

## **Schedule 4: “Storage, Handling and Dispensing at LNG/LCNG Dispensing Stations”**

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## **Schedule 4: “Storage, Handling and Dispensing at LNG/LCNG Dispensing Stations”**

### **1.0 Scope**

This technical standard and specifications including safety standards lays down the minimum requirements in design, operation, inspection, maintenance, training, consumer safety at Retail Outlets dispensing LNG/LCNG with above ground LNG storage. It does not cover the certification or fitness requirements of vehicles.

These provisions shall apply to the following -

- a. The requirements of the design, fabrication and installation and commissioning of LNG storage facility using cryogenic vacuum insulated containers of double wall constructed in accordance with approved pressure vessel codes and the requirements for safe vaporization, transfer and handling.
- b. The requirements of the road transportation of LNG in a cryogenic double walled vacuum insulated pressure vessel for the safe transportation and handling.
- c. Dispensing stations with following variants:
  - i. Dispensing of LNG
  - ii. Dispensing of CNG (LCNG)
  - iii. Provision for connection for supply of PNG
  - iv. Filling of CNG cascades

These facilities can be standalone, any combination of above or co located with Petroleum i.e. MS, HSD dispensing stations

### **2.0 Definitions**

- i. “Auto LNG” Means a liquefied natural gas (LNG) Meant for automotive fuel;’;
- ii. “Auto LNG dispensing station” means any premises used for storing and dispensing auto LNG as automotive fuel to the motor vehicles;’;
- iii. “LCNG” means CNG produced at the fueling station from LNG by pumping and vapourisation.
- iv. ”Impounding area” means an area that may be defined through the use of dykes or the topography at the site for the purpose of containing any accidental spill of LNG or flammable refrigerants;

### **3.0 Storage Installations and Handling**

#### **3.1 Installation Layout and General Requirements**

- (1) For the pressurized LNG storage installations
  - (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 1060m<sup>3</sup>.

TABLE-1

## Distances from Impound Wall and Property Line

Sl. No.	Water Capacity of the largest vessel (m <sup>3</sup> )	Minimum distance from edge of impoundment or vessel drainage system to property line	Minimum distance between storage vessels
1.	< 0.5	0 m	0
2.	> 0.5 but $\leq$ 1.9	3 m	1 m
3.	> 1.9 but $\leq$ 7.6	4.6 m	1.5 m
6.	>7.6 but $\leq$ 63	7.6 m	1.5 m
7	> 63 but $\leq$ 114.0	15.0 m	1.5 m
8	>114.0 but $\leq$ 265	23.0 m	1/4 of the sum of the diameters of adjacent vessel (minimum 1.5 m)
9	>265.0 but $\leq$ 379	1/2 vessel diameter (minimum 30.0 m)	

NOTE: If the aggregate water capacity of a multiple container installation is 1.9 m<sup>3</sup> or greater, the minimum distance must comply with the appropriate portion of this table, applying the capacity rather than the capacity per container, If more than one installation is made, each installation must be separated from any other installation by at least 7.6 m. Do not apply minimum distances between adjacent containers to such installation.

TABLE-2

## MINIMUM DISTANCE BETWEEN VESSEL AND DYKE WALL

Sl. No.	Water capacity of vessel (m <sup>3</sup> )	Inner edge of the dyke wall and outer shell of the storage vessel or D/2 (whichever is higher)
1.	Not above 3.8	0.5 m
2.	Above 3.8 but not above 7.6	1.0 m
3.	Above 7.6 but not above 56.8	1.5 m
4.	Above 56.8 but not above 114.0	1.5 m
5.	Above 114.0 but not above 265.0	1/4 of the sum of the diameters of adjacent vessels (minimum 1.5 m)
6.	Above 265.0 but not above 379	

TABLE-3

MINIMUM DISTANCE (s) BETWEEN EQUIPMENT / ITEMS INSTALLED OUTSIDE THE DYKE WALL  
AND OUTER EDGE OF DYKE WALL

Sl. No	Equipment / Items	Dyke wall (Outer Edge)
1.	Property Line / Fencing	As per Table 1 of this schedule
2.	Center of Truck Unloading Platform	Min. 4.0 m and min 9 m from the adjoining property. The fill point shall also observe minimum 9.0 meter safety distance to the adjoining property.
3.	Priority Panel	Outside dyke wall
4.	CNG Cascade (For LCNG station)	The safety distance as per Table I A of Gas Cylinders Rules, 2016 from edge of the dyke. The cascade shall be segregated from LNG facility by providing concrete wall up to the height of the cascade.
5.	On site building/ Control room/sales office	Outside the safety distances as per Table 1 of this schedule.
6.	LNG and CNG Dispensers (if LCNG station)	Min. 6.0 m (and also, min 6.0 m from centre of hard stand).

The above facilities can be either standalone or co-located. The minimum distance between dispenser, fill point, impounding/ dyke wall, vent etc. shall be as per Table -4 below:

**Table - 4**

The minimum distance between various facilities at LNG, LCNG dispensing stations

Sr. No	Station	Inter Distance / Norm	Distance (Mtr)
A	<b>Dispensing Stations not co-located with Petroleum Retail outlets</b>		
1	Standalone (LNG or LCNG)	Auto LNG/ LCNG Dispenser & Property line	6
		Auto LNG/ LCNG Dispenser & Impound Wall	6
2	LNG and LCNG	Auto LNG and LCNG Dispenser	6
3	LNG, LCNG and Cascade Filling	Mobile CNG Cascade Filling Point and LNG/CNG Dispenser	6
		The cascade shall be segregated from the LNG facility by providing concrete wall upto height of cascade (Refer table of 1A of GCR 2016)	-
4	Auto LNG, LCNG, Cascade filling and connection for supply of piped gas	Shall comply with the PNGRB T4S for CGD Networks Regulations for connection for supply of PNG	-
B	<b>Dispensing Stations Co-located with Petroleum Retail Outlets</b>		
5	LNG/LCNG dispensing at Retail Outlet	LNG/LCNG and MS/ HSD Dispenser	6
6		MS/HSD fill point and Impound wall	9
7		MS/HSD Vent & Impound wall	9
8		MS/HSD fill point/ Vent and Auto LNG/ LCNG Dispenser	9
9		Center of LNG Truck unloading platform (Hard stand) to MS/HSD Vent/ Fill point	9

NOTE : NON FUELING FACILITIES AT LNG OR LCNG STATIONS - Non fueling facilities like small convenience stores, service station, ATM, PCO, whenever provided, shall be beyond safety distance mentioned in this schedule. In addition a minimum distance of 10 meter from the LNG/LCNG dispensers shall be maintained. The accessibility to such non fuelling facilities shall not be through operational area. While providing such facilities, factors like degree of congestion in the premises, easy entry and exit of the vehicle coming for refueling and easy maneuverability of LNG road tanker while moving out of the premises in the event of emergency shall also be taken into consideration.

(b) For non-pressurised LNG storage installation,

The safety distances specified in the PNGRB (Technical Standards and Specifications including Safety Standards for LNG Facilities) Regulations, as amended from time to time, shall be followed.

(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) Seismic effect;
  - (c) Erosive action from a spill;
  - (d) Effect of the temperature, thermal gradient, and any other anticipated degradation resulting from sudden or localised contact with LNG.
- (3) The structural members of the impoundment system shall be designed and constructed to prevent impairment of reliability and structural integrity as a result of the following -
- (a) Imposed loading from full hydrostatic head of impounded LNG;
  - (b) Effect of rapid cooling to the temperature of liquid to be confined
  - (c) Fire exposure
  - (d) Natural forces (Earthquake, wind, rain etc.)
- (4) Impoundment or dyke areas shall be designed to prevent water collection. Drainage pumps and piping should be provided to remove water from collecting in the impoundment area. Where drainage pumps with automatic controls are used, these shall be provided with cut off devices that prevent their operation when exposed to LNG storage temperature.
- (5) Compressors, CNG Cascades, Odorizers etc. shall not be located inside the impounding area.
- (6) Odorizing unit shall be provided in LCNG stations.
- (7) The ambient air vaporizers and remotely heated vaporizers may be located inside impounding area.
- (8) The impounding system for LNG storage vessel shall have a minimum 110 % of the volumetric capacity of the largest vessel in an impoundment.
- (9) The height of the impoundment wall shall be adequate to contain spillage of LNG. Dyke wall height should be between 0.6 meter to 1 meter from the dyke floor level.
- (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.
- (11) No other flammable liquid or storage vessel shall be located within an LNG impounding area.
- (12) A clear space of 0.9 meters shall be provided for access to all isolation valves serving multiple vessels. The isolation valve of LNG vessel piping should be close to outer vessel.
- (13) LNG vessels, cold boxes, piping and pipe supports and other cryogenic apparatus installed within dyke shall be designed and constructed in a manner to prevent damage to these structures and equipment due to freezing or frost heaving in the soil.
- (14) Adequate flameproof lighting shall be provided for facilities transferring LNG during night.
- (15) For layout and installation of electrical equipment, clause 4.3 of Schedule – 1 of these regulations shall be referred.
- (16) Electrical grounding and bonding shall be provided in line with IS 3043. For further details, clause 4.4 of Schedule – 1 of these regulations shall be referred.
- (17) Layout shall ensure unobstructed access and exit of the consumers and vehicles including LNG tankers, CNG cascades etc.as applicable at all times.
- (18) Entrance, exit and paving shall be arranged in a manner, so as to minimise the risk of collision.
- (19) The operating personnel shall have an unobstructed overall view of the facilities both from the sales room and from the delivery area.
- (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
- (21) The designated location for tanker unloading shall not hinder other traffic. The tanker shall always be placed in drive out position.
- (22) Crash/ impact barriers shall be installed to protect dispensing units against accidents involving vehicle movements.
- (23) The storage area which includes the pumps and the related piping shall be suitably segregated from the rest of the premises and located in a manner that it is away from the area frequented by public during their movement within the station and also from the path of vehicles entering and leaving the premises.

Typical layouts of auto LNG / LCNG Station with provision of mobile cascade filling and PNG and auto LNG / LCNG dispensing Station co-located with Petroleum ( MS, HSD) Retail outlet provided in Figure – I and Figure – II respectively.

#### **4.0 LNG Storage Vessel - General design requirements:**

##### **(a) Foundation:**

- (1) LNG vessels foundations shall be designed and constructed in accordance with established / approved engineering practices. Prior to the start of design and construction of the foundation, a subsurface investigation shall be conducted to determine the stratigraphy and physical properties of the soils.
- (2) The design of saddles and legs for the LNG vessel shall include erection load, wind loads and thermal loads.
- (3) Foundation and support shall have a fire resistance rating of not less than two hrs. Support up to 0.4 meter may not need fire proofing.
- (4) LNG vessels installed in areas subject to flooding shall be secured to prevent release of LNG or floatation of the vessel in the event of a flood.

##### **(b) Vessel Design:**

- (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.
- (2) The inner vessel shall be designed for the most critical combination of loading resulting from internal pressure, liquid heads. The Inner vessel supports system shall be designed for shipping, seismic, and operating loads.
- (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 mm<sup>2</sup>/liter of the water capacity of the inner vessel but not exceeding 2000 cm<sup>2</sup> and have pressure setting not exceeding 25 psi (1.72 Kg/cm<sup>2</sup>)
- (4) Thermal barriers shall be provided to prevent outer tank from falling below its design temperature.
- (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.
- (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 ASME Boiler and Pressure Vessel Code, Section VIII or ASME B 31.3 or equivalent.

- (7) LNG vessels shall be designed to accommodate both top and bottom filling unless other positive means are provided to prevent stratification.
- (8) Any portion of the outer surface area of an LNG vessel that could accidentally be exposed to low temperatures resulting from the leakage of LNG or cold vapor from flanges, valves etc. shall be intended for such temperatures or protected from the effects of such exposure.
- (9) Seismic loads shall be considered in the design of the LNG vessel support systems.

#### **5.0 Fitments:**

- (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.
- (2) Relief devices shall be vented directly to the atmosphere. 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 manual full opening stop valve or a flow diverter valve.
- (3) Safety relief valve shall be designed and installed to prevent any accumulation of water, or other foreign matter at its end.
- (4) The minimum pressure relieving capacity in kg/hr shall not be less than 3% of the full tank contents in 24 hours.
- (5) All liquid connections to the LNG vessel except relief valve and instrumentation connection shall be equipped with automatic fail safe product retention valves.
- (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.
- (7) Automatic shutoff valves that require excessive time to operate during emergency i.e. sizes exceeding 200mm shall be pneumatically operated and also have means of manual operation.
- (8) 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.
- (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.
- (10) LNG vessel shall be equipped with at least one liquid level gauging device. The devices shall be designed and installed so that they can be replaced without taking the tank out of operation. The level and pressure shall be visible to the operating personnel during unloading/ loading and transfer.
- (11) LNG vessel shall be equipped with a high liquid level flow cut off device.
- (12) LNG vessel shall be equipped with pressure gauge connected to the vessel at a point above the maximum intended liquid level.
- (13) Instrumentation for storage and vaporization facilities shall be so designed so that if a power or instrument air failure occurs, the system will proceed to a failsafe condition and



maintain that condition until the operator takes appropriate action to reactivate or secure the system.

## 6.0 Equipment

1. Pumps and compressors employed in LNG source shall be provided with a pressure relieving device on the discharge to limit the pressure to the maximum safe working pressure of the casing and downstream piping and equipment.
2. Each pump shall be provided with adequate vent, relief valve, or both to prevent over-pressuring the pump casing during the maximum possible rate of cool down.
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.
4. The material of construction of LNG vaporizers is recommended as Austenitic Stainless-Steel piping with outer Aluminum fins.
5. Manifolder vaporizers shall be provided with both inlet and discharge block valves for each set of vaporizer
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.
7. Two inlet valves shall be provided to isolate an idle, manifolded vaporizer to prevent leakage of LNG into the vaporizer. A safe means of disposing LNG or gas that can accumulate between the valves shall be provided in case the vaporizers are of size having inlets more than 50 mm diameter.
8. (i) The ambient air vaporizers shall be installed inside the impounding area.  
(ii) Where the heated vaporizer is located 15 m or more from the heat source, the remote shutoff location shall be at least 15 m from both the vaporizer and heat source.  
(iii) Where the heated vaporizer is located less than 15 m from the heat source or nearest LNG vessel , it shall have an automatic shut off valve in the LNG liquid line located at least 3 m from the vaporizer and shall close when either of the following occurs:
  - (1) Loss of line pressure (excess flow).
  - (2) The occurrence of a fire is detected by an instrument designed for the purpose and located to detect a fire in the covered area or abnormal temperature sensed in the immediate vicinity of the vaporizer (fire)
  - (3) Low temperature in the downstream of the vaporizer.
  - (4) Manual ESD trip

If the facility is attended, manual operation of the automatic shutoff valve shall be at least 15 m away from the vaporizer, in addition to the requirement as specified in para (iii) above.
- (iv) The above conditions shall be applicable for LNG vaporizers for purposes other than pressure building coils or LNG to CNG (LCNG) systems.
9. A distance of minimum 1 meter shall be maintained between vaporizers.
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 loss of line pressure occurs or abnormal temperature is sensed in the immediate vicinity of the vaporizer or when low temperature in the vaporizer discharge line occurs.
11. Each set of vaporizer shall be provided with a safety relief valve(s) sized in accordance with the following requirements, namely:-

- (a) Ambient vaporizers—relief valve capacity shall allow discharge equal or greater than 150% of the rated vaporizer natural gas flow capacity without allowing the pressure to rise 10% above the vaporizer maximum allowable working pressure.
  - (b) Relief valves on heated vaporizers – same as sub-clause (a) above, however, it shall be located such that they are not subjected to temperatures exceeding 60°C. during normal operation.
- 12. Automation shall be provided to prevent the discharge of either LNG or vaporizer gas into a distribution system at the temperature either above or below the design temperature of the send out system.
  - 13. Vaporizers shall be provided with outlet temperature monitors.
  - 14. Aluminium shall be used only downstream of a product retention valve in vaporizer service.

### **7.0 Piping System:**

- (1) All piping system and components shall be designed to –
  - (a) Accommodate the effects of thermal cycling fatigue to which the systems shall be subjected.
  - (b) Provide for expansion and contraction of piping and piping joints due to temperature changes.
  - (c) Meet the requirements of ASME 31.3
- (2) Piping material including gaskets and thread compounds shall be compatible throughout the range of temperature to which they are subjected.
- (3) The valves provided in the installation shall be of extended bonnet type with packing seals in a position that prevents leakage or malfunction due to freezing.
- (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.
- (5) All the piping section between the two valves where the liquid may be trapped shall have the thermal relief valve.

### **8.0 Transfer of LNG :**

- (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.
- (2) Adequate check valves shall be provided to prevent backflow and shall be located as close as practical to the point of connection to any system from which backflow might occur.

### **9.0 Pump and Compressor Control:**

In addition to a locally mounted device for shutdown of the pump or compressor drive, a readily accessible, remotely located device shall be provided at least 7.5 meters away from the equipment to shut down the pump in an emergency.

### **10.0 Tank Vehicle Unloading Facilities:**

- (1) The tank vehicle unloading area shall be of sufficient size to accommodate the vehicles without excessive movement or turning.
- (2) Transfer piping, pumps, and compressors shall be located or protected by barriers so that they are safe from damage by vehicle movements.
- (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.

- (4) At least one qualified person shall be in constant attendance while unloading is in progress.
- (5) Written procedures shall be available to cover all transfer operations and shall cover emergency as well as normal operating procedures.
- (6) Loading and unloading areas shall be posted with signs that read "No Smoking."
- (7) Prior to transfer, gauge readings shall be obtained or inventory established to ensure that the receiving vessel cannot be overfilled, and levels shall be checked during transfer operations.
- (8) The transfer system shall be checked prior to use to ensure that valves are in the correct position, and pressure and temperature conditions shall be observed during the transfer operation.
- (9) Transfer operations shall be commenced slowly and if any unusual variance in pressure or temperature occurs, transfer shall be stopped until the cause has been determined and corrected.
- (10) Pressure and temperature conditions shall be monitored during the transfer operation.
- (11) While tank vehicle unloading operations are in progress, vehicle traffic shall be prohibited within 25 ft (7.6 m) of LNG facilities or within 50 ft (15 m) of refrigerants whose vapors are heavier than air.
- (12) Truck vehicle engines shall be shut off if not required for transfer operations.
- (13) The engine shall not be started until the truck vehicle has been disconnected and any released vapors have dissipated.

#### **11.0 Emergency Shut Down System (ESD System) :**

- (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.
- (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.
- (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.

#### **12.0 Fire Protection Facilities:**

- (1) Each LNG storage facility shall be provided with 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.
- (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.
- (3) Fire detectors shall activate an alarm at the 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.
- (4) Fire protection shall be provided for all LNG fueling facilities. The extent of such protection shall be determined by an evaluation based on sound fire protection engineering principles, analysis of local conditions, vehicle operations hazards within the facility, exposure to or from other property, and the size of the LNG containers. The evaluation shall determine the following, as a minimum:
  - i. The type, quantity, and location of equipment necessary for the detection and control of fires, leaks, and spills of LNG, flammable refrigerants, or flammable gases or liquids
  - ii. The methods necessary for the protection of vehicles, equipment, and structures from the effects of fire exposure.

- iii. The equipment and processes to be incorporated within the emergency shutdown (ESD) device system.
  - iv. The type, quantity, and location of sensors necessary to initiate automatic operation of the ESD system
  - v. The availability and duties of individual facility personnel and the availability of external response personnel during an emergency
  - vi. The protective equipment and special training required by personnel for emergency duties.
- (5) Fire fighting facilities need to be carefully planned after considering the availability of municipal fire tenders and other related matters and, at least the following portable fire extinguishers shall be positioned, namely: -

Sr. No.	Location	Type of Extinguishers
<u>1</u>	<u>Storage and decantation area</u>	<u>1 x 75 kg. DCP / ABC with dial gauge</u>
<u>2</u>	<u>LNG/ LCNG Dispensing forecourt</u>	<u>1 x 75 kg. DCP / ABC with dial gauge</u>
<u>3</u>	<u>MCC or Electrical Installation</u>	<u>1 x 4.5 kg CO2 Per 25 Sq. M floor area</u>

- (6) Portable or wheeled fire extinguishers of DCP and/or foam type shall be made available at strategic locations. At least 4 such extinguishers of 10 kg. capacity each shall be provided.
- (7) Additionally, two sets of sand buckets each comprising at least 4 sand bucket shall be provided at strategic locations.
- (8) These facilities shall be in addition to the fire firefighting facilities required for standalone dispensing stations as given in Schedule - 1 and Schedule-3 of these Regulations.

### 13.0 Boil Off Gas Management

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

### 14.0 LNG or LCNG Dispensing

This section lays down the requirements for LNG dispensers.

#### (A) General

- (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.
- (2) All facility piping other than the dispensing hose to the vehicle shall be behind a barrier, which in the case of an equipment or device malfunction deflects the saturated LNG upward.
- (3) LNG fueling facilities transferring LNG during the night shall have permanent, adequate lighting at points of transfer and operation.

#### (B) System Components

- (1) Vehicle Fueling Dispenser :
  - (a) The dispenser shall be protected damage due to vehicle collision.
  - (b) An ESD shall be provided with a shutoff valve for stopping liquid supply and shutting down of the transfer equipment.

- (c) An ESD actuator, distinctly marked for easy recognition with a permanently affixed, legible sign, shall be provided near the dispenser, vehicle unloading facility and in sales/control room.
  - (d) The maximum delivery pressure at the fuelling nozzle shall not exceed the maximum allowable working pressure of the vehicle fuel tanks.
  - (e) (i) Hose or arms shall be equipped with a shutoff valve at the fuel end and a breakaway device to minimise release of liquid and vapour in the event that a vehicle pulls away while the hose remain connected.  
(ii) Such a device shall be installed and maintained in accordance with the OEM's maintenance/safety instructions.  
(iii) A breakaway device shall be provided to separate using a force not less than 102 kgf and not greater than 125 kgf where applied in any direction that the vehicle would move.
  - (f) The hose shall be secured to protect it from damage when not in use.
  - (g) (i) Where a hose or arm of nominal 76 mm diameter or larger is used for liquid transfer or where one of nominal 100 mm diameter or larger is used for vapour transfer, an emergency shutoff valve shall be installed in the piping of the transfer system within 3.1 m from the nearest end of the hose or arm.  
(ii) Where the flow is away from the hose, a check valve shall be permitted to be used as the shutoff valve.  
(iii) Where either a liquid or vapour line has two or more legs, an emergency shutoff valve shall be installed either in each leg or in the feed line before the legs.
  - (h) The operating instructions for dispenser shall be posted near or on the dispenser.
  - (i) Operating instructions identifying the location and operation of emergency controls shall be posted conspicuously in the facility area.
- (2) Vehicle Fuelling Connector:
- (a) A fuelling 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.
  - (b) The fuelling connector either shall be equipped with an interlock device that prevents release while the line is open or have self-closing ends that automatically close upon disconnection.
- (3) Installation of Emergency Shutdown Equipment (ESD):
- (a) ESD shall be provided near to the dispenser, LNG unloading facilities and sales / control room.
  - (b) Instrumentation for LNG fuelling facilities shall be designed so that, in the event of a power or instrumentation failure, the system goes into a fail-safe condition until the operators either reactivate or shut down the system.
  - (c) All ESDs shall be manually reset.

## 15.0 Operation, Maintenance and Training

- A. Each LNG/ LCNG installation / dispensing station shall provide for written operating, maintenance and training procedures. Such procedures shall be drawn based on experience, knowledge of similar facilities.
- B. Each LNG/ LCNG installation / dispensing station shall meet the following requirements, namely:-
  - (1) Have written procedures covering operation, maintenance and training.

- (2) Keep up-to-date drawings of plant equipments.
  - (3) Have written emergency plan as part of the operations manual.
  - (4) Shall be in liaison with local authorities like Police, Fire Department, Health Authorities and keep them informed about emergency plans and their role in emergency situations.
  - (5) Have documents wherein safety related malfunctions are identified and analyzed for the purpose of determining their causes and preventing the possibility of reoccurrence.
- C. Operating Procedures Manual : Every LNG / LCNG installation / dispensing station shall have a written manual of emergency procedures that shall include a types of emergencies that are anticipated and shall include the following procedures, namely:-
- (1) Start up and shut down procedure including initial start up of the LNG/ LCNG facility.
  - (2) Purging and inerting components.
  - (3) Cooling down components.
  - (4) Identify the possibility of abnormal conditions.
  - (5) Safety precautions requirement to be taken while repairs/maintenance in the installation is being carried out.
  - (6) Procedures for responding to controllable emergencies including notifying personnel and use of equipments i.e. appropriate to handling of emergency.
  - (7) Procedure for recognising an uncontrollable emergency and for taking action to ensure that harm to the personnel in the premises and to the public outside is limited.
  - (8) Procedure for immediate notification of the emergency to the local authorities.
  - (9) Procedure for coordinating with local authorities in the preparation of any evacuation plan which may be required to protect the public in the event of emergency.
- D. Maintenance:
- (1) Every installation shall have a written procedure based on experience and knowledge of similar facilities and conditions under which the installation shall be maintained.
  - (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.
  - (3) The written manual shall set out inspection and maintenance programme for each components forming part of the installation. In addition to fixing a schedule for inspection and tests, the procedure to be followed during repairs so as to ensure safety of persons and property shall also be laid down.

## 16.0 Road Transportation

### (A) Design - General Requirements :

The safety relief valves provided on the inner vessel of the LNG transport tank shall be sized to meet most stringent condition of simultaneous occurrence of loss of vacuum and external fire. The combined capacity of the safety valves shall be sufficient to limit the pressure in the vessel to the test pressure -

- (1) The transport vessel shall be designed and constructed as per the ASME Section VIII Div I Boiler & pressure vessel code, EN13530 or equivalent code and also to meet the requirements of ISO 20421. The design temperature of the vessel, piping and valves shall be such that it is suitable for requirement sustaining cold shock caused by a loading of liquid Nitrogen into the vessel during its testing and commissioning.

- (2) Each vessel shall have adequate insulation that will prevent the vessel pressure from exciting the relief valve set pressure within the specified holding time when the vessel is loaded with LNG at the design condition of –
    - a) Specified temperature and pressure of the LNG.
    - b) Ambient temperature
  - (3) The outer vessel/jacket of the cryogenic vessel for transportation of LNG shall be made of no other material other than steel.
  - (4) No Aluminium valve or fitting external to the wetted outer vessel shall be installed on LNG transportation vessels. Each transportation vessel shall consist of a suitably supported welded inner vessel enclosed within an outer shell with vacuum insulation between the two.
- (B) Structural Integrity:
- (1) The design and construction of each vessel used for transportation of LNG shall be in accordance with ASME Section VIII Div. 1 of ASME Boiler & pressure vessel Code, EN13530 or equivalent code. The vessel design shall include calculation of stress due to design pressure, the weight of lading, the weight of structure supported by the vessel wall, and the effect of the temperature gradients resulting from lading and ambient temperature extremes.
  - (2) In order to account for stresses due to impact in an accident, the design calculation of the vessel shell and heads shall include the load resulting from the design pressure in combination with the dynamic pressure resulting from a longitudinal deceleration of 2g. For this loading condition, the stress value used shall not exceed 75% of the yield strength of the material of construction.
  - (3) The fittings and accessories mounted on the vessel shall be protected in such a way that damage caused by overturning can not impair operational integrity. This protection may take the form of cylindrical profile of the vessel, of strengthening rings, protective canopies or transverse or longitudinal members so shaped that effective protection is given.
  - (4) The welding of the appurtenances to the vessel wall shall be made of attachment of the mounting pad so that there will be no adverse effect upon the loading retention integrity of the vessel.
- (C) Pressure Relief Devices, Piping, Valves and Fittings :
- (1) Hoses shall be approved for the service and shall be designed for a bursting pressure of at least five times working pressure.
  - (2) If a threaded pipe is used, the pipe and fitting shall be Schedule 80 or higher rating.
  - (3) Each hose coupling shall be designed for a pressure of at least 120% of the hose design pressure and there shall be no leakage when connected.
  - (4) Piping shall be protected from damage due to thermal expansion and contraction, jarring and vibration. Slip joints shall not be used.
  - (5) Each valve shall be suitable for the vessel design pressure at the vessel design service temperature.
  - (6) All fittings shall be rated for the maximum vessel pressure and suitable for the coldest temperature to which they will be subjected in actual service.
  - (7) When a pressure building coil is used on the vessel, the vapor connection to that coil shall be provided with a valve or check valve as close to the vessel shell as practicable to stop flow in case of damage to the coil. The liquid connection to the coil shall also be provided with a valve.
  - (8) Each vessel shall be rated for its holding time, the holding time being the time as 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.

- (9) 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.
- (10) Rupture discs shall not be used on the LNG transport vessels.
- (11) The outer vessel shall be protected by any accidental accumulation of pressure in the annular space by using a relief plate or plug or a rupture disc. The relief device shall function at a pressure of 25 psi or the internal design pressure of the outer tank or the external design pressure of the inner tank, whichever is less.

(D) Damage Protection During Transportation

- (1) All valves, fittings, pressure relief devices and other accessories to the vessels, which are not isolated from the vessel by closed intervening shut off valves or check valves shall be installed within the framework of motor vehicle or within a suitable collision resistant guard or housing. Further, appropriate ventilation shall also be provided.
- (2) Each pressure relief device shall be protected so that in the event of the upset of the vehicle on to a hard surface, the device's opening will not be prevented and its discharge will not be restricted.
- (3) The threaded end connection safety valves are preferred in stainless steel body construction.
- (4) Each protective device or housing and its attachment to the vehicle structure shall be designed to withstand static loading in any direction that it may be loaded as a result of front, rear, side or sideswipe collision or the overturning of the vehicle.
- (5) All the valves of tank shall be at rear inside on operation box (cabinet) of suitable size and shall not project out of tank frame.

(E) Rear End Protection:

- (1) Rear end vessel protection devices shall consist of at least one rear bumper designed to protect the transport vessel and piping in the event of a rear end collision.
- (2) The rear end vessel protection device shall be designed so that it transmits the force of the collision directly to the chassis of the vehicle.
- (3) The rear end vessel protection device and its attachments to the chassis shall be designed to withstand a load equal to twice the weight of the loaded cargo vessel and attachments, using a safety factor of four based on the tensile strength of the materials used with such load being applied horizontally and parallel to the major axis of the transport vessel.
- (4) Every part of the loaded transport vessel and any associated valve, pipe, and enclosure or protected fitting or structure shall be at least 35.5 cm above ground level.

(F) Discharge Control Devices:

- (1) Each liquid filling and liquid discharge line shall be provided with a shut off valve located as close to the vessel as practicable. Unless this valve is manually operable at the valve, the line shall also have a manual shut off valve.
- (2) Each liquid filling and liquid discharge line shall be provided with an on vehicle remotely controlled self-closing shutoff valve.
- (3) Each control valve shall be of fail-safe design and spring- based.
- (4) Each remotely controlled shut off valve shall be provided with on vehicle remote means of automatic closure, both mechanical and thermal.



- (5) Each remotely controlled shut off valve shall be provided with on-vehicle remote means automatic closure, both mechanical and thermal. One means may be used to close more than one remotely controlled valve. Remote means of automatic closure shall be installed at the ends of the tanker farthest away from the loading/unloading connection area.

(G) Shear Section:

Unless the valve is located in a rear cabinet forward of and protected by the bumper, the design and installation of each valve, damage to which could result in loss of liquid or vapor shall incorporate a shear section or breakage groove adjacent to and outboard of the valve. The shear section or breakage groove shall yield or break under strain without damage to the valve that would allow the loss of liquid or vapour.

(H) SUPPORTS AND ANCHORING:

In case, the transport tanker vehicle is such designed and constructed that the vessel is not wholly supported by the vehicle frame, the transport vessel shall be supported by external cradles or load rings. The design calculations for the supports and load bearing vessel and the support attachments shall include beam stress, shear stress, torsion stress, bending moment and acceleration stress for the loaded vehicle as a unit, using a safety factor of four based on the tensile strength of the material and static loading that uses the weight of the transport vessel and its attachments when filled to the design weight of the loading. Minimum static loadings shall be maximum of the following individually -

- (i) Vertically downward of two (2);
- (ii) Vertically upward of one and half (1.5);
- (iii) Longitudinally of one and half (1.5); and
- (iv) Laterally of one and half (1.5).

(I) GAUGING DEVICES:

(a) Liquid level gauging devices :

The vessel shall have one liquid level device that provides a continuous level indication ranging from full to empty and that is maintainable or replaceable without taking the vessel out of service

(b) Pressure gauges :

Each vessel shall be equipped with a pressure gauge connected to the vessel at a point above the maximum liquid level that has a permanent mark indicating the maximum allowable working pressure of the tanker. The pressure gauge shall be housed in a canopy of the tanker.

## 17.0 Competence Assessment and Assurance

- 17.1 The objective is to provide good understanding of all the facets of dispensing activities including operations, procedures, maintenance and hazards of CNG and the risks associated with handling of the product. Training shall ensure that the jobs are performed in accordance with the laid down procedures and practices.
- 17.2 Every entity shall develop, implement, and maintain a written training plan to instruct all CNG dispensing station personnel with respect to the following:

- 17.2.1 Carrying out the emergency procedures that relate to their duties at the CNG dispensing station as set out in the procedure manual and providing first aid.
- 17.2.2 Permanent maintenance, operating, and supervisory personnel with respect to the following:
- i. The basic operations carried out at the CNG dispensing station
  - ii. The characteristics and potential hazards of CNG dispensing station and other hazardous fluids involved in operating and maintaining the CNG dispensing station, including the serious danger from frostbite that can result upon contact with POL products and CNG.
  - iii. The methods of carrying out their duties of maintaining and operating as set out in the manual of operating, maintenance and transfer procedures.
  - iv. Fire prevention, including familiarization with the fire control plan of the CNG dispensing station; fire fighting; the potential causes of fire/ accident in CNG dispensing station; the types, sizes, and likely consequences of a fire/ accident at a CNG dispensing station.
  - v. Recognizing situations when it is necessary for the person to obtain assistance in order to maintain the security of the CNG dispensing station.
- 17.3 Training shall be imparted to the staff attached with the CNG dispensing station at the time of induction, which is to be followed up by periodic refresher courses once every year. The training programme shall inter alia cover following aspects:
- a. Hazardous characteristics of CNG.
  - b. Familiarisation with operational procedures & practices.
  - c. Commissioning of new facilities and equipment.
  - d. Hands on experience on operation of equipment.
  - e. Routine maintenance activities of the facilities.
  - f. Knowledge of emergency and manual shut down systems
  - g. Immediate and effective isolation of any CNG leak.
  - h. Accounting of product
  - i. Safety regulations and accident prevention.
  - j. Fire fighting facilities ,methods of fire fighting and its upkeep.
  - k. Evacuation and safe egress of the vehicles.
  - l. Housekeeping
  - m. Safety in transportation of CNG.
  - n. First aid.
  - o. Emergency plan /drills
  - p. Natural gas leakage possibility and its containment.
  - q. Filling nozzles, types of gasket/ seal etc.
  - r. Access control of vehicles so as to allow the vehicle with tested cylinders to be filled with CNG

17.4 Appropriate training techniques shall be adopted which will include:

- a. Classroom training
- b. Hands on/ practical training
- c. Demonstration
- d. Case studies
- e. Training aids

17.0 Proper records for the training and refresher courses shall be maintained at the installation.

## **18.0 Emergency Plan and Procedure**

- 18.1 A comprehensive ERDMP shall be developed in accordance to the Petroleum and Natural Gas Regulatory Board (Codes of Practices for Emergency Response and Disaster Management Plan (ERDMP)) Regulations, 2010. The copies of the ERDMP shall be available to all personnel at the CNG dispensing station.
- 18.2 Provision of minimum 2 points for emergency shutdown shall be maintained;
- The entity having control over the dispensing station shall draw an operational emergency plan in consultation with adjoining establishments and local authorities e.g. fire brigade, police, and other District Emergency Authorities etc. for the following circumstances:
- a. Loss of or interruption to the gas supplies due to leaks or failure of pipeline
  - b. Over-odorisation of the gas
  - c. Major failure of LCNG / LNG fittings
  - d. Accidents or other emergencies, which can affect the L-CNG/ LNG dispensing station
  - e. Civil emergencies
  - f. Emergency situations during transportation of LCNG through mobile cascade vehicles
  - g. Any other risk arising from the existence or use of the LCNG/ LNG dispensing station.
- 18.3 The above emergency plan shall be disseminated amongst all personnel involved and ensured that they understand their roles and responsibilities in the event of an emergency.
- 18.4 The operator of the dispensing station should have close liaison with Fire Service, the Police, the Municipal Authorities and the person supplying gas to CNG facility.
- 18.5 Important telephone numbers for emergency use shall be displayed prominently.
- 18.6 Means of communication shall be always at the disposal of the Incharge of the installation on 24 hours basis.
- 18.7 The emergency plan should be tested as per PNGRB ERDMP regulations.
- 18.8 First aid kit shall contain items to handle possible emergencies as per Rules applicable to factories in the concerned State for such purpose; and
- 18.9 Electrical shock treatment chart written in bilingual (English and local languages) and RO attendants shall be given training on how to treat an electrocuted person before help from a doctor is available.

## 19.0 Automation

The automation (Forecourt Control) where provided, shall comply with the provisions as specified clause 5.0 of Schedule – 1 of these Regulations.

## 20.0 Safety Inspections/ Audit

The safety inspections / audit of CNG dispensing station shall be carried out as given below:

TYPE	FREQUENCY	AGENCY
General Inspection	Daily	Operating personnel
	Twice in a quarter	Authorised personnel of marketing company
Safety Audit	Once in a year	Authorised Person
Electrical Audit	Once in three years	Licensed Electrical agency

The comprehensive checklist shall be developed in line with the similar checklists provided in Schedule – 1 of these Regulations.

Figure - I

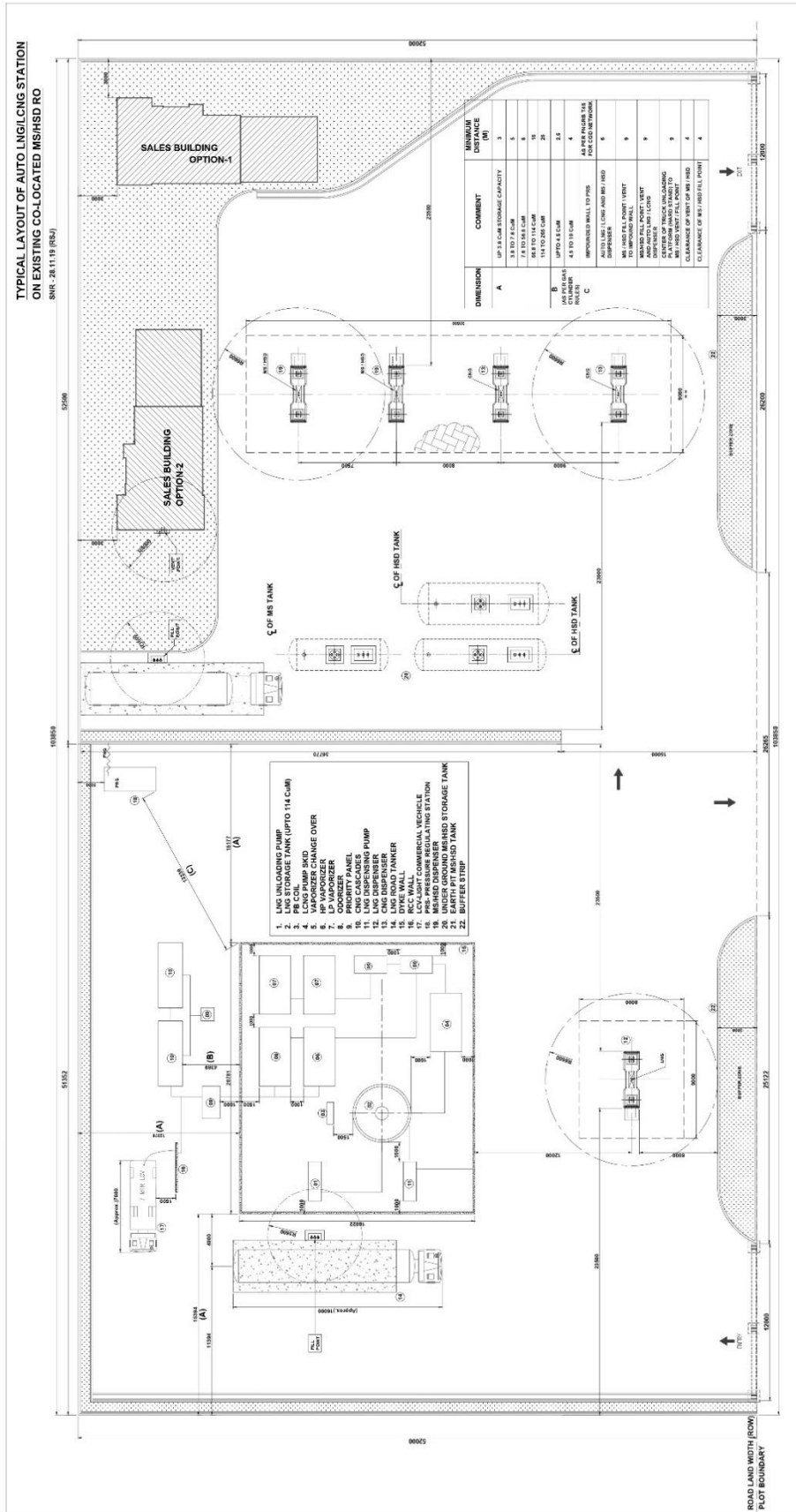


Figure - II

