Annexure 1

T4S Reference	SEI Comments
3.0 Storage Installation and Handling	
3.1 TABLE-1, TABLE-2 and TABLE 3	
3.1 (1) (a) the minimum safety distances between the LNG storage vessels and the nearest building or line of adjoining property shall be in accordance with the distances specified in Table (1) of this schedule. The maximum aggregate capacity of each such LNG installation shall not exceed 1060m3	1) Distances shall be based on the calculated release rate and the determined Lower Flammability Limit (LFL) distance for the system under consideration. The highest risk activity is LNG transfer (supply of LNG). It is recommended to specify distances between transfer point of bulk LNG transfer to buildings with persons and to large bulk storage tank (to prevent escalation effect). 2) The other risk is the radiation of external sources onto the large bulk storage, which may lead to an impact on people. It is recommended to specify minimum safety distances between items that can act as radiation source onto the storage (e.g. buildings, parked cars/trucks, LNG transfer systems like hoses and transfer arms, vent stack/flare etc.). 3) It is recommended to analyze the effect of vent stack dispersion and in case of ignition (radiation) onto people and equipment, resulting in specified minimum height and safety distances. 4) It is recommended that the vent stack height, is such that no liquid (LNG) rainout, is possible at ground level, in order to minimize the potential for a vapor Cloud Explosion (VCE). 5) Safety distances prescribed, shall reflect the particular design (fluid pressure and characteristics upon release), as well as be tailored to the potential consequences for a given site, meaning that sites where a high number of people may be impacted, must implement more stringent safety distances.
3.1 (2) The LNG installation shall be designed to withstand the following without loss of structural or functional integrity - a) The direct effect of wind forces; b) Loading due to seismic effect; c) Erosive action from a spill; d) Effect of the temperature, any thermal gradient, and any other anticipated degradation resulting from sudden or localized contact with LNG.	In addition, it is recommended that the following added to confirm the structural and functional integrity of the installation: e) internal and external pressures, f) equipment vibration, g) weight effects of components and fluids (hydrostatic head), h) flow induced vibration, i) effect of soil settlement or aquifer (ground water level),

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	j) transport and erection load.
	With regards to "Effect of the temperature, thermal gradient, and any other anticipated degradation resulting from sudden or localized contact with LNG.", it is recommended to specify the following elements: • The type of study, i.e. 'Finite Element Analysis or equivalent' • The key scenarios, i.e. puncture hole failure of annular space piping, • The key loads, i.e. thermal, seismic, … Reference of API 579-1 may be taken.
3.1 (3) The structural members of the impoundment system shall be designed and constructed to prevent impairment of the impoundments reliability and structural integrity as a result of the following- (a) Imposed loading from full hydrostatic head of impounded LNG; (b) Hydro dynamic action from injected material.	Most standards prescribe containment for atmospheric LNG, where a large spill is prone to pool. Pressurized/saturated LNG storage, like in retail applications, tends to completely flash if spilled. LNG spills can be managed through a spill containment system (e.g. impoundment, bunding). However, if this is not designed appropriately, containment may contribute to further escalation instead of bringing the desired safety gain. It is therefore strongly recommended to consider the following requirements: • If there is a potential risk for liquid pooling in case of large leak (mainly low pressure or atmospheric storage), it is strongly recommended to divert the pool away from the large bulk storage and other process equipment to prevent further escalation (or even BLEVE risk). • Also, having a spill containment system with channels may be recommended instead, of dyked or contained area around the tank. Impoundment with wall could lead to congestion and confined spaces, with undesirable escalation effects such as VCE. • For LNG filling stations, vapor clouds or jets are most likely and not pooling where containment may not be a requirement in the design. In line with this comment, the tables with safety distances may have to be adopted.

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	• Reference may be taken from EN1473 for further recommendations on spill management for pressurized LNG storage.
3.1 (5) Compressors, CNG Cascades, Odorizers etc. shall not be located inside the impounding area	Pressurized storage tanks are also not recommended inside the impounding area due to BLEVE (Boiling Liquid Expansion Vapor Explosion) risk. See comment 3.1 (3).
3.1 (8) The impounding system for LNG storage vessel shall have a minimum 110 % of the volumetric capacity of the largest vessel in an impoundment.	See comments 3.1 (3)
3.1 (9) The height of the impoundment wall shall be adequate to contain spillage of any LNG. Dyke wall height of 0.6 meter to 1 meter is recommended from ground level. 3.1 (10) Height of the foundation of the vessel shall be minimum 0.4 meter or designed in such a way to prevent exposure of carbon steel material to the spilled LNG.	The basis for 0.6 m to 1 m height for the dyke wall is not clear. It is recommended to replace this statement with – 'The design of the impoundment, if required, shall be as such that it's volume is enough to handle the maximum spilled volume. Materials shall either be suitable to handle cryogenic temperatures, or a study shall demonstrate that materials stay within allowable stresses not leading to further escalation (e.g. API 579 part 3 & part 9) due to embrittlement.'
3.1 (12) A clear space of at least 0.9 meters shall be provided for access to all isolation valves serving multiple vessels. The isolation valve of LNG vessel piping should be as close to outer vessel as possible.	To ensure that the risk of jet-fire near the tank is mitigated, it is recommended to add to this clause: 'All filling and discharge lines of the main storage tank shall be equipped with an ESD valve as close as possible to the tank and shall have welded connections between the storage tank and the first ESD valve in the line. Alternatively, in-tank ESD-valves may be used, if available.'
3.1 (14) Adequate flameproof lighting shall be provided for facilities transferring LNG during night.	It is recommended to have a holistic review of the potential leak sources and subsequent application of "flameproof" and "explosion proof" instruments and auxiliary (such as light fixtures). This should address Control of Ignition sources during normal operation (day/night), potential upset scenarios and maintenance. Reference can be taken from 'IEC 60079 Series Explosive Atmosphere Standards', especially: • IEC 60079-10-1, Explosive atmospheres — Part 10-1: Classification of areas — Explosive gas atmospheres.

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	• IEC 60079-14, Explosive atmospheres — Part 14: Electrical installations design, selection and erection. • IEC 60079-17, Explosive atmospheres — Part 17: Electrical installations inspection and maintenance.
3.1 (18) Entrance, exit and paving shall be arranged in a manner, so as to minimize the risk of collision.	It is recommended to add to this clause to protect unloading skids and other process equipment: 'Crash or impact barriers shall be installed to protect vulnerable equipment against accidents involving vehicles'
3.1 (20) Personal Protection: Every person handling any operations involving LNG shall always wear appropriate personal protective equipment (PPE) not limited to – (i) Safety goggles (ii) Insulated gloves (iii) Cover-all – covering "head to toe" (iv) Safety Shoes (v) Safety Helmet	It is recommended to ensure that amend to: (iii) ***Non-static*** Cover-all – covering "head to toe" It is also recommended to prescribe a "face shield" to customers and operators handing LNG transfers to protect them against LNG sprays/ droplets.
4.0 LNG Storage Vessel - General design requirements	
4.0 (b) (1) The vessel meant for storage of LNG including piping between inner and outer vessel shall be designed in accordance with ASME Section VIII Div I and / EN13458 / ASME: B.31.3, process piping or equivalent code.	For completeness, the following references may be added: • For materials: 'All materials shall be designed in accordance with ASME Boiler Pressure Vessel Section II or equivalent EN standard' • For thermowells: 'Design in accordance with ASME PTC 19.3 TW'
4.0 (b) (3) The outer vessel shall be equipped with a relief or other device to release internal pressure and shall have discharge area of at least 0.34 mm2/liter of the water capacity of the inner vessel but not exceeding 2000 cm2 and have pressure setting not exceeding 25 psi (1.72 kg/cm2)	In case of a prolonged fire impinging on the LNG tank, the thermal stresses caused by the fire and the mechanical stress caused by the vacuum in the tank annular space can result in buckling of the outer jacket and loss of containment. It is therefore recommended to prescribed vacuum lift plates to remove the vacuum in the annular space in a fire case. The vacuum lift plates shall not be placed both at the top or bottom of the tank, to avoid a chimney effect. In addition, it is recommended to include

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	• vacuum lift plates to protect the outer jacket, in case of a spill in the annular space. • The placement of the vacuum lift places shall not be on the top nor the bottom of the tank, in order to avoid a chimney effect, in case of a fire.
4.0 (b) (4) Thermal barriers shall be provided to prevent outer tank from falling below its design temperature.	The definition of thermal barriers is not clear.
4.0 (b) (5) Those parts of LNG vessels which come in contact with LNG and all materials used in contact with LNG or cold LNG vapor shall be physically and chemically compatible with LNG and intended for service at – 162°C.	The material in contact with LNG is usually designed for a minimum temperature of -196 degC (not -162 degC) as the commissioning of these facility takes place with Liquid Nitrogen (LIN). It should be noted that using the incorrect material on process equipment and bolts is directly related to mechanical integrity. There are incidents in the industry where this has led to several fatalities due to asphyxiation with LIN. It is recommended to replace the above clauses with the following statement – 'Materials shall either be suitable to handle cryogenic temperatures, or a study shall demonstrate that materials stay within allowable stresses not leading to further escalation (e.g. API579 part 3 & part 9) due to embrittlement.'
4.0 (b) (7) LNG vessels shall be designed to accommodate both top and bottom filling unless other positive means are provided to prevent stratification.	• Stratification in pressurized bullet tanks is not a (safety) issue. Stratification is an issue for large atmospheric storage tanks. For pressurized tanks, this is less of a risk because the tank can withstand the (potential) higher pressures that occur when stratification rolls over. • It is recommended to have a minimum amount of liquid lines connected to the tank preferable top filling. In case of a large leak in the transfer system, top filling line will prevent flow back to the liquid line. Also, it introduces the risk of overpressure due to piston effect. It is recommended to use top filling with vapor collapse mechanisms.
4.0 (b) (6) All piping that is a part of LNG vessel including all piping internal to the vessel, within void space, and external piping connected to the vessel up to the first circumferential external joint of the piping shall be in accordance with	It is recommended to specify the type of welds and connections allowed. • Though ASME B31.3 allows having threaded joint, for tank connection threaded joint and socket welded

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ASME Boiler and Pressure Vessel Code, Section VIII or ASME B 31.3 or equivalent.	fittings should not be used as the same is prone to failure and leaking. • Nozzle connections shall be flanged with through studs or specified with a butt weld end connection.
4.0 (x) Recommended addition	It is recommended to specify a performance metric for the insulation applied in the annular space of the LNG double-walled vacuum insulated tank. • To avoid excessive BOG generation. A typical boil-off rate for double-walled vacuum insulated LNG storage tanks is set to maximum 0.25% vol./ day. • Insulation is also a crucial barrier in case of impinging pool/ jet fire to avoid further escalation (e.g. BLEVE). It is recommended to select and design the insulation that can remain intact during a fire: "Vessel jacket and insulation shall remain intact and functional during a fire."
5.0 Fitments	
5.0 (1) Each LNG double walled vessel shall have at least 2 numbers of safety relief valves capable of achieving the required relief capacity on standalone basis and shall be sized to relieve the flow capacity determined for the largest single contingency or any reasonable and probable combination of contingencies and shall include conditions resulting from operational upset, vapor displacement and flash vaporization.	In addition, it is recommended to consider the following: • PRV set point and line-up: recommend to use guidance provided in the EN 13458 and EN 13645 standards, to avoid RV chattering. • PRV shall be of soft seat type, to minimize fugitive emissions. PRV seat leakage rate shall be in accordance with API STD 527 or EN 12266-1
5.0 (2) Relief devices shall be vented directly to the atmosphere. […]	It is strongly recommended to add the following statement; 'All the discharge lines of relief valves, vent valve, bleed valves etc. shall be connected to a vent stack which shall vent at a safe height.' The local vents are closer to potential sources of ignition, could be in the vicinity of people (e.g. maintainers) and can lead to accumulation of gas in the area of relief. A vent stack at a safe height, mitigates all the above.
5.0 (2) […] Each safety relief valve for LNG vessel shall be able to be isolated from the vessel for maintenance or other purposes by means of a	If both relief paths can be blocked simultaneously (by manual valves), the impact during an emergency or upset scenario can be catastrophic. It is of the utmost importance that at least one

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manual full opening stop valve or a flow diverter valve.	of the relief valves remains in operations. It is strongly recommended to add the following statement: 'Suitable isolation valves shall be arranged to allow each relief valve to be isolated individually for testing or maintenance whilst still maintaining the full capacity of the relief valve/valves in any position of the closing valve system (e.g. a full-port-opening three-way valve).'
5.0 (4) The minimum pressure relieving capacity in kg/hr shall not be less than 3% of the full tank contents in 24 hours.	The basis of this requirement is not clear. It is recommended to size the safety relief valve based on scenarios such as fire, loss of vacuum, outrunning pump and any other relevant scenario contributing to an overpressure. Reference from ISO16924, or API 521 may be taken.
5.0 (6) The automatic shut off valves shall be designed to close on occurrence of any of the following conditions i. fire detection ii. uncontrolled flow of LNG from vessel iii. manually and remotely operated	The following detections are also recommended to be added: iv. gas detection v. high pressure trip on storage tank vi. high level trip on storage tank vii. low temperature trip in vent stack Following statement is also recommended to be added in the same clause: viii. ESD link between the trailer and facility to block outlet trailer in case of leak or rupture transfer system.
5.0 (8) All LNG vessels shall have a device that prevents the vessel from becoming liquid full or from covering the inlet of the relief valve with liquid when the pressure in the vessel reaches the set pressure of relieving device under all conditions.	In addition, the following statement is recommended: 'A minimum vapour cap shall be taken in account. Also, the density of LNG changes when the temperature rises, resulting in liquid expansion. It shall be assured that vapour space is always there, taking in account the liquid swelling. High-level alarm and high-level trip shall be set, taking in account the liquid swelling.' The Standard refers to the water capacity of a tank. For the avoidance of doubt, it is recommended to address the behavior of LNG: LNG density is highly volatile. In a retail facility, stored LNG at 0 barg vs. 6 barg, will swell ~15% (dependent on composition), leading to overfill and

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	overpressure scenarios that may result in mechanical failure of the main storage tank if not addressed properly.
5.0 (9) LNG vessel should be provided with one independent high liquid level alarm which can be part of the liquid level gauging devices. However, the high liquid level flow cutoff device shall not be considered as a substitute for the alarm.	It is recommended to mandatorily provide an independent high liquid level alarm in LNG vessel as a failure of high-level alarm resulting in overfill may lead to safety threats including fatalities. Also, it is recommended to add the following additional trips: • low temperature trip in vent stack to detect overfill • high pressure trip (set below RV setpoint) to detect overpressure (due to overfill)
5.0 (11) Each LNG vessel shall be equipped with a high liquid level flow cut off device.	Please refer to comment on 11.0. The overfill scenario has the potential impact of several scenarios. It is recommended to consider adding the following requirement: 'A SIL 2 protection shall be considered as a minimum.'
5.0 (12) LNG vessel shall be equipped with pressure gauge connected to the vessel at a point above the maximum intended liquid level.	In addition of Pressure gauge following instruments should be installed 1. Pressure transmitter for initiating ESD and continuous monitoring of ESD 2. RTD type temperature transmitter inside thermowell for temperature monitoring
5.0 (x) Recommended addition	To allow draining the tank in an emergency • LNG storage tank shall be equipped with a DN 50 (NPS 2) drain valve located downstream of the isolation valve.

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6.0 Equipment	
6.0 (3) Vaporizers shall be designed, fabricated and inspected as per the requirements of ASME Boiler and Pressure Vessel Code, Section VIII Div. 1 or any other equivalent code.	It should be noted that ambient air vaporizers are not pressure vessels and cannot be designed according to Section VIII Div. 1. They can be designed against ASME.
6.0 (6) The discharge valve of each vaporizer and the piping components and relief valves installed upstream of each vaporizer outlet valve/ spec break flange, shall be designed for operation at LNG storage temperature.	It is recommended to replace with the comment below: • Each vaporizer shall have a relief valve at the outlet sized for the maximum vaporizer capacity flow. • In case of spec break after vaporizer, sufficient low-temperature trip shall be installed to prevent e.g. embrittlement risk downstream of the spec break.
6.0 (10) Any ambient vaporizer installed within 15 meters of the LNG vessel shall be equipped with an automatic shutoff valve in the liquid line. This valve shall be located minimum at least 3 meters from the vaporizers and shall close when • (1) loss of line pressure occurs or abnormal temperature is sensed in the immediate vicinity of the vaporizer, or • (2) when low temperature in the vaporizer discharge line occurs.	It is recommended to add the following: • (3) Gas detection • (4) Fire detection • (5) manual ESD trip
7.0 Piping System	
7.0 (4) All piping system and components shall be designed to – (a) Accommodate the effects of thermal cycling fatigue to which the systems shall be subjected.	It is recommended to specify the fatigue loads for LNG as the thermal loading is severe compared to any other fuel: 'Accommodate the effects of thermal cycling fatigue to which the systems shall be subjected for LNG nozzles that make physical connections to the outer jacket, substantiating the thermal gradient along with the externally applied piping load having sufficient fatigue life of 3 cycles per day over the full 20 year lifetime.'
7.0 (4) Shut-off valves shall be provided for all vessel connections except connections for liquid level alarms and connections that are blind flanged or plugged.	Following additional statement is recommended: • For instrument lines, it may be recommended to have maximum orifice size specified to prevent jet/cloud when instrument line is damaged. • In addition, as a minimum, a manual valve on instrument lines is recommended, such that emergency action can be taken to close the valve (with special protection suit and procedures).

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8.0 Transfer of LNG	
8.0 (1) Isolation valves shall be installed so that each transfer system can be isolated at its extremities. Where power-operated isolation valves are installed, an analysis shall be made to determine the closure time so that it does not produce a hydraulic shock capable of causing line or equipment failure.	It should be noted that the delivery trailer has a significant volume that cannot be contained with the current measures. Isolation of this volume in case of upset is critical to enable safe operation and delivery. This is in line with the best practices followed in countries in Europe and Singapore etc. It is recommended to add the following requirement: ESD link with the trailer to control trailer liquid valve which shall be activated in case of a large leak in the transfer system or even a rupture of the transfer system.
9.0 Pump and Compressor Control	
-	No comments
10.0 Tank Vehicle Unloading Facilities	
10.0 (3) Isolation valves and bleed connections shall be provided at the unloading manifold for both liquid and vapour return lines so that hoses and arms can be blocked off, drained of liquid, and depressurized before disconnecting. Bleeds or vents shall discharge in a safe area.	It is recommended to add the following requirement: 'To remove moisture and oxygen prior to connecting the hoses, the manifold and hose shall be purged with nitrogen.'
10.0 (4) At least one qualified person shall be in constant attendance while unloading is in progress.	In addition, it is recommended the following to include a **Dead Man Button (DMB)** to ensure the operator/ driver remains a valid and effective barrier throughout the complete process. A dead man button, for this application, should require that the operator/ driver presses the button every x minutes (e.g. 2 minutes). If the dead man button is not pressed after the requested time the LNG transfer will automatically stop. This is seen as a critical barrier, as the LNG offload is the most safety-critical operation in LNG retail. Taking reference from **ISO16924, clause** 7.4.1.1-2, the following statements are recommended: • 'At least one qualified person (usually the LNG tanker driver) shall be in continuous attendance and shall have an unobstructed view of the LNG transfer point while offloading is in progress. This person shall be able to monitor the level and pressure of the LNG storage tank and control the offloading process.'

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	• 'The qualified person shall sanction the filling process either continuously or intermittently at periods not exceeding three minutes (e.g. by holding or pushing a button). Failure to do so shall automatically interrupt the filling process by stopping the transfer pump.'
10.0 (6) Loading and unloading areas shall be posted with signs that read "No Smoking."	It is recommended to implement full control of ignition sources during loading and unloading operations by: • Restricting incoming traffic (e.g. closing the station during LNG unloading/ offloading) • Implement exclusion zones during loading and unloading of LNG • Ensure that LNG vehicles are not an ignition source during loading and unloading operations (examples: 1) LNG customer engine is switched off during loading 2) LNG customer trucks shall have ATEX compliant equipment or be switched off during loading operations 3) LNG customers trucks, with the refrigerated unit (trailer) shall be switched off during loading operations and shall be designed such, that in case a PRV from the customers tank open during normal operation (not exclusive to refueling) no LNG vapors can enter the refrigeration unit, causing ignition.
10.0 (x) Recommended addition	• **ESD interlink**: An ESD Interlink, enables the process to the stop, in case of a hazard, from both the station and the trailer side. This is a critical barrier to ensure the validity of several recovery barriers such as fire and gas detection, LNG tank overfill protection, LNG trailer hose rupture.
10.0 (x) Recommended addition	• **Grounding**: Grounding/ earthing of the trailer and LNG transfer equipment is required prior to the LNG transfer. This is to prevent ignition sources is hazardous.
10.0 (x) Recommended addition	• It is strongly recommended that prior to any LNG transfer (from an LNG trailer to the LNG station), that all ESD valves, dedicated to the LNG transfer operation (e.g. trailer valves) are tested (and actuated). Upon successful actuation, the LNG offload (transfer) can commence as per the specified procedure. This is a safety critical barrier.

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10.0 (x) Recommended addition	• It is strongly recommended to have a interlock between the pressure transmitter and the LNG transfer pump so that when the LNG in the LNG storage tank after filling is saturated by the of a saturation vaporizer, the transfer pump shall automatically be stopped at a set pressure lower than the set pressure of the relief valves of the LNG storage tank. (Ref ISO16924 cl 7.4.15)
10.0 (x) Recommended addition	• It is recommended to have low pressure or high flow trip to detect a hose rupture and consequently activate an ESD during tank vehicle unloading.
11.0 Emergency Shut Down System (ESD System)	
11.0 *All*	It is challenging to foresee a complete set of the various combination of functionality (e.g. LNG, CNG, with/without compressors), the associated hardware, safety scenarios and required ESD barriers in one standard. This standard intends to list basic ESD criteria. In addition, it is recommended to follow guidance or standard to design the required ESD. Therefore, it is recommended to add the following requirement: 'The ESD system shall be designed in accordance with IEC 61508 and IEC 61511.' IEC 61508 and IEC 61511 provide methods for analyzing, assessing, designing, installing and maintaining ESD systems.
11.0 (1) Each LNG facility shall incorporate an ESD system that when operated isolates or shuts off sources of LNG and shuts down equipment that add or sustain an emergency if continued to operate. 11.0 (2) The ESD system shall be of a failsafe design and shall be installed, located or protected from becoming inoperative during an emergency or failure at the normal control system.	It is unclear what the minimum effect is of a full ESD. It is recommended to specify a minimum: a) alarm horn sounds (for at least 5 min); b) alarm beacon turned on; c) offload pump stopped (if running); d) offload trailer valve closed (if open, via ESD Interlink); e) station trailer offload valves closed (if open f) (remote) notification or alarm messages generated; g) dispensing pumps stopped and dispensing valves closed (if running); h) dispensing valves closed (if dispensing); i) saturation/vaporization feed valves closed; j) dispensing recirculation valves closed at each dispenser;

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11.0 (3) Initiation of the ESD system shall be manual, automatic, or both manual and automatic. Manual actuators shall be located in an area accessible in an emergency and at least 15 meters away from the equipment they serve, and shall be distinctly marked with their designated function.	It is recommended to add the following requirement to ensure that manual ESD buttons are available in the right locations: a) at each dispenser; b) on the control panel in control room; c) near LNG truck off-loading point; d) at each entry point to the LNG compound; e) on the exterior wall of the control building adjacent to the door.
12.0 Fire Protection Facilities	
12.0 (1) Each LNG storage facility shall be provided with continuously monitored low - temperature sensors or flammable gas detectors, which shall activate visual and audible alarms at the plant site and at constantly attended location if the facility is not attended continuously.	It is recommended to Gas Detection and not Low-temperature detectors. Low temperature detectors may only work for low temperature (atmospheric LNG), while the scope of the storage in this Standard is pressurized LNG. Temperature sensors are expected to have a low chance of detection.
12.0.(2) Flammable gas detection system shall activate an audible and a visual alarm at level not higher than 25% of the LEL of the gas being monitored	It is recommended that the reaction towards an LNG leak is staged as such: • 10% LEL (or similar): Leads to a process alarm • 20% LEL (or similar): Leads to a process trip, and ESD activation This is to promote awareness and response readiness upon a small leak. Gas detectors are vulnerable to wind and leak dispersion orientation. Therefore, sufficient gas detectors shall be installed in areas where an LNG leak can occur.
12.0 (3) Fire detectors shall activate an alarm at the plant site and at a constantly attended location if the plant site is not attended continuously. If determined by an evaluation that it is necessary then fire detectors shall be permitted to activate the ESD system.	In the case of Gas detections, there is a loss of primary containment, and it is an early warning for the potential fire. To prevent further escalation, it is recommended to take immediate action. It is recommended to amend the statement. Fire and Gas detectors shall activate an alarm at the plant site and at a constantly attended location if the plant site is not attended continuously. If determined by an evaluation that it is necessary, then fire and gas detectors shall be permitted to activate the ESD system.

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13.0 Boil Off Gas Management	
13.0 When LNG station is being set up, the capacity of storage tank may be optimized so as to minimize the BOG venting. For effective BOG management, the operator may use the gas for alternative supplies like CGD to avoid venting with the approval of the Competent Authority.	We recommend permitting the RO operator to use the BOG for supplying to any gas customer in the vicinity of the RO, including supplying into the near-by CGD distribution network to avoid venting of Methane. If such alternative use is not possible, it is recommended to implement additional measures (Sec 6.3.2 of ISO16924) such as insulation, operational optimization of the pump and LNG circulation to minimize venting as optimization of the tank capacity doesn't help in effective BOG management. It is recommended to take reference from ISO16924 Natural gas fuelling stations — LNG stations for fueling vehicles, Section 6.3.2 in lien with the standards followed in many other countries: • 6.3.2.1 The design and operation of the fuelling station shall minimize the venting of boil-off gas to the atmosphere. • 6.3.2.2 During normal operation, venting should be limited to minor releases of gas resulting, for example, from disconnection of hoses. • 6.3.2.3 Boil-off gas from other parts of the LNG fuelling station may be returned to the LNG storage tank for accumulation and/or treated in other suitable ways. • 6.3.2.4 In the case of emergency, venting of boil-off gas to the atmosphere is permitted provided that it is vented in a safe manner to a safe location.
14.0 LNG or LCNG Dispensing	
14.0 (A) (1) LNG dispensing sites dispensing saturated LNG with personnel in the immediate vicinity shall provide barrier walls or equal protection in order to protect the dispensing operator and vehicle.	It is recommended to specify minimum means of protection taking best practices from ISO standards applied globally. As a minimum, it is recommended to add: 'The operator, truck driver and vehicle shall be mainly protected by the following proposals: • dead man' switch (or dead man button) that stops dispensing when releasing dispenser button, • gas detection near dispenser, tripping at 25% LEL • break-away device in case of drive away with connected hose,

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	• high pressure trip, to prevent vehicle overpressure' Further reference can be taken from ISO16924
14.0 (B) 1-a) The dispenser shall be protected from vehicle collision damage.	It is recommended to specify preventive and mitigating barriers: • Preventive barriers include impact crash barriers, dispenser islands at height and traffic routing, allowing only one-way traffic. • Impact sensor (e.g. accelero meter) will prevent further escalation. Further reference can be taken from ISO16924
14.0 (B) 1-d) The maximum delivery pressure at the fueling nozzle shall not exceed the maximum allowable working pressure of the vehicle fuel tanks.	For scenarios where the pump control malfunctions, it is recommended to install safety barriers to mitigate the risks associated with a delivery pressure above the maximum allowable working pressure. It is recommended to add: 'A high-pressure trip shall be included as a minimum requirement in case the normal control fails.'
14.0 (B) 2-a) A fueling connector and mating vehicle receptacle shall be used for reliable, safe, and secure transfer of LNG or gas vapour to or from the vehicle, with minimal leakage.	It is strongly recommended to specify a vehicle dry-connect/disconnect nozzle and receptacle as per ISO12617. This is the global OEM reference standard for all suppliers in this supply chain. It also includes reference about maintaining leak tightness and cleanliness to ensure 'reliable, safe, and secure transfer'.
15.0 Operation, Maintenance and Training	
15.0 D-2) The procedure shall incorporate the need to carry out periodic inspection, tests on every equipment and system in service to verify that the equipment is maintained in accordance with the equipment manufacturer's recommendations.	In follow-up of the remarks under 'Section 11.0 ESD System', for safety critical equipment, it is strongly recommended to follow the guidance of international standards to ensure the reliability of the safety system. The following additional statement is recommended: 'The ESD system shall be maintained in accordance with the IEC 61508 and IEC 61511.'
16.0 Road Transportation	
16.0 C-8) Each vessel shall be rated for its holding time, the holding time being the time as	The holding time is dependent on

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determined by testing that will elapse from loading until the pressure of the contents, under equilibrium conditions reaches the level of the lowest pressure relief valve setting.	a) the amount of liquid in the vessel (where low liquid levels have very short holding times), b) the lowest pressure relief valve setting c) the insulating properties (e.g. thickness and material). If the Standard is recommending the holding time in order to avoid venting, it is recommended to add the b) and c) to the requirement. Alternatively, reference may be taken from ISO 21014, EN 12213 or equivalent standard.
17.0 Competence Assessment and Assurance	
17.0 (x) Recommended addition	The Standard does not specify LNG specific training, while the behavior of LNG is quite different compared to CNG. It is recommended to develop competency requirements equivalent and analogous to CNG, to ensure that the adequate and specific for LNG handling is in place.