MODULE
REGAS TRAIN 3
REGAS TRAIN 2
REGAS TRAIN 1
NO.4 TANK
NO.3 TANK
NO.2 TANK
NO.1 TANK
CARGO VALVE NUMBERING
CARGO SYSTEM

CNG LOADING ARM
MLA-101 A: 12"



REVIEWED, work may proceed
David Miller Nov 4 2021

Electrical Plan: M4734463-220 /
PKGT-EMC-BTH-ELE-SLD-0001

②

Hydraulical Plan: M4734463-230 /
PKGT-EMC-BTH-CIV-DWG-0002

LIST OF CONNECTIONS ON MARINE LOADING ARM

Stutzen Nr. *CONNECT'N NO.*	DN *SIZE*	PN *PRESSURE*	Dichtflaeche *FLANGE FACING*	Type *TYPE OF FLANGES*	Bemerkungen *REMARKS*
N1	12"	900 LBS.	W.N. R.F.	FLANGE	OUTLET FLANGE
N2	12"	-	-	SPECIAL FLANGE	HYDRAULIC COUPER (=EMERGENCY RELEASE COUPLER)
N3	2"	900 LBS.	W.N. R.F.	FLANGE + BLIND	PURGE CONNECTION AT RISER BOTTOM
N4	2"	900 LBS.	W.N. R.F.	FLANGE +BLIND	VENT (FOR PIPING PRESSURE TEST WITH FLUID)
N5	2"	-	-	OUTLET, OPEN PIPE	BLOW DOWN AND PURGE OUTLET TO ENVIROMENT
N6	2"	900 LBS.	W.N. R.F.	FLANGE +BLIND	MULTI FUNCTION NOZZLE
N7	1"	900 LBS.	W.N. R.F.	FLANGE + BLIND	FOR PRESSURE TRANSMITTER INCLUDING BLOCK AND BLEED VALVE
N8	1"	900 LBS.	W.N.-R.F.	FLANGE +BLIND	FOR PRESSURE TRANSMITTER INCLUDING BLOCK AND BLEED VALVE
N9	1"	900 LBS.	W.N. R.F.	FLANGE +BLIND	FOR PRESSURE TRANSMITTER INCLUDING BLOCK AND BLEED VALVE
N14	12x1.5 mm^2			OPEN PIPE	LEKAGE DETECTION LINE (SERIAL) FOR BASE-, FULCRUM- AND APEX SWIVEL

LIST OF CONNECTIONS ON SPOOL PIECE

Stutzen Nr. *CONNECT'N NO.*	DN *SIZE*	PN *PRESSURE*	Dichtflaeche *FLANGE FACING*	Type *TYPE OF FLANGES*	Bemerkungen *REMARKS*
N10	12"	-	-	SPECIAL FLANGE	COUNTERFLANGE FOR HYDRAULIC COUPLER
N11	2"	900 LBS.	W.N. R.F.	FLANGE +BLIND	MULTI FUNCTION NOZZLE
N12	16"	900 LBS.	W.N. R.T.J	FLANGE	CONNECTION TO SHIP PIPING
N13	1"	900 LBS.	W.N. R.F.	FLANGE	PRESSURE GAUGE MANOMETER INCLUDING BLOCK AND BLEED VALVE

LEGEND:
- ○ = FIELD INSTRUMENT
- ⋈ = BALL VALVE
- PT = PRESSURE TRANSMITTER
- PI = PRESSURE INDICATOR
- → = FLOW OF N2 DURING PURGING

PROPOSED NITROGEN VOLUME FOR PURGING:

Notes

1. EMERGENCY BLOW DOWN VALVES ARE TO OPEN BEFORE PRESSURE IS ABLE TO ESCAPE VIA THE QC/DC FLANGE.
2. ALL VALVES ARE FULL BORE.

MLA-101 A : 12" CNG (RH DESIGN)
MLA-101 B : 12" CNG (RH DESIGN)
MLA-101 C : 12" CNG FUTURE (LH DESIGN)

CUSOTMER DOC No.: PKGT-EMC-BTH-PIP-PID-0001 ①

EMCO WHEATON
A Gardner Denver Product

Emco Wheaton GmbH
35274 Kirchhain, Germany

REV	ÄNDERG.	DATUM
3	EMCO/CUST	05.10.2021
2	EMCO/CUST	22.09.2021
1	EMCO/CUST	14.09.2021

	DATUM	NAME
GEZ/ *DRN*		
GEP/ *CHD*	27.08.2021	akab
FORMAT/ *SIZE*	A1	

MATERIAL
GEWICHT */WEIGHT*

MASSTAB *SCALE* 1:1

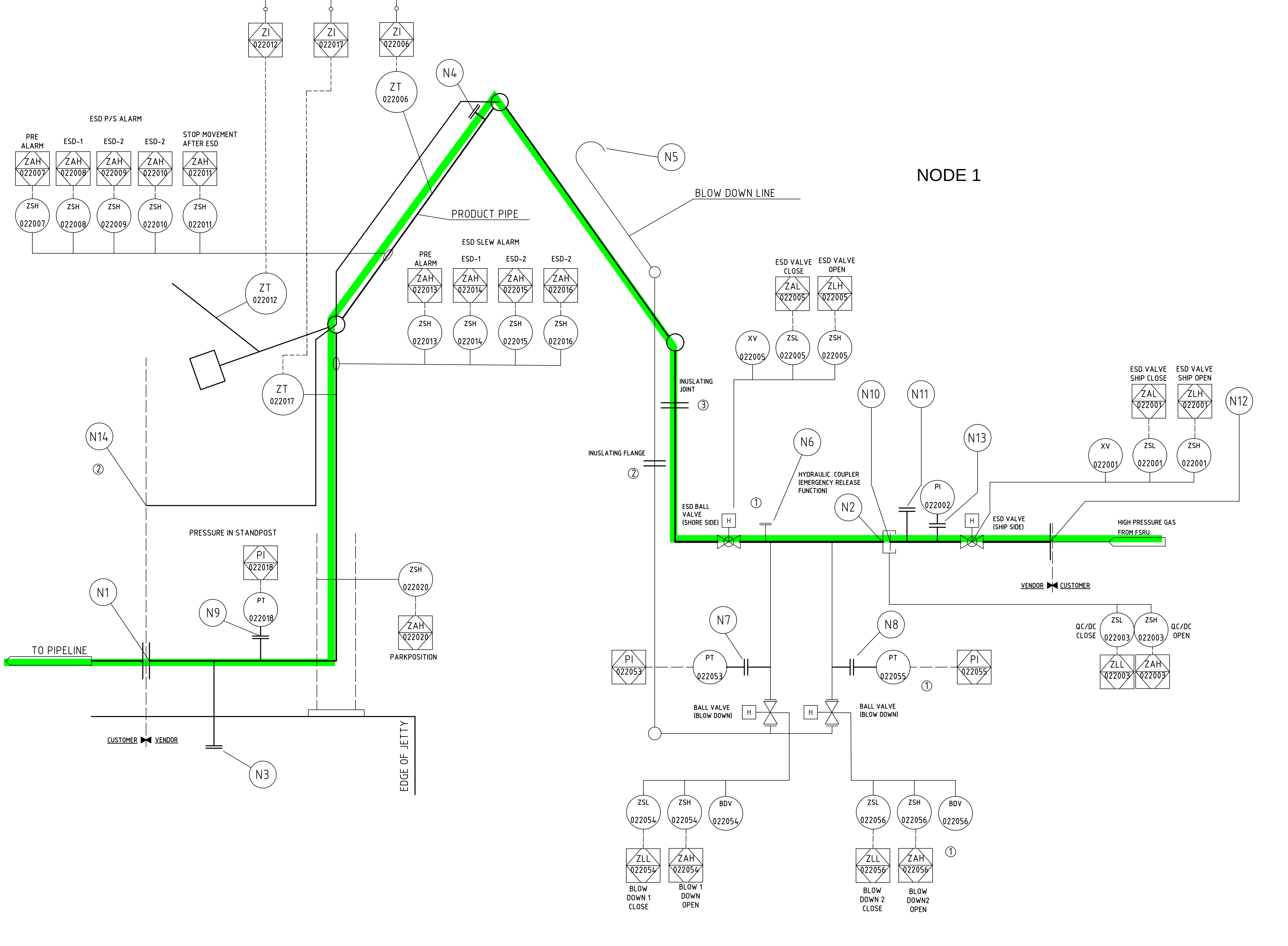
PIPING & INSTRUMENTATION DIAGRAM
CNG LOADING ARMS 12"
12" HP

ZEICHN.NR. */DRWG.NO.* M4734463-250

ERSATZ FÜR:
ENTST. AUS:

CNG LOADING ARM
MLA-101 B: 12"

REVIEWED, work may proceed
David Miller Nov 4 2021



Electrical Plan: M4734463-220 / PKGT-EMC-BTH-ELE-SLD-0001

② Hydraulical Plan: M4734463-230 / PKGT-EMC-BTH-CIV-DWG-0002

LIST OF CONNECTIONS ON MARINE LOADING ARM

Stutzen Nr. *CONNECT'N NO.*	DN *SIZE*	PN *PRESSURE*	Dichtflaeche *FLANGE FACING*	Type *TYPE OF FLANGES*	Bemerkungen *REMARKS*
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CUSOTMER DOC No.: PKGT-EMC-BTH-PIP-PID-0001 ①

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A Gardner Denver Product

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GEP/ *CHD*	27.08.2021	akab
FORMAT/ *SIZE*	A1	

MATERIAL

GEWICHT */WEIGHT*

MASSTAB *SCALE* 1:1

PIPING & INSTRUMENTATION DIAGRAM
CNG LOADING ARMS 12"

12" HP

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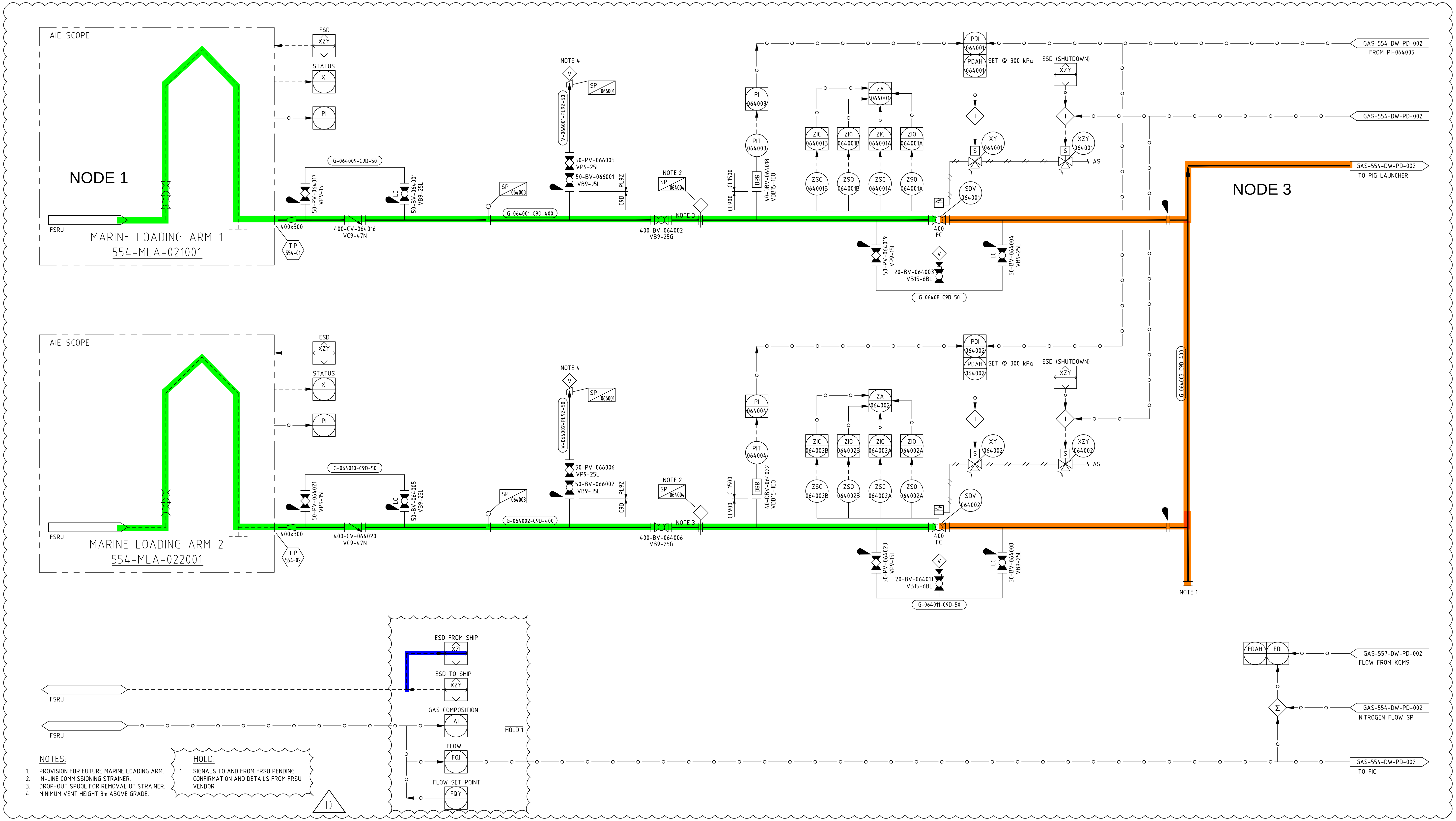


NOTES:

1. PROVISION FOR FUTURE MARINE LOADING ARM.
2. IN-LINE COMMISSIONING STRAINER.
3. DROP-OUT SPOOL FOR REMOVAL OF STRAINER.
4. MINIMUM VENT HEIGHT 3m ABOVE GRADE.

HOLD:

1. SIGNALS TO AND FROM FRSU PENDING CONFIRMATION AND DETAILS FROM FRSU VENDOR.

No	BY	CHKD	ENG	Q.A.	DATE	DESCRIPTION
D	JPR	SJH	PJB	NKH	11/01/22	ISSUED FOR REVIEW (210275)
C	JPR	SJH	PJB	NKH	30/08/21	ISSUED FOR REVIEW (210275)
B	AV	SJH	PJB	NKH	15/06/21	ISSUED FOR HAZOP (210275)
A	NJM	SJH	PJB	NKH	02/06/21	ISSUED FOR 30% DESIGN REVIEW

GPA ENGINEERING QA

DRAWING No.	REFERENCE DRAWINGS
GAS-554-DW-PD-002	PORT KEMBLA GAS TERMINAL - PORT KEMBLA PIPELINE PIG LAUNCHER - PID

ASSET MANAGER
Jemena
Produced by Jemena Asset Management (6) Pty Ltd ABN 52 104 352 650

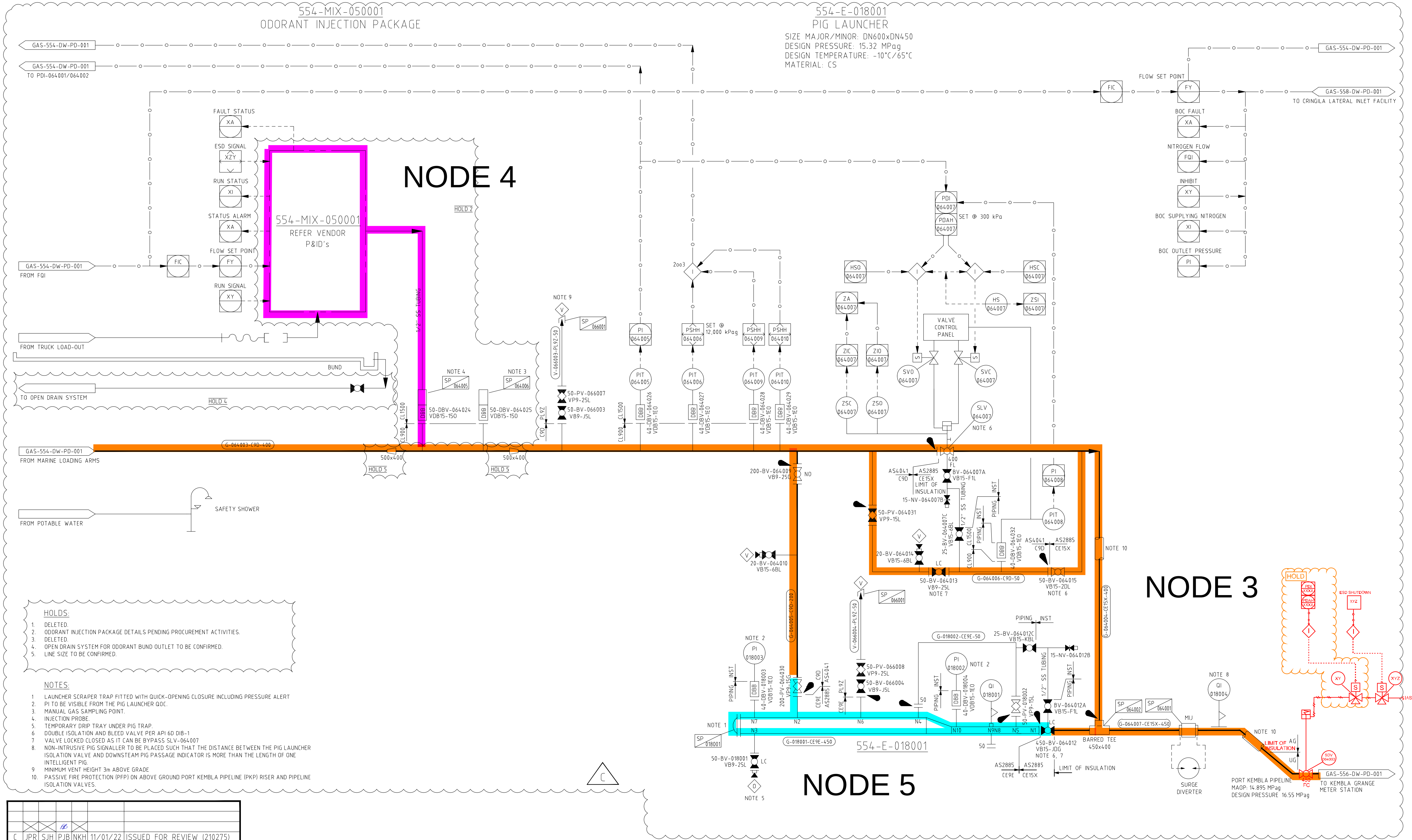
ASSET OWNER
Jemena
Jemena EGP(1) P/L ABN 15 068 570 847
Jemena EGP(2) P/L ABN 77 006 919 115

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPRV	CLIENT
D	11/01/22	ISSUED FOR REVIEW (210275)	GPA	SJH	NKH	
C	30/08/21	ISSUED FOR REVIEW (210275)	GPA	SJH	NKH	
B	15/06/21	ISSUED FOR HAZOP (210275)	GPA	SJH	NKH	
A	02/06/21	ISSUED FOR 30% DESIGN REVIEW (210275)	GPA	SJH	NKH	

CONSULTANT
GPA
www.gpaeng.com.au

PORT KEMBLA GAS TERMINAL
HP GAS TRANSFER
PIPING & INSTRUMENTATION DIAGRAM

DRAWN
DESIGN
CHECKED
APPROVED
DATE
FACILTY
SUBJECT
SCALE N.T.S.
SUPERSEDES
A1
DRAWING NUMBER GAS-554-DW-PD-001
REV D



HOLDS:

1. DELETED.
2. ODORANT INJECTION PACKAGE DETAILS PENDING PROCUREMENT ACTIVITIES.
3. DELETED.
4. OPEN DRAIN SYSTEM FOR ODORANT BUND OUTLET TO BE CONFIRMED.
5. LINE SIZE TO BE CONFIRMED.

NOTES:

1. LAUNCHER SCRAPER TRAP FITTED WITH QUICK-OPENING CLOSURE INCLUDING PRESSURE ALERT
2. PI TO BE VISIBLE FROM THE PIG LAUNCHER QOC.
3. MANUAL GAS SAMPLING POINT.
4. INJECTION PROBE.
5. TEMPORARY DRIP TRAY UNDER PIG TRAP.
6. DOUBLE ISOLATION AND BLEED VALVE PER API 6D DIB-1
7. VALVE LOCKED CLOSED AS IT CAN BE BYPASS SLV-064007
8. NON-INTRUSIVE PIG SIGNALLER TO BE PLACED SUCH THAT THE DISTANCE BETWEEN THE PIG LAUNCHER ISOLATION VALVE AND DOWNSTEAM PIG PASSAGE INDICATOR IS MORE THAN THE LENGTH OF ONE INTELLIGENT PIG.
9. MINIMUM VENT HEIGHT 3m ABOVE GRADE
10. PASSIVE FIRE PROTECTION (PFP) ON ABOVE GROUND PORT KEMBLA PIPELINE (PKP) RISER AND PIPELINE ISOLATION VALVES.

C	JPR	SJH	PJB	NKH	11/01/22	ISSUED FOR REVIEW (210275)
B	JPR	SJH	PJB	NKH	30/08/21	ISSUED FOR REVIEW (210275)
A	AV	SJH	PJB	NKH	15/06/21	ISSUED FOR HAZOP (210275)
No	BY	CHKD	ENG	Q.A.	DATE	DESCRIPTION

GPA ENGINEERING QA

DRAWING No.	REFERENCE DRAWINGS
GAS-554-DW-PD-001	PORT KEMBLA GAS TERMINAL - HP GAS TRANSFER - PID

ASSET MANAGER
Jemena
Produced by Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER
Jemena
Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPRV	CLIENT
D	01-FEB-22	REDLINE MARKUP FOR AIE HAZOP (NOT ISSUED) - BURIED PIPELINE ISOLATION VALVE ADDED				
C	11/01/22	ISSUED FOR REVIEW (210275)	GPA	SJH	NKH	
B	30/08/21	ISSUED FOR REVIEW (210275)	GPA	SJH	NKH	
A	15/06/21	ISSUED FOR HAZOP (210275)	GPA	SJH	NKH	

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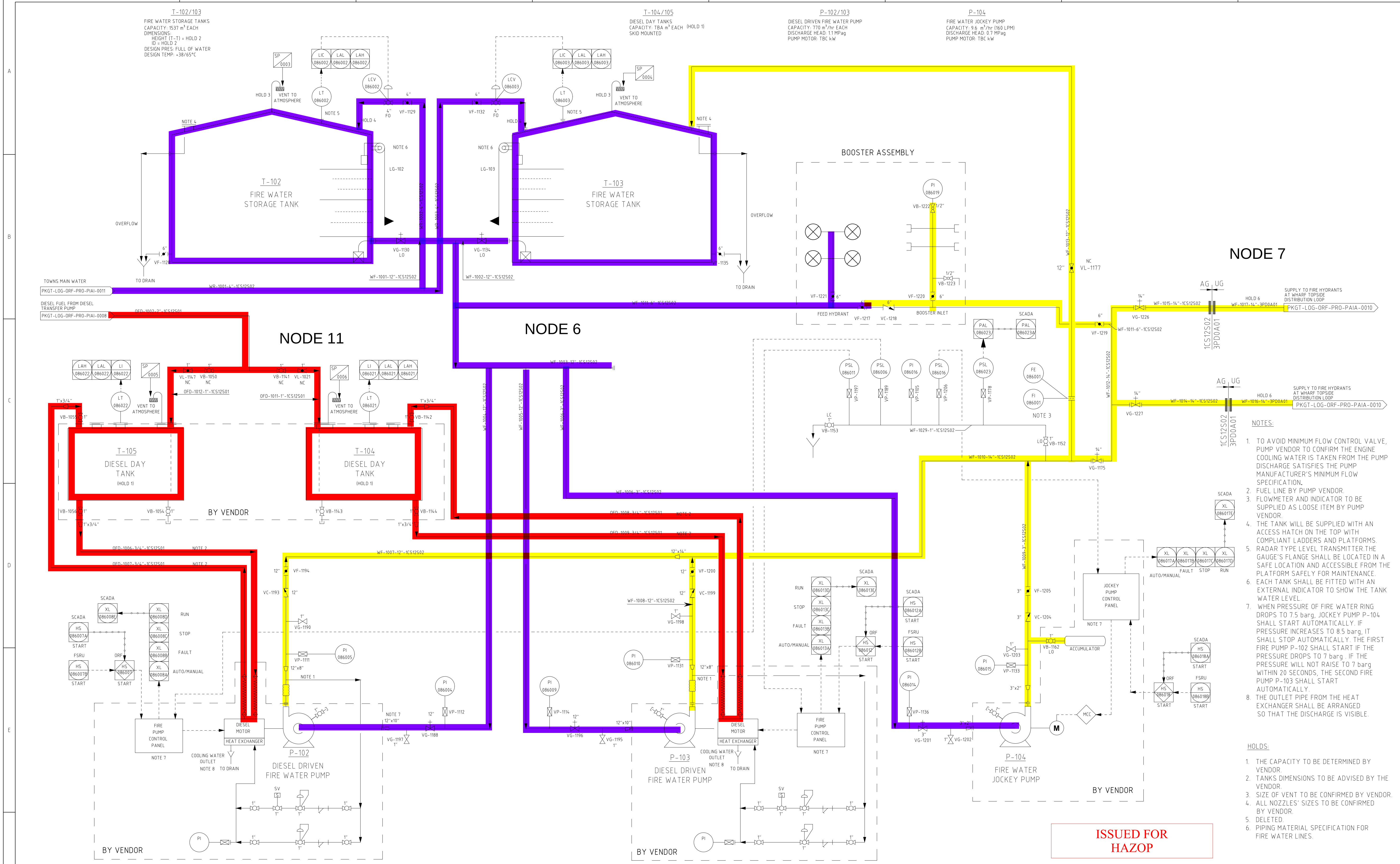
PORT KEMBLA GAS TERMINAL
PIG LAUNCHER
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	FACILTY	SUBJECT	
DESIGN	SCALE N.T.S.		
CHECKED	SUPERSEDES		A1
APPROVED	DRAWING NUMBER GAS-554-DW-PD-002		REV D
DATE			

REV B - 220117



NOTES:

1. TO AVOID MINIMUM FLOW CONTROL VALVE, PUMP VENDOR TO CONFIRM THE ENGINE COOLING WATER IS TAKEN FROM THE PUMP DISCHARGE SATISFIES THE PUMP MANUFACTURER'S MINIMUM FLOW SPECIFICATION.
2. FUEL LINE BY PUMP VENDOR.
3. FLOWMETER AND INDICATOR TO BE SUPPLIED AS LOOSE ITEM BY PUMP VENDOR.
4. THE TANK WILL BE SUPPLIED WITH AN ACCESS HATCH ON THE TOP WITH COMPLIANT LADDERS AND PLATFORMS.
5. RADAR TYPE LEVEL TRANSMITTER.THE GAUGE'S FLANGE SHALL BE LOCATED IN A SAFE LOCATION AND ACCESSIBLE FROM THE PLATFORM SAFELY FOR MAINTENANCE.
6. EACH TANK SHALL BE FITTED WITH AN EXTERNAL INDICATOR TO SHOW THE TANK WATER LEVEL.
7. WHEN PRESSURE OF FIRE WATER RING DROPS TO 7.5 barg, JOCKEY PUMP P-104 SHALL START AUTOMATICALLY. IF PRESSURE INCREASES TO 8.5 barg, IT SHALL STOP AUTOMATICALLY. THE FIRST FIRE PUMP P-102 SHALL START IF THE PRESSURE DROPS TO 7 barg . IF THE PRESSURE WILL NOT RAISE TO 7 barg WITHIN 20 SECONDS, THE SECOND FIRE PUMP P-103 SHALL START AUTOMATICALLY.
8. THE OUTLET PIPE FROM THE HEAT EXCHANGER SHALL BE LOCATED SO THAT THE DISCHARGE IS VISIBLE.

HOLDS:

1. THE CAPACITY TO BE DETERMINED BY VENDOR.
2. TANKS DIMENSIONS TO BE ADVISED BY THE VENDOR.
3. SIZE OF VENT TO BE CONFIRMED BY VENDOR.
4. ALL NOZZLES' SIZES TO BE CONFIRMED BY VENDOR.
5. DELETED.
6. PIPING MATERIAL SPECIFICATION FOR FIRE WATER LINES.

REV No	DATE	DESCRIPTION	DRN	CHK'D	DSG'D	DSGCHK	PM APP
B	16/01/22	ISSUED FOR HAZOP	MJ	MZR	DA/AM	LA	CJS
A	07/12/21	ISSUED FOR REVIEW	AGI	BAC	AM	LA	CJS

DOC No.	DESCRIPTION
REFERENCE DOCUMENTS	

CLIENT: AIE

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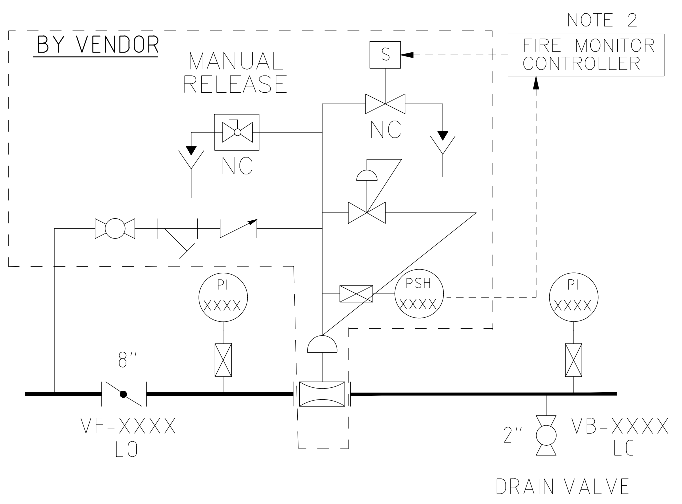
DRAWN
CHECKED
DESIGNED
DES. CHECK
PROJ. MGR
CLIENT
DRG No.

PORT KEMBLA GAS TERMINAL DETAILED DESIGN
WHARF TOPSIDE
FIREWATER PUMPS AND STORAGE TANKS
PIPING AND INSTRUMENTATION DIAGRAM

A1 | DRG No: PKGT-LOG-ORF-PRO-PAIA-0009 | Rev: B

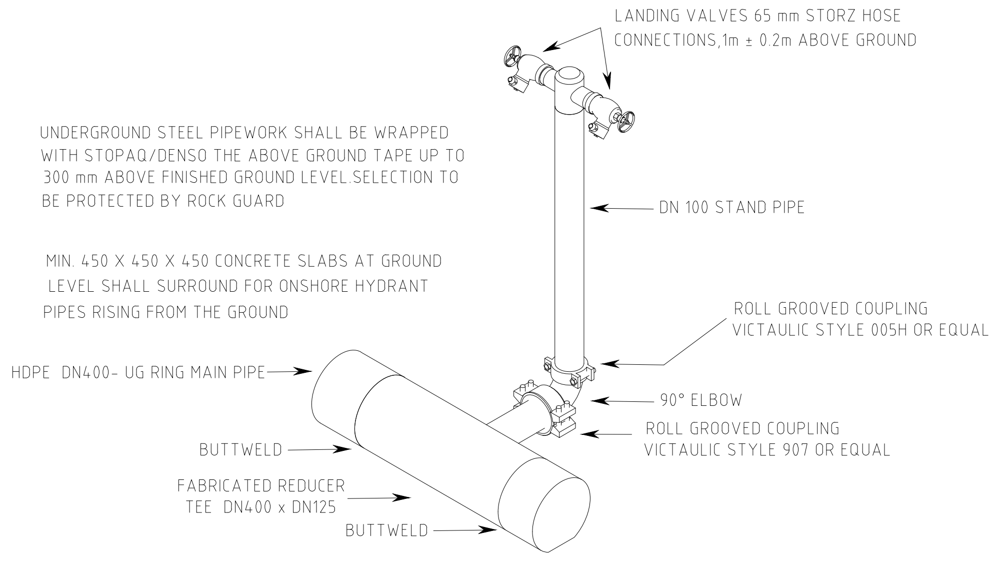
Dwg name: \\logicamms.internal\LCM\Projects\EAST-BNE\41-82198.00 - AIE Port Kembla ORF Design\15 Drafting & Design\02 Drawings\02 Process\PID\PKGT-LOG-ORF-PRO-PAIA-0009_B.dwg | User: ben.claughton | Plot time: 19-01-22 @ 11:09am

REV B - 220118



X-106/07 MONITOR CONTROL VALVE

(HOLD 2)



HYDRANT CONNECTION DETAIL

SMO-101/2

FIRE MONITOR TOWERS
DIMENSION: (HOLD 1)

FM-101/2

REMOTE FIRE MONITOR
DESIGN FLOW : 6,400 L/M @ 0.7 MPag

FH-101~7

FIRE HYDRANT
DUAL OUTLET TYPE
DESIGN FLOW : 10 L/S@0.7 MPag
FROM EACH SINGLE OUTLET

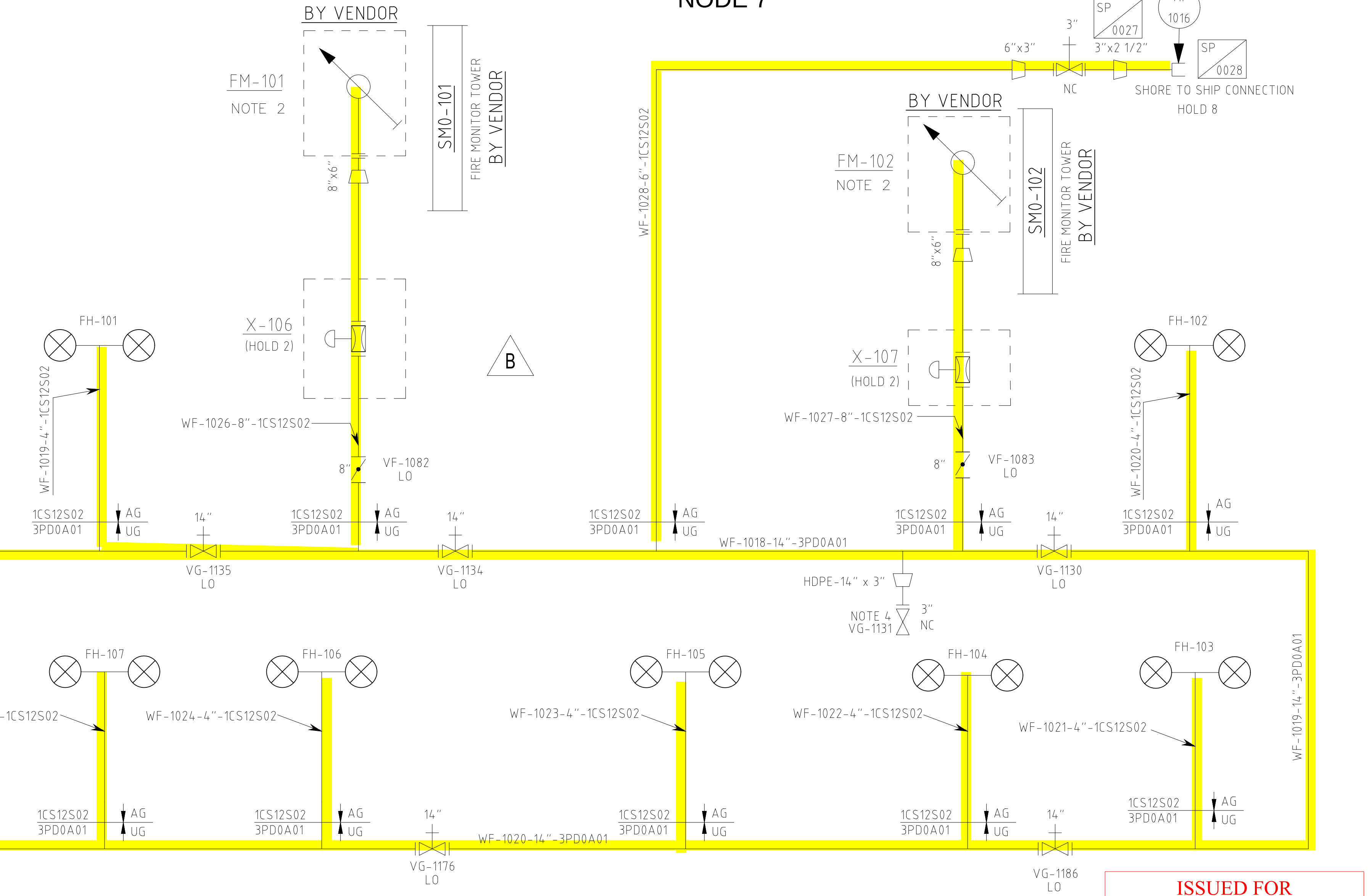
NOTES:

1. ALL HYDRANTS TO BE DUAL OUTLET TYPE WITH STORZ CONNECTION.
2. THE FIRE MONITORS CAN BE REMOTELY CONTROLLED VIA SCADA (JEMENA CONTROL ROOM AND ORF EMERGENCY CONTROL ROOM) AND VIA ONE MOBILE WIRELESS CONTROLLER.
3. AUTOMATIC AIR VENT VALVE AT HIGH POINT .

HOLDS:

1. FIRE MONITOR TOWER'S DESIGN TO BE CONFIRMED BY VENDOR.
2. DETAILS OF MONITOR CONTROL VALVE PACKAGE ARRANGEMENT TO BE CONFIRMED BY VENDOR.
3. DELETED.
4. TO BE LOCATED AT THE LOWEST SECTION OF THE FIRE WATER RING MAIN UNDER THE JETTY EDGE OPERABLE WITH CHAIN LEVER.
5. PIPING MATERIAL SPECIFICATION FOR FIRE WATER LINES.
6. DELETED.
7. FIRE STUDY FINDINGS.
8. SHIP TO SHORE MUTUAL AID SIZE AND LOCATION.

NODE 7



ISSUED FOR HAZOP

DOC No.	DESCRIPTION	REV No	DATE	DESCRIPTION	DRN	CHK'D	DSG'D	DSGCHK	PM APP
		B	16/01/22	ISSUED FOR HAZOP	MJ	MZR	DA/AM	LA	CJS
		A	07/12/21	ISSUED FOR REVIEW	AGI	BAC	AM	LA	CJS
REFERENCE DOCUMENTS		REVISIONS							

CLIENT:

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DRG No.

SCALE:	AS SHOWN
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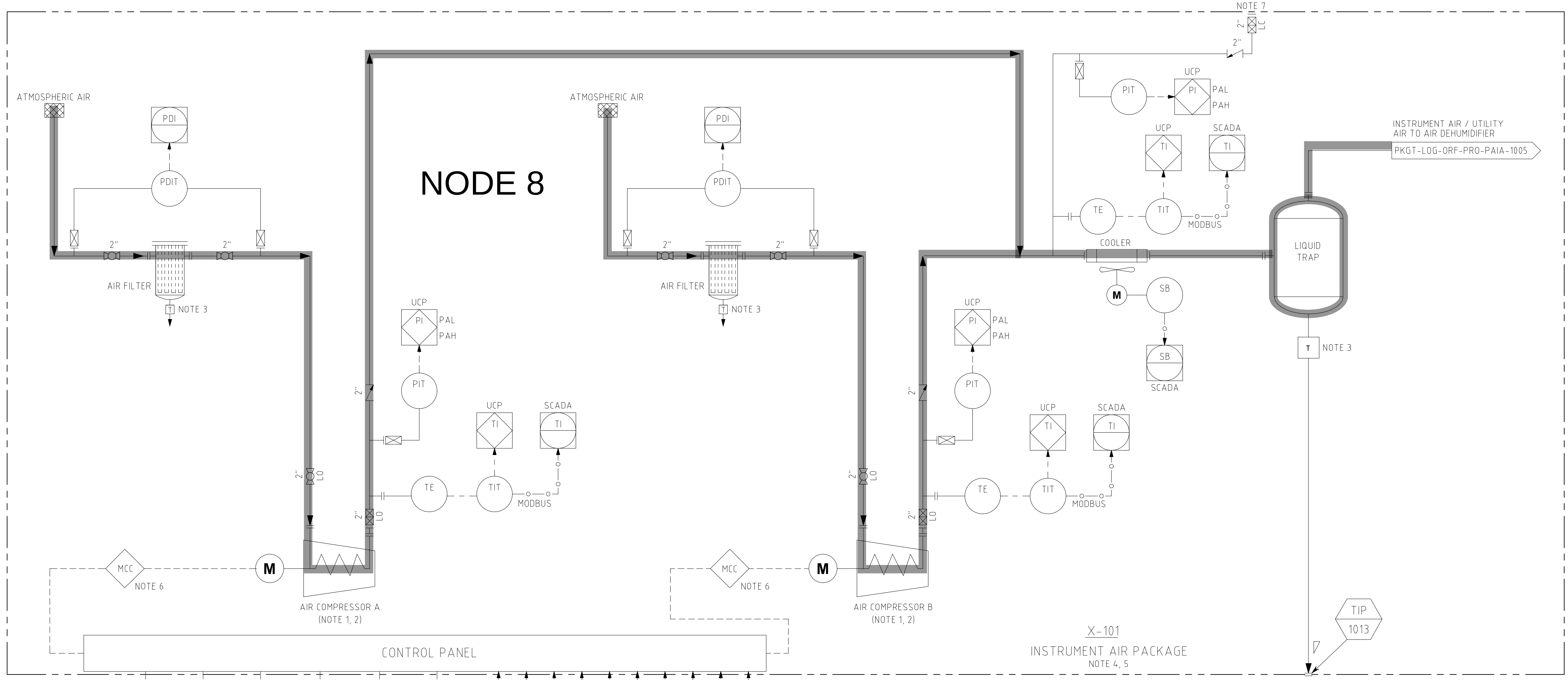
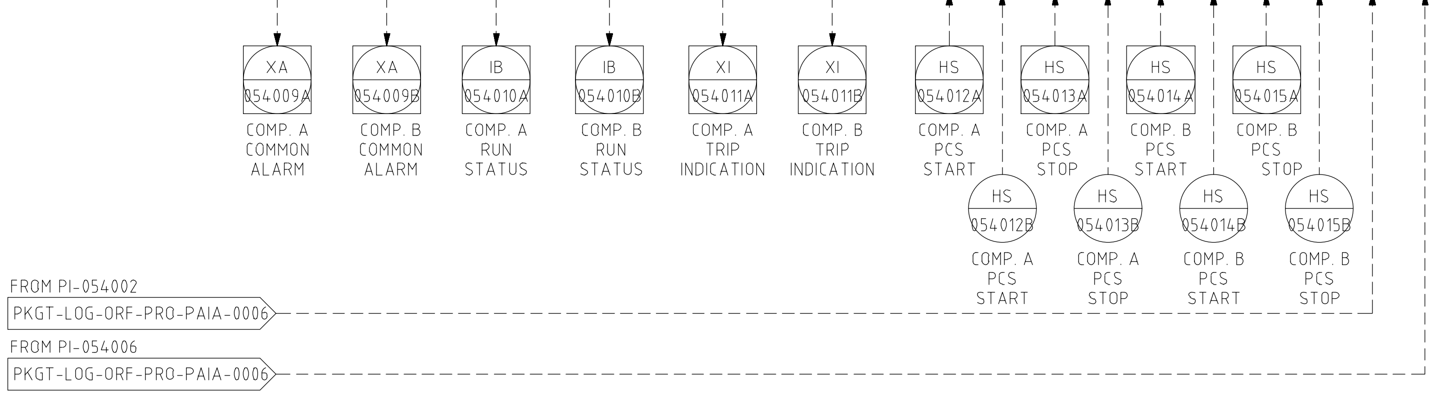
CHECKED	
DESIGNED	
DES. CHECK	
PROJ. MGR	
CLIENT	

PORT KEMBLA GAS TERMINAL DETAILED DESIGN
WHARF TOPSIDE
FIREWATER MAIN RING, FIRE MONITORS AND HYDRANTS
PIPING AND INSTRUMENTATION DIAGRAM

A1 | DRG. No. PKGT-LOG-ORF-PRO-PAIA-0010 | Rev B

X-101
INSTRUMENT AIR PACKAGE
DESIGN PRESSURE: 1.2 MPa g
DESIGN TEMPERATURE: 0 /65°C
(HOLD 1)





HOLD:

1. PACKAGE DETAILS TO BE CONFIRMED WITH VENDOR.

NOTES:

1. CAPACITY CONTROL OF AIR COMPRESSORS TO BE "LOADING-UNLOADING-STOP" CYCLING CONTROL.
2. AIR COMPRESSORS IN 2x100% CONFIGURATION.
3. LIQUID TRAP AUTOMATIC DRAIN.
4. THE INSTRUMENT AIR PACKAGE IS A VENDOR PACKAGE.
5. PKGT-LOG-ORF-PRO-PAIA-0004 AND PKGT-LOG-ORF-PRO-PAIA-0005 COMPRISE OF ONE PACKAGE.
6. MOTOR CONTROL CENTER
7. PROVISION FOR A SKID MOUNTED/PORTABLE AIR COMPRESSOR. AIR FILTER IS INCLUDED IN THE PORTABLE AIR COMPRESSOR SKID (TBC).

ISSUED FOR HAZOP

REV No	DATE	DESCRIPTION	DRN	CHK'D	DSG'D	DSGCHK	PM APP
B	18/01/22	ISSUED FOR HAZOP	PS	BAC	AM	LAA	CJS
A	25/11/21	ISSUED FOR REVIEW	AG	BC	LP	LA	CJS

DOC No.	DESCRIPTION

REFERENCE DOCUMENTS
REVISIONS

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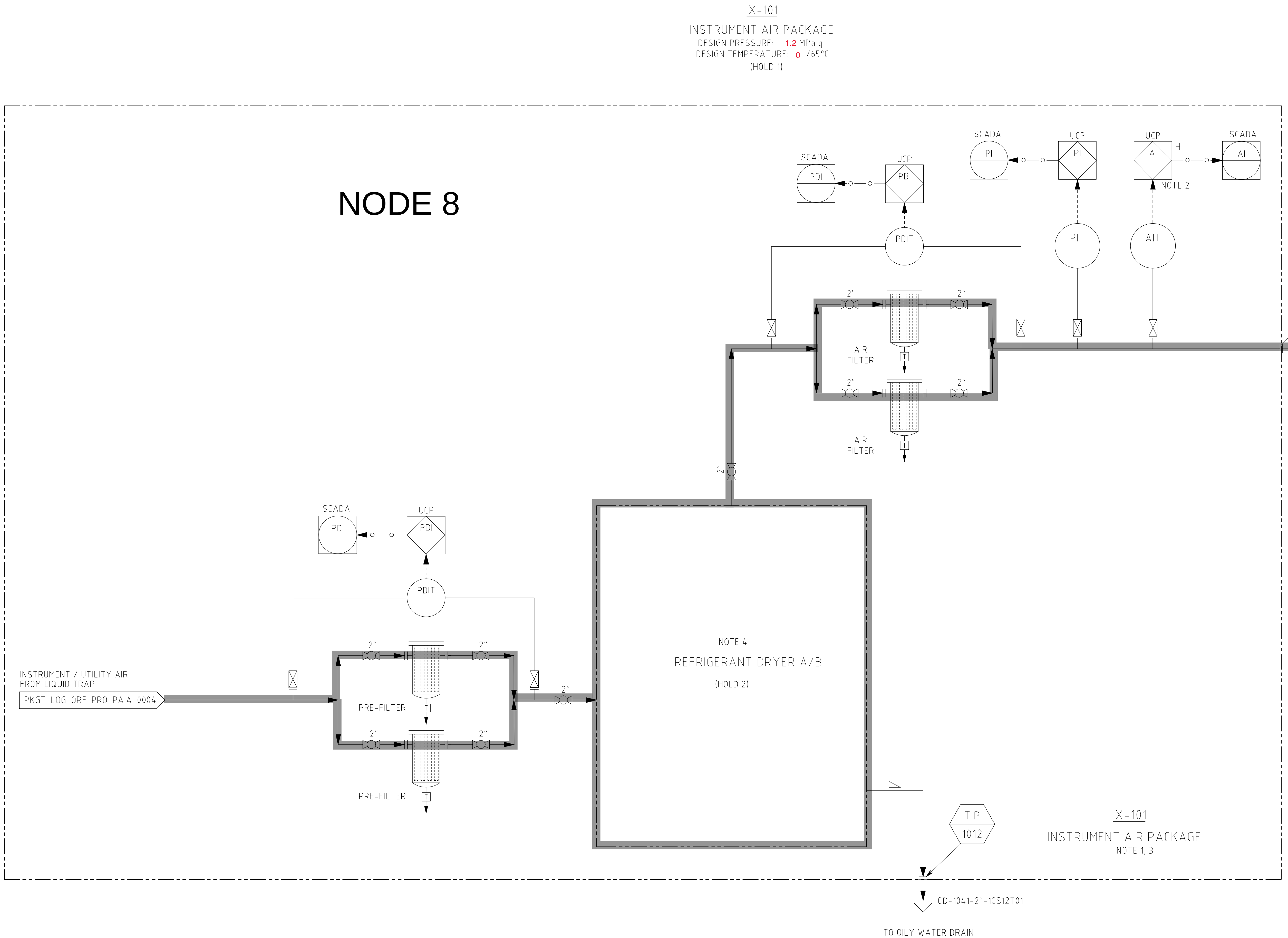
SCALE:	AS SHOWN
DRAWN	LCN
CHECKED	
DESIGNED	
DES. CHECK	
PROJ. MGR	
CLIENT	

PORT KEMBLA GAS TERMINAL DETAILED DESIGN
WHARF TOPSIDE
INSTRUMENT AND UTILITY AIR PACKAGE 1/2
PIPING AND INSTRUMENTATION DIAGRAM

A1 DRG. No. PKGT-LOG-ORF-PRO-PAIA-0004 Rev B



NOTES:
1. PKGT-LOG-ORF-PRO-PAIA-0004 AND PKGT-LOG-ORF-PRO-PAIA-0005 COMPRISE OF ONE PACKAGE
2. MOISTURE ANALYZER.
3. INSTRUMENT AIR PACKAGE IS A VENDOR PACKAGE.
4. EXPECTED DEWPOINT OF 3°C

HOLD:
1. PACKAGE DETAILS TO BE CONFIRMED WITH VENDOR.
2. VENDOR TO CONFIRM REFRIGERANT DRYER DETAILS.

ISSUED FOR HAZOP

REV No	DATE	DESCRIPTION	DRN	CHK'D	DSG'D	DSGCHK	PM APP
B	18/01/22	ISSUED FOR HAZOP	PS	BAC	AM	LAA	CJS
A	03/12/21	ISSUED FOR REVIEW	AG	BC	LP	LA	CJS

REVISIONS

DOC No.	DESCRIPTION

REFERENCE DOCUMENTS

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SCALE:	AS SHOWN
DRAWN	LCN
CHECKED	
DESIGNED	
DES. CHECK	
PROJ. MGR	
CLIENT	

PORT KEMBLA GAS TERMINAL DETAILED DESIGN
WHARF TOPSIDE
INSTRUMENT AND UTILITY AIR PACKAGE 2/2
PIPING AND INSTRUMENTATION DIAGRAM

A1 DRG No PKGT-LOG-ORF-PRO-PAIA-0005 Rev B

Dwg name. \\logicamms.internal\LCM\Projects\EAST-BNE\41-82198.00 - AIE Port Kembla ORF Design\15 Drafting & Design\02 Drawings\02 Process\PID\PKGT-LOG-ORF-PRO-PAIA-0005__B.dwg | User ben.claughton | Plot time 19-01-22 @ 2 27pm

V-101

INSTRUMENT AIR RECEIVER

DIMENSIONS:

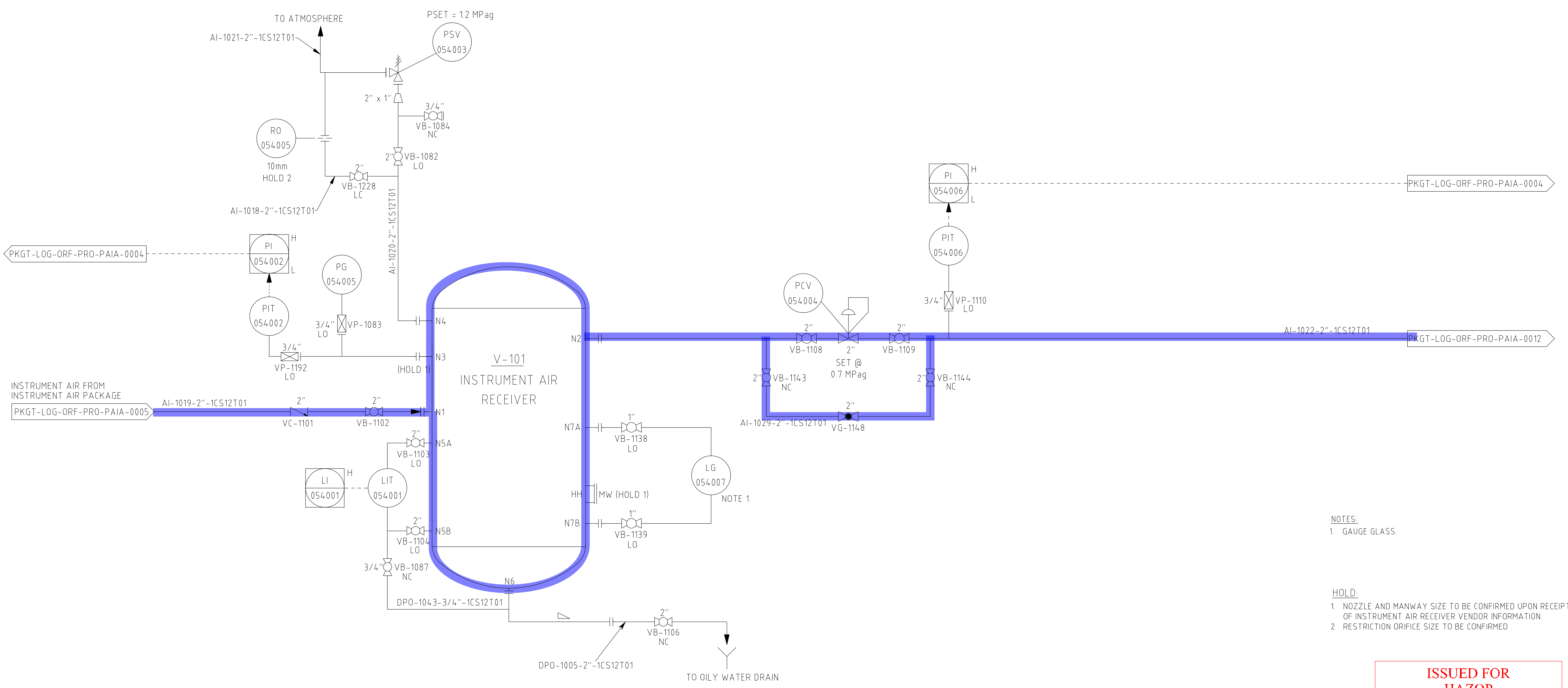
HEIGHT= 2.4 m T/T

ID= 1.1 m

DESIGN PRES: 1.2 MPag

DESIGN TEMP: 0°/65°C

NODE 9



NOTES:

1. GAUGE GLASS.

HOLD:

1. NOZZLE AND MANWAY SIZE TO BE CONFIRMED UPON RECEIPT OF INSTRUMENT AIR RECEIVER VENDOR INFORMATION.
2. RESTRICTION ORIFICE SIZE TO BE CONFIRMED

ISSUED FOR HAZOP

REV No	DATE	DESCRIPTION	DRN	CHK'D	DSG'D	DSGCHK	PM APP
B	18/01/22	ISSUED FOR HAZOP	PS	BAC	AM	LAA	CJS
A	03/12/21	ISSUED FOR REVIEW	AG	BC	LP	LA	CJS

DOC No.	DESCRIPTION
REFERENCE DOCUMENTS	

REVISIONS

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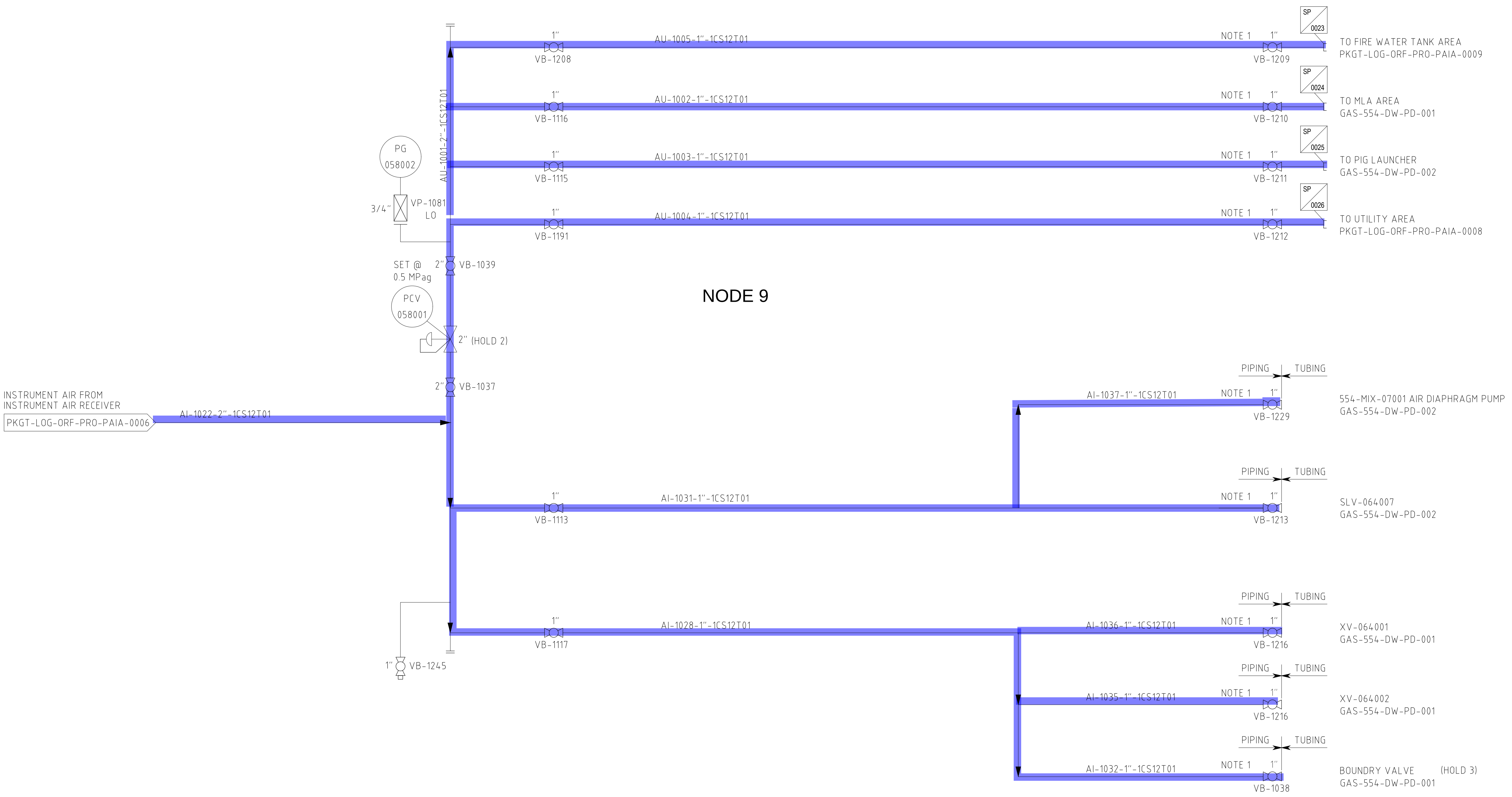
DRG No.

SCALE:	AS SHOWN
DRAWN	LCN
CHECKED	
DESIGNED	
DES CHECK	
PROJ MGR	
CLIENT	

PORT KEMBLA GAS TERMINAL DETAILED DESIGN
WHARF TOPSIDE
UTILITY AIR HEADER AND INSTRUMENT RECEIVER
PIPING AND INSTRUMENTATION DIAGRAM

A1 DRG. No. PKGT-LOG-ORF-PRO-PAIA-0006 Rev B



HOLD:

1. NUMBER OF INDIVIDUAL UTILITY AIR CONNECTIONS TO BE CONFIRMED BASED ON 3D MODEL REVIEW.
2. SET PRESSURE TO BE CONFIRMED.
3. VALVE TAG NUMBER AND IA USAGE TO BE CONFIRMED.

NOTES:

1. LENGTH OF 1" LINE TO BE MINIMISED.

ISSUED FOR HAZOP

REV No	DATE	DESCRIPTION	DRN	CHK'D	DSG'D	DSGCHK	PM APP
B	18/01/22	ISSUED FOR HAZOP	ISS	BAC	AM	LAA	CJS
A	03/12/21	ISSUED FOR REVIEW	AG	BC	LP	LA	CJS

DOC No.	DESCRIPTION

REFERENCE DOCUMENTS

REVISIONS

CLIENT:

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DRG No.

SCALE:	AS SHOWN
DRAWN	LCN
CHECKED	
DESIGNED	
DES. CHECK	
PROJ. MGR	
CLIENT	

PORT KEMBLA GAS TERMINAL DETAILED DESIGN
WHARF TOPSIDE
UTILITY AND INSTRUMENT AIR DISTRIBUTION
PIPING AND INSTRUMENTATION DIAGRAM

A1 | DRG. No. PKGT-LOG-ORF-PRO-PAIA-0012 | Rev B

Dwg name: \\logicamms.internal\LCM\Projects\EAST-BNE\41-82198.00 - AIE Port Kembla ORF Design\15 Drafting & Design\02 Drawings\02 Process\PID\PKGT-LOG-ORF-PRO-PAIA-0012_B.dwg | User: ben.claughton | Plot time: 19-01-22 @ 2:32pm

X-105

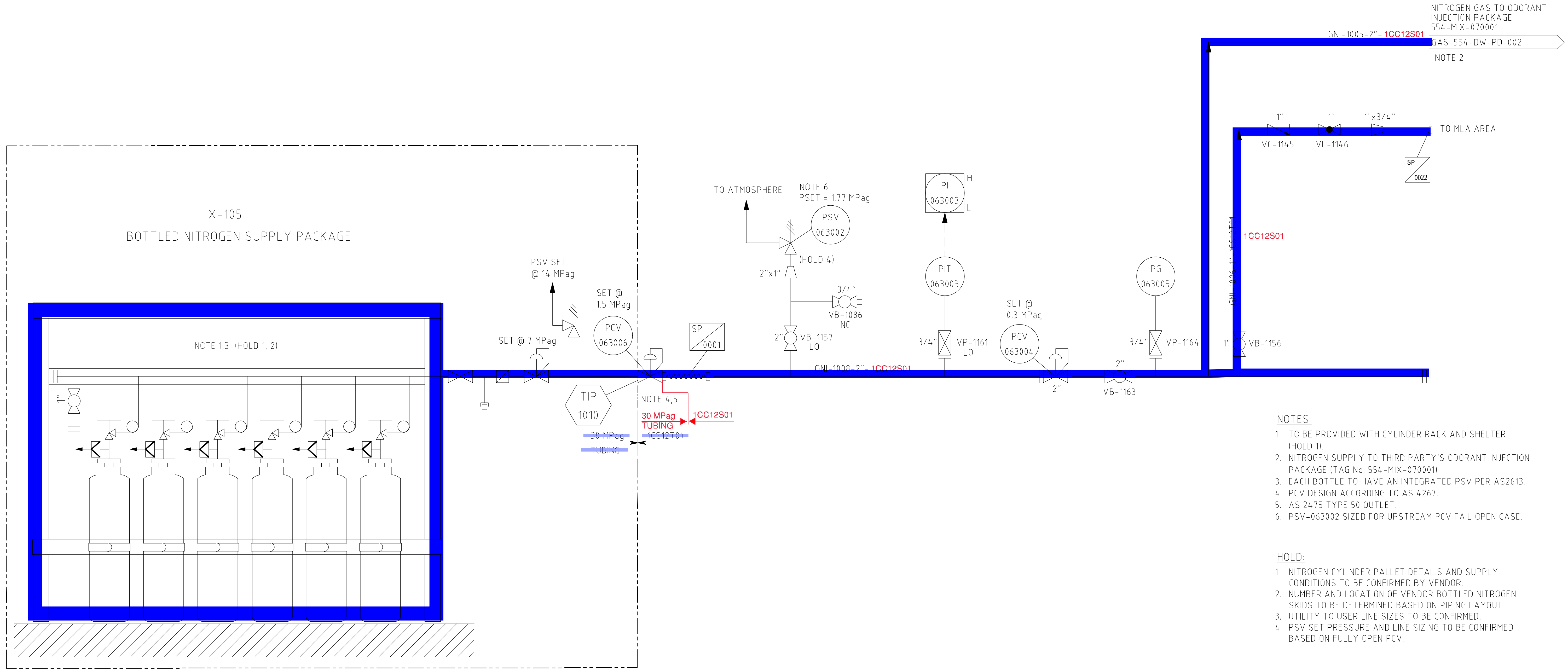
BOTTLED NITROGEN SUPPLY PACKAGE

CAPACITY (PER BOTTLE): 50 LITRES

SUPPLY PRESSURE: 30 MPag

(HOLD 1)

NODE 10



NOTES:

1. TO BE PROVIDED WITH CYLINDER RACK AND SHELTER (HOLD 1).
2. NITROGEN SUPPLY TO THIRD PARTY'S ODORANT INJECTION PACKAGE (TAG No. 554-MIX-070001)
3. EACH BOTTLE TO HAVE AN INTEGRATED PSV PER AS2613.
4. PCV DESIGN ACCORDING TO AS 4267.
5. AS 2475 TYPE 50 OUTLET.
6. PSV-063002 SIZED FOR UPSTREAM PCV FAIL OPEN CASE.

HOLD:

1. NITROGEN CYLINDER PALLET DETAILS AND SUPPLY CONDITIONS TO BE CONFIRMED BY VENDOR.
2. NUMBER AND LOCATION OF VENDOR BOTTLED NITROGEN SKIDS TO BE DETERMINED BASED ON PIPING LAYOUT.
3. UTILITY TO USER LINE SIZES TO BE CONFIRMED.
4. PSV SET PRESSURE AND LINE SIZING TO BE CONFIRMED BASED ON FULLY OPEN PCV.

ISSUED FOR HAZOP

REV No	DATE	DESCRIPTION	DRN	CHK'D	DSG'D	DSC'D	PM
B	18/01/22	ISSUED FOR HAZOP	PS	BAC	JM	LAA	CSS
A	03/12/21	ISSUED FOR REVIEW	AG	BC	LP	LA	CSS

DOC No.	DESCRIPTION
REFERENCE DOCUMENTS	

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DESIGNED	
DES. CHECK	
PROJ. MGR	
CLIENT	

PORT KEMBLA GAS TERMINAL DETAILED DESIGN
WHARF TOPSIDE
BOTTLED NITROGEN SUPPLY PACKAGE
PIPING AND INSTRUMENTATION DIAGRAM

A1 DRG No PKGT-LOG-ORF-PRO-PAIA-0007 Rev B

Dwg name: \\logicamms.internal\LCM\Projects\EAST-BNE\41-82198.00 - AIE Port Kembla ORF Design\15 Drafting & Design\02 Drawings\02 Process\PID\PKGT-LOG-ORF-PRO-PAIA-0007_B.dwg | User: ben.claughton | Plot time: 19-01-22

T-101

DIESEL STORAGE TANK

CAPACITY: $5m^3$
DIMENSIONS:
LENGTH (T-T): (HOLD 1) mm
IN DIAMETER: (HOLD 1) mm
DESIGN PRESSURE: FULL OF LIQUID
DESIGN TEMPERATURE: +0°/65°C

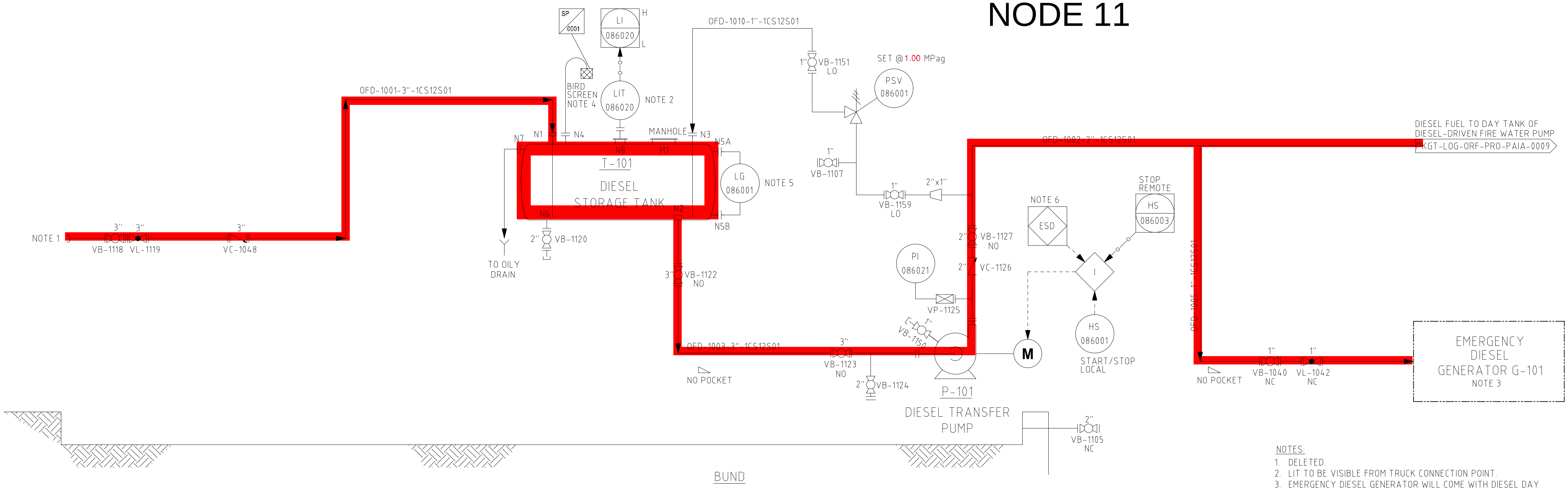
(HOLD 1)

P-101

DIESEL TRANSFER PUMP

CAPACITY: $4m^3/hr$ (HOLD1)
DISCHARGE HEAD: 0.05 MPag (HOLD 1)
POWER RATED: xx kW (HOLD 1)

NODE 11



HOLD:
1. DIESEL STORAGE TANK AND PUMP DETAILS TO BE CONFIRMED.

NOTES:
1. DELETED.
2. LIT TO BE VISIBLE FROM TRUCK CONNECTION POINT.
3. EMERGENCY DIESEL GENERATOR WILL COME WITH DIESEL DAY TANK WHICH IS VENDOR SCOPE SUPPLY.
4. DESICCANT TYPE BREATHER.
5. LG TO BE VISIBLE FROM TRUCK CONNECTION POINT.
6. TO SHUT THE PUMP OFF IN CASE OF FIRE.

ISSUED FOR HAZOP

REV No	DATE	DESCRIPTION	DRN	CHK'D	DSG'D	DSGCHK	PM APP
B	18/01/22	ISSUED FOR HAZOP	PS	BAC	AM	LAA	CJS
A	02/12/21	ISSUED FOR REVIEW	AG	BC	AM	LA	CJS

DOC No. | DESCRIPTION — REFERENCE DOCUMENTS

REVISIONS

CLIENT:

AIE

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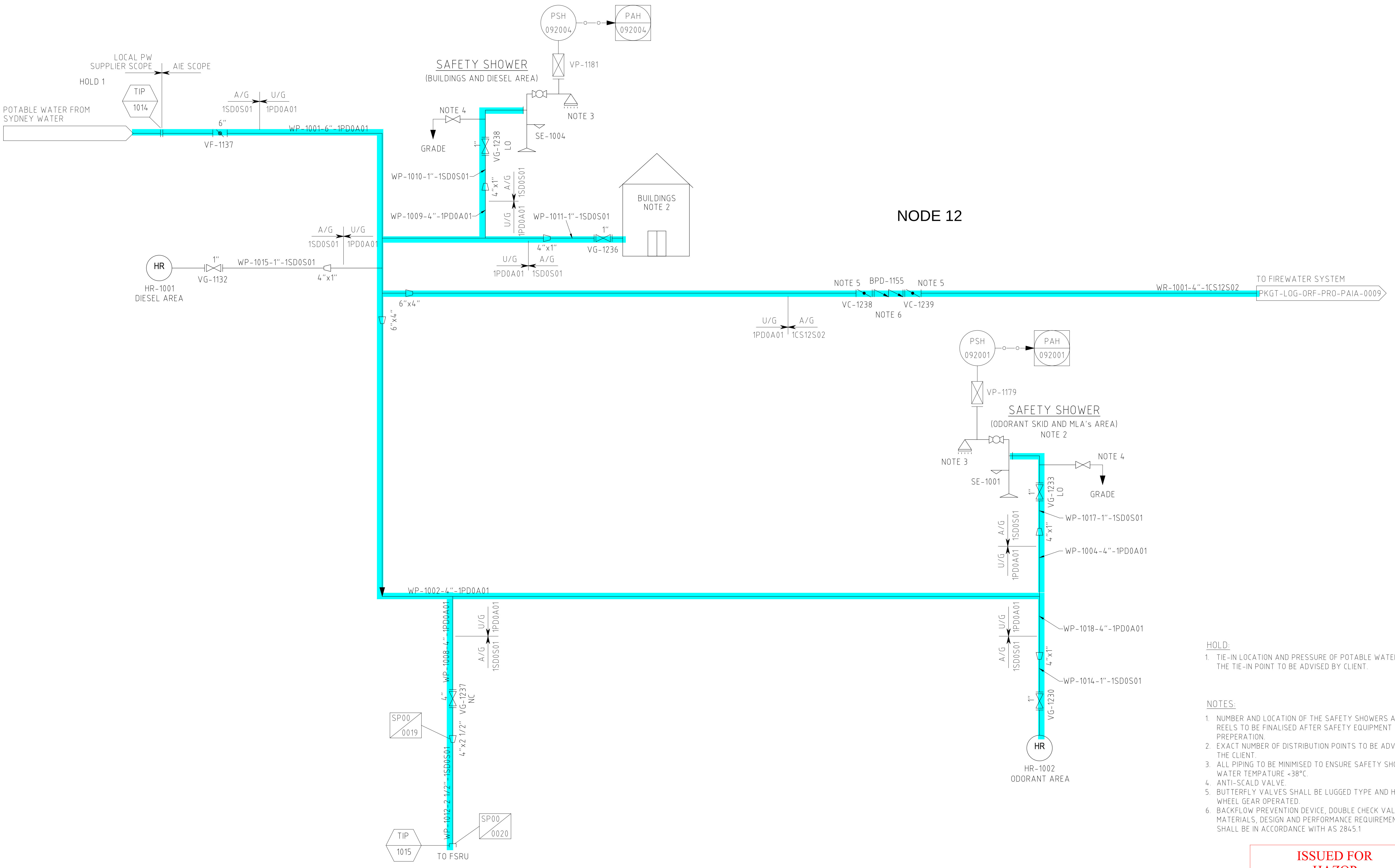
DRG No.

SCALE: AS SHOWN
DRAWN: LCN
CHECKED
DESIGNED
DES. CHECK
PROJ. MGR
CLIENT

PORT KEMBLA GAS TERMINAL DETAILED DESIGN
WHARF TOPSIDE
DIESEL FUEL SUPPLY FACILITIES
PIPING AND INSTRUMENTATION DIAGRAM

A1 | DRG No PKGT-LOG-ORF-PRO-PAIA-0008 | Rev B

Dwg name: \\logicamms.internal\LCM\Projects\EAST-BNE\41-82198.00 - AIE Port Kembla ORF Design\15 Drafting & Design\02 Drawings\02 Process\PID\PKGT-LOG-ORF-PRO-PAIA-0008_B.dwg | User: ben.claughton | Plot time: 21-01-22 @ 1:49pm



HOLD:

1. TIE-IN LOCATION AND PRESSURE OF POTABLE WATER AT THE TIE-IN POINT TO BE ADVISED BY CLIENT.

NOTES:

1. NUMBER AND LOCATION OF THE SAFETY SHOWERS AND HOSE REELS TO BE FINALISED AFTER SAFETY EQUIPMENT LAYOUT PREPERATION.
2. EXACT NUMBER OF DISTRIBUTION POINTS TO BE ADVISED BY THE CLIENT.
3. ALL PIPING TO BE MINIMISED TO ENSURE SAFETY SHOWER WATER TEMPATURE <38°C.
4. ANTI-SCALD VALVE.
5. BUTTERFLY VALVES SHALL BE LUGGED TYPE AND HAND WHEEL GEAR OPERATED.
6. BACKFLOW PREVENTION DEVICE, DOUBLE CHECK VALVES, MATERIALS, DESIGN AND PERFORMANCE REQUIREMENTS SHALL BE IN ACCORDANCE WITH AS 2845.1

ISSUED FOR HAZOP

REV No	DATE	DESCRIPTION	DRN	CHK'D	DSG'D	DSGCHK	PM APP
B	25/01/22	ISSUED FOR HAZOP	ISS	BAC	AM	LAA	CJS
A	02/12/21	ISSUED FOR REVIEW	AG	BC	AM	LA	CJS

REVISIONS

DOC No.	DESCRIPTION

REFERENCE DOCUMENTS

CLIENT: AIE

LOGICAMMS a verbrec company

DRG No.

SCALE:	AS SHOWN
DRAWN	LCN
CHECKED	
DESIGNED	
DES. CHECK	
PROJ. MGR	
CLIENT	

PORT KEMBLA GAS TERMINAL DETAILED DESIGN
WHARF TOPSIDE
POTABLE WATER
PIPING AND INSTRUMENTATION DIAGRAM

A1 | DRG. No. PKGT-LOG-ORF-PRO-PAIA-0011 | Rev B