PHILIPPINE NATIONAL STANDARD

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DPNS on LPG Import Terminal / Depot with Safety Practices

BUREAU OF PHILIPPINE STANDARDS (BPS)
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- International Organization for Standardization (ISO)
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Foreword

This Philippine National Standard (PNS) for LPG Import Terminal / Depot with Safety Practices was prepared by the Department of Energy's (DOE) Technical Committee on Petroleum Processes and Facilities (BPS/TC 68) through its Technical Working Group on LPG Facilities (TWG 1) – LPG Import Terminal / Depot with Safety Practices. This Standard was approved for adoption as Philippine National Standard by the Bureau of Philippine Standards.

This Standard provides for the minimum facility requirements for LPG Import Terminals / Depots to ensure safe and efficient storage and receiving of bulk LPG.

It is anticipated that the materials referenced herein would form the basic requirements for safe, environment-friendly, responsible operations of LPG Import Terminals / Depots, and act as the primary and minimum requirements in this sector of the Downstream Oil Industry.

The provisions in this PNS are voluntary in nature and may be used as a reference by any interested party. Compliance with this Standard or part/s thereof is voluntary unless otherwise imposed or referred to by law, or regulations issued by competent authorities. Existing laws or regulations shall prevail when there is a conflict with this PNS.

Published by the Bureau of Philippine Standards

1 Scope

This Standard specifies the minimum facility requirements for LPG Import Terminal / Depot for receiving bulk LPG from vessel and storage of bulk LPG.

This Standard also incorporates the Safety Practices that should be observed in the operations and upkeep of LPG Import Terminals / Depots.

2 Normative references

The following document is referred to in the text in such a way that some or all their content constitutes provisions of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

PNS/DOE FS 2 Liquefied Petroleum Gas (LPG) refilling plant – General requirements

International Safety Guide for Oil Tankers and Terminals (ISGOTT)

National Fire Code of the Philippines (R.A. 9514)

NFPA 58, Liquefied Petroleum Gas Code

ASME A13.1-2007, Scheme for the Identification of Piping System

3 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

3.1
aboveground storage tanks
a tank or pressure vessel where all parts of which are exposed above ground

3.2
depot
refers to a facility used to receive, unload, and load LPG from local sources. It is equipped with a port, jetty, and other infrastructure

3.3
import terminal
refers to a facility used to import, receive, unload and load LPG from local or foreign sources. It is equipped with a port, jetty, and other infrastructure

3.4
installations
tanks or pressure vessels, pumps, compressors, pipelines, valves, accessories and all other

associated equipment required for the receipt, transfer, storage and shipment of LPG

3.5
loading
means transfer of LPG product from the delivery tank truck or lorry to the stationary bulk storage tank. Loading is also synonymous to “product receiving”

3.6
LPG
Liquefied Petroleum Gas which consists of commercial propane gas or commercial butane gas or a mixture of the two gases, with properties conforming to the standards set forth under PNS, distributed or sold to consumers either in LPG cylinders through a pipeline system, bulk storage tanks, or other means of distribution

3.7
mounded tank or vessel
a tank or pressure vessel located above or partially above the general grade level but covered with earth, sand or other suitable material. A tank designed for underground service installed above the minimum depth required for underground service and covered with earth, sand or other material

3.8
shall
indicates a provision that is mandatory

3.9
sources of ignition
devices or equipment that, because of their modes of use or operation, are capable of providing sufficient thermal energy to ignite flammable LPG vapor-air mixtures when introduced into such a mixture or when such a mixture comes into contact with them, and that will permit propagation of flame away from them

3.10
unloading
means transfer of LPG product from the stationary Bulk storage tank to the delivery tank truck or lorry

3.11
water capacity
total volume of tank or pressure vessel in water, expressed in liters, gallons, cubic meter or cubic feet

4 LPG Bulk Storage Tanks – General Requirements

This clause covers the requirements for aboveground and mounded pressurized LPG storage tanks.

4.1 Tank Design Materials and Construction

4.1.1 LPG tank design, materials, construction, inspection and testing shall be in

accordance with ASME Code Section VIII Division 1, Section VIII Div. 2 or other equivalent international accepted Code or Standard for unfired pressure vessel. For mounded tank, in addition to ASME, the design, materials, construction, inspections and testing shall be supplemented/ augmented by Standard EEMUA Publication 190 - Guide for the Design, Construction and Use of Mounded Horizontal Cylindrical Steel Vessels for Pressurized Storage of LPG at ambient temperatures.

4.1.2 The design pressure of the LPG tank shall not be less than the maximum vapor pressure of the actual grades of LPG to be handled at the highest or maximum temperature that the contents will reach during normal service.

4.1.3 Materials used for LPG tanks shall be suitable for use at the lowest temperature the contents will reach in normal service, which may be below the minimum ambient temperature, and shall in any event be suitable for use at 0°C.

4.1.4 The design pressure to be used at the top of the tank shall be equal to the maximum vapor pressure of the product (LPG, propane or butane) corresponding to the maximum temperature mentioned above plus allowance to ensure that in normal operation, pressure relief valve (PRV) does not open. This allowance is normally 10% or 1.7 bars above the vapor pressure, whichever is greater.

4.1.5 The maximum vapor pressure attained by an LPG to be used shall be the basis for the tank maximum allowable working pressure (MAWP) or minimum design pressure and shall be in accordance with Table 1.

4.1.6 Shop fabricated containers shall be fabricated and provided with lifting lugs and sufficient pads or doubler plates for lifting the container or tank.

4.1.7 Field-erected LPG tank shall be built in accordance with ASME Boiler and pressure Vessel Code except that design and construction using joint efficiencies that do not specify radiography (RT) shall not be allowed or permitted (ASME Code Section VIII Div. 1, Table UW 12, Column C).

4.1.8 The number of connections or nozzles on tank or pressure vessel below the maximum liquid level (i.e. below the vapor space) should be reduced to a minimum.

4.1.9 Only piping connected associated with the storage tank shall be located within the storage area.

4.1.10 All pipelines connected to the tank shall be adequately supported in such a way that forces and bending moments on the tanks are kept within acceptable limits.

4.1.11 Tanks having a capacity of more than 20,000 liters shall be subjected to the

Environmental Impact Assessment process, refer to DENR regulations.

Table 1 – Maximum Vapor Pressure and Maximum Allowable Working Pressure (MAWP)

Maximum Vapor Pressure at 37.8 °C (100 °F) not to exceed		Maximum Allowable Working Pressure (MAWP) or Minimum Design Pressure					
		Current ASME Code		Earlier Codes			
				API-ASME		ASME	
PSIG	MPaG	PSIG	MPaG	PSIG	MPaG	PSIG	MPaG
80	0.6	100	0.7	100	0.7	80	0.6
100	0.7	125	0.9	125	0.9	100	0.7
125	0.9	156	1.1	156	1.1	125	0.9
150	1.0	187	1.3	187	1.3	150	1.0
175	1.2	219	1.5	219	1.5	175	1.2
215	1.5	250	1.7	250	1.7	200	1.1
215	1.5	312	2.2	312	2.2	-	-

4.2 Tank markings

4.2.1 LPG bulk storage tank shall be identified by the attachment of a nameplate.

4.2.2 The markings specified shall be on a stainless-steel nameplate attached to the container and located to remain visible after the container is installed.

4.2.3 The nameplate shall be attached to minimize corrosion of the nameplate or its fastening means and so as not to contribute to corrosion of the container due to galvanic corrosion.

4.2.4 Where the tank is mounded, or otherwise covered to obscure the nameplate and data, the nameplate shall be installed or duplicated on adjacent piping or on a structure that is directly attached to the tank such as manholes or domes in a clearly visible manner.

4.2.5 The bulk storage tank Nameplate shall contain the following minimum information or data:

a. Name and address of the tank manufacturer;
b. Manufacturer's designated serial number;
c. Water capacity of the tank in liters, gallons, cubic meters or cubic feet;
d. Design pressure or MAWP in MPa, PSI, kg/cm or bars;
e. Outside surface area (OSSA) in square meters or square feet;
f. Design code or standard used;
g. Shell and head thicknesses; Material specifications for shell and heads;

h. OAL (overall length), OD or ID (outside diameter or inside diameter), HD (head design);
i. Design temperature in °C or °F (min and max);
j. ASME Boiler and Pressure Vessel Code symbol (optional - this is true only if tank is ASME stamped);
k. Date of Hydro static test or Year of manufacture;
l. Product name (propane, butane or LPG);

4.3 Tank location

4.3.1 Tanks shall be located outside of buildings.

4.3.2 The site or location of tank shall consider the direction of the prevailing wind in the area or locality, i.e. storage tank shall be located downwind of other facilities such that in case of product leak the other facilities are in the opposite direction of the path of leak.

4.3.3 The tank shall be located or sited in an area that is accessible to firefighting equipment and vehicles that can access the area without any obstruction.

4.3.4 The tank area location and topographical nature allows that in case of LPG leak, the flow is far as possible from possible ignition sources, important work areas and the LPG is disposed and diluted easily.

4.3.5 Tanks shall be oriented so that their longitudinal axes do not point towards other containers and flammable liquid storage tanks on the same or adjoining property.

4.3.6 LPG Bulk Storage tanks shall not be located within dikes that enclosed flammable liquid tanks and shall not be located within dikes that enclosed refrigerated LPG tanks.

4.3.7 The area under the tanks shall be graded or shall have dikes or curbs installed so that the flow or accumulation of flammable liquids with flash points below 93.4 °C (200 °F) is prevented.

4.4 Spacing and Separation Distances

4.4.1 Separation distances are intended to protect the LPG facilities from the radiation effects of fires involving other facilities as well as to minimize the risk of escaping LPG being ignited before being dispersed or diluted.

4.4.2 Bulk Storage tank shall be located in accordance with Table 3, Table 4 and Table 5 with respect to the distance between tanks, the distance between tank and the nearest important building or group of buildings not associated with the LPG plant, or a line of adjoining property that can be built upon.

4.4.3 The distances given in Table 3, Table 4 and Table 5 are the minimum permitted and referred to the horizontal distance in plan between the tank and the nearest point of a specified feature, e.g. an adjacent storage tank, building, property line, except for underground and mounded tanks where some distances are measured from the Pressure Relief Valves (PRV) or on the manhole cover.

4.4.4 Aboveground LPG Storage tanks must be grouped in rows and not in blocks. Horizontal tanks like “bullet” tanks shall be placed in parallel and not in line or at angles to one another, as there exists a possibility that, if involved in a fire, tanks may be displaced along their longitudinal axis.

4.4.5 Multiple aboveground tanks (or groups of tanks) installed for use in a single location shall be limited to the number of tanks in one group, with each group separated from the next group in accordance with the degree of fire protection provided in Table 2.

Table 2 – Maximum number of containers in a group and their separation distances

Fire protection provided by	Maximum number of containers in one group	Minimum separation between groups	
		Ft	m
Hose streams only	6	50	15
Fixed monitor nozzles	6	25	7.6
Fixed water spray	9	25	7.6
Insulation	9	25	7.6

4.4.6 The maximum number of tanks in any aboveground group shall be six (6). However, depending on the type of Fire Protection provided this can be increased to nine (9), refer to Table 2. Any one group of tanks shall be separated from any group of tanks by a minimum of 15 m between adjacent vessel shells.

4.4.7 No horizontal separation shall be required between aboveground LPG Tanks containing flammable or combustible liquids installed in accordance with NFPA 30, Flammable and Combustible Liquids Code.

4.4.8 Implement fire protection barriers and water deluge or foam systems around storage tanks, especially in high-risk areas, to protect against radiant heat in the event of an adjacent fire.

4.4.9 For tank sizes over 265,000 liters (70,000 gallons), the separation distances indicated in Table 3 shall not apply to installations built prior to 1978. A hazard and risk analysis shall be conducted in place of Table 3.

Table 3 – Minimum Separation Distance from tank to important building and/ or source of ignition not associated with the plant, between containers or to a line adjoining property that can be built upon

WATER CAPACITY PER CONTAINER (in liters)	Minimum distances (in meters)		
	Mounded or Underground Containers	Aboveground Containers	Between Containers
Less than 500	3	0	0
500 to 1,000	3	3	0
Above 1,000 to 1,900	3	3	1
Above 1,900 to 7,600	3	7.6	1
Above 7,600 to 114,000	15	15	1.5
Above 114,000 to 265,000	15	23	¼ of sum of diameters of adjacent containers
Above 265,000 to 341,000	15	30	
Above 341,000 to 454,000	15	38	
Above 454,000 to 757,000	15	61	
Above 757,000 to 3,785,000	15	91	
Above 3,785,000	15	122	

4.4.10 Separation distances for aboveground tanks may be reduced by the provision of fire or radiation wall, provided detailed drawings or plans are submitted to and approved by authority having jurisdiction.

4.4.11 The minimum separation distances of aboveground LPG tank to other buildings, structures or points within the Bulk Plant shall be as indicated in Table 4.

However, the separation distance between each of the bulk plant's fixed storage tank and the nearest point of the cylinder filling hall may be reduced from 15 meters to as low as three (3) meters provided that the following conditions are met:

a) Appropriate refilling plant personnel training;
b) Non-combustible filling hall deign and structure; and
c) Available fire protection at site with redundant controls.

In no case shall the separation distance be lower than three (3) meters.

Table 4 - Minimum separation distance from LPG tanks to other points within bulk plants

Reference feature	Distance (m)
a. Non-controlled areas or buildings, boundary or fixed source of ignition	15
b. Cylinder Filling Hall	15
c. Building wall surrounding product tanks of Flammable liquids with flash point up to 65ºC	6
d. Bulk LPG Lorry loading/unloading area	15

Note: See Figure 1

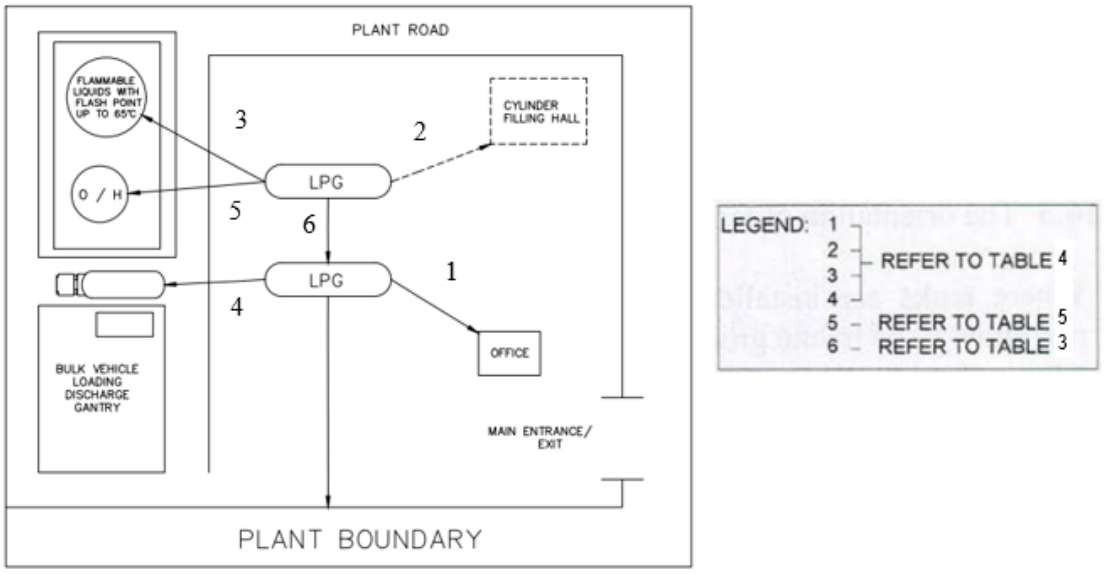

Figure 1: Typical Distances for LPG Import Terminal

4.4.12 No permanent source of heat should be located within 15 m (50 ft) from an LPG storage tank.

4.4.13 Weeds, long grasses, deciduous shrubs and trees, and any combustible materials shall be removed from the area within the required minimum safety distances.

4.4.14 LPG storage tanks, pumps, compressors, re-filling hall etc. shall not be located directly beneath electrical power cables. For cables carrying less than 1.0 kV the tanks should be sited at least 1.5 m from a line drawn vertically downwards from the power cables. For cables carrying 1.0 kV or greater the distance should be increased to 7.5 m.

4.4.15 The minimum separation distances between an LPG storage tank and tanks

containing oxygen or gaseous hydrogen shall follow Table 5.

Table 5 – Separation distances of LPG tanks and Oxygen and Hydrogen tanks

Separation from oxygen tanks aggregate capacity					Separation from gaseous hydrogen tanks aggregate capacity		
LPG tanks aggregate water capacity			More than 11 m^3 * to 566m^3* including unconnected reserves	More than 566 m^3* including unconnected reserves		11 m^3* to 85 m^3*	More than 85 m^3*
Gal	m^3	11 m^3 or less	M	m	Less than 11 m^3	M	m
≤1200	≤4.5	None	6	7.6	-	-	-
>1200	>4.5	None	6	15	-	-	-
≤500	≤1.9	-	-	-	None	3	7.6
>500	>1.9	-	-	-	None	7.6	15

Cubic meter (ft^3) measured at 21ºC (70ºF) and atmospheric pressure.

4.5 Tank Installation

4.5.1 Aboveground Storage Tank

4.5.1.1 Tank foundation and support design shall conform to the standard prescribed in PSME Code, Philippine National Building Code, NFPA 58, API 2510 and ASME code.

4.5.1.2 Supports shall be constructed solid non-flammable material. If the distance of the bottom of the tank to the ground is greater than 0.5 m, the support must also be constructed of materials that resist deformation when exposed to fire.

4.5.1.3 Tank supports and foundation shall be made of one or a combination of the following materials:

a) reinforced masonry;
b) reinforced concrete; and
c) steel plates, pipes or structural shapes.

4.5.1.4 The design of the foundation shall be based on a thorough knowledge of the load-bearing capacity and settlement properties of the soil. Where information regarding soil conditions is not available, an actual soil investigation shall be conducted.

4.5.1.5 The size and depth of foundation shall be designed to limit settlement of the tank to prevent excessive stresses in the tank and connected piping.

Settlement shall be monitored during the hydrostatic test of tank.

4.5.1.6 For steel column leg supports shall not be directly attached or welded to the tank base plates but to the pads or doubler plates provided for such attachments. The material for the pads or doubler plates shall be of the same specification as the tank plate. The diagonal members for bracing the column leg supports shall not be directly welded to the tank but to the leg column supports only.

4.5.1.7 The steel skirt support for vertical cylindrical tank shall be attached and directly welded to the tank bottom shell course and not to bottom head or end of tank. The steel skirt support material shall be of the same specification as the tank plate.

4.5.1.8 Steel column leg supports and skirt support for spherical tank and vertical cylindrical tank respectively shall be designed to be fire-proofed up the shell of the tank.

4.5.1.9 Tank supports shall comply with the pressure vessel standard considering the tank shell stressing and transmission of the loading to the ground.

4.5.1.10 The horizontal cylindrical tank shall have two steel saddle supports only, welded to the shell and designed to accommodate expansion and contraction of the tank i.e. by using fixed and sliding supports. Consideration shall be given to location of steel saddles to obtain the most desirable stress distribution in the vessel shell.

4.5.1.11 The shape of saddle supports for horizontal cylindrical tank shall conform to the fabricated shape of the vessel or to the contour of steel doubler pads attached to the tank.

4.5.1.12 Tank supports shall be designed to prevent or drain any accumulation of water and be of sufficient height to allow adequate access for installation, maintenance and use for the bottom fittings.

4.5.1.13 Tank supports shall be designed to allow a minimum of 1.5 m clearance between the bottom of the tank shell and the bottom of the finished ground level.

4.5.1.14 Every tank shall be supported to prevent the concentration of excessive loads on the supporting portion of the shell or heads.

4.5.1.15 For aboveground tank, design of the foundation should take into consideration the following:

a) Ground conditions with special reference to the allowable bearing

pressures;

b) The necessity to avoid floatation, if there is a risk of flooding, by securely anchoring, weighting or the use of adequate height;
c) The necessity to avoid settlement particularly differential settlement;
d) Expansion and contraction of the tank shell; and
e) The greatest combined effect incurred by static loading is due to the weight of the tank, its contents, water used for hydrostatic test, wind loading, seismic effect, operational loading such as vibration, thermal effects etc.

4.5.1.16 Provisions to minimize corrosion shall be provided on that portion of the tank that is in contact with the foundations or saddle supports.

4.5.1.17 Tank shall be kept properly painted or otherwise protected from the elements.

4.5.1.18 Vertical tanks shall be designed to be self-supporting without the use of guy wires and shall consider wind, seismic forces (earthquake), and hydrostatic test loads.

4.5.1.19 Design pressure (see Table 1) for vertical tank shall be the pressure at the top head with allowance made for increased pressure on the lower shell sections and bottom head due to the static pressure of the product.

4.5.1.20 Wind loading on containers of 37.9 m3 (10,000 gal) or larger shall be in accordance with the Philippine National Structural Code or Philippine National Building Code.

4.5.1.21 A seismic design for installations of tanks of 37.9 m^3 (10,000 gal) or larger shall be made that meets the approval of the authority having jurisdiction.

4.5.1.22 If insulation is used, it shall be capable of limiting the tank temperature to not over 427 °C (800 °F) for minimum of 50 minutes, as determined by test with insulation applied to a steel plate and subjected to a test flame substantially over the area of the test plate and shall be resistant to weathering and the action of hose streams. (See Annex D of NFPA 59).

4.5.1.23 Pressure relief devices shall be sized based on the largest flow capacity determined by the largest single condition or any reasonable and probable combination of conditions, including the following:

a) Fire exposure;
b) Operational upset, such as failure of a control device;
c) Other circumstances resulting from equipment failures and operating errors;
d) Vapor displacement during filling;
e) Flash vaporization during filling, because of filling or because of mixing of products of different compositions.
f) Loss of refrigeration;
g) Heat input from pump re-circulation; and

h) Drop in barometric pressure.

Table 6: Pressure relief valve flow capacity as a function of tank surface area

Surface area (ft^2)	**Flow rate (ft^3 / min air)**	**Surface area (ft^2)**	**Flow rate (ft^3 / min air)**	**Surface area (ft^2)**	**Flow rate (ft^3 / min air)**
< 20	626	170	3620	600	10,170
25	751	175	3700	650	10860
30	872	180	3790	700	11550
35	990	185	3880	750	12220
40	1100	190	3960	800	12880
45	1220	195	4050	850	13540
50	1330	200	4130	900	14190
55	1430	210	4300	950	14830
60	1540	220	4470	1000	15470
65	1640	230	4630	1050	16100
70	1750	240	4800	1100	16720
75	1850	250	4960	1150	17350
80	1950	260	5130	1200	17960
85	2050	270	5290	1250	18570
90	2150	280	5450	1300	19180
95	2240	290	5910	1350	19780
100	2340	300	5760	1400	20380
105	2440	310	5920	1450	20980
110	2530	320	6080	1500	21570
115	2630	330	6230	1550	22160
120	2720	340	6390	1600	22740
125	2810	350	6540	1650	23200
130	2900	360	6690	1700	23900
135	2990	370	6840	1750	24470
140	3080	380	7000	1800	25050
145	2170	390	7150	1850	25620
150	3260	400	7300	1900	26180
155	3350	450	8040	1950	26750
160	3440	500	8760	2000	27310
165	3530	550	9470	-	-

4.5.2 Mounded Tank

4.5.2.1 Mounded tank shall be regarded as an underground tank for the purpose of separation distances, provided it has at least 0.3 m (1 ft) of cover on top of the tank shell.

4.5.2.2 Mounding material shall be earth, sand, or other non-combustible, non-corrosive materials and shall provide a minimum thickness of cover for the tank of at least 0.30 m (1 ft.) on top of the tank shell.

4.5.2.3 A protective cover shall be provided on top of mounding materials subject to erosion.

4.5.2.4 The cover over the mounded tank shall be stable under all weather conditions.

Where any exposed surfaces are protected by fixed water sprays the mounding shall be protected against possible erosion during testing.

4.5.2.5 Tank valves and appurtenances shall be accessible for operation or repair, without disturbing mounding material, as follows:

a) Where tanks are mounded and the bottom of the tank is 0.76 m (30 in.) or more above the surrounding grade, access to bottom connections shall be provided by an opening or tunnel with a 1.2 m (4 ft.) minimum diameter and a 0.9 m (3 ft.) minimum clear area.

b) Bottom connections that extend beyond the mound shall be part of the tank or shall be installed in compliance with the ASME Code and shall be designed for the forces that can act on the connections.

4.5.2.6 Mounded tank shall be coated and protected from corrosion. Mounded tank shall be protected against corrosion by application of suitable paint coatings or anti-corrosion wrappings and anti-corrosion cathodic protection (like sacrificial anodes or impressed current cathodic protection).

4.5.2.7 All tank metallic components and structures that are underground or buried shall be coated or protected and maintained to minimize corrosion.

4.5.2.8 Corrosion protection of all other materials shall be in accordance with accepted engineering practices.

4.5.2.9 The flow capacity of pressure relief valves installed on mounded containers shall be a minimum of 30 percent of the flow specified in Table 6

4.5.3 Multi-tank installations

4.5.3.1 LPG tanks shall not be installed above or below any other tank such that their outlines overlap when viewed in plan;

4.5.3.2 Precautions must be taken when tanks are interconnected in the liquid phase to ensure that the maximum permissible liquid level in any of the tanks is not exceeded or no overfilling shall occur. There should be an isolating valve between adjacent tanks;

4.5.3.3 A vapor equalizing line of adequate size interconnecting all tanks which are interconnected in the liquid phase is essential; and

4.5.3.4 Installation having a liquid return line to the storage tanks, e.g. from pumps, re-filling hall etc. must be designed to avoid overfilling by the inadvertent return of product to tanks otherwise isolated.

4.6 Tank Appurtenances and Equipment

4.6.1 Nozzles and Connections

4.6.1.1 LPG tanks shall be provided with at least one each of the following:

a) Pressure relief device situated at the vapor portion of the vessel;
b) Fixed maximum liquid level device or equivalent high-level alarm;
c) Liquid level gauge or indicator;
d) Pressure gauge;
e) Drains or other means of removing liquid contents;
f) Filling connection;
g) Service connection; and
h) Temperature gauge for liquid and vapor are optional.

4.6.1.2 All fittings installed on the tank shall be suitable for LPG service over the range of temperatures and pressures that the product will reach in service.

4.6.1.3 Labels or appropriate markings shall be required and maintained in safety valves, liquid level gauging devices, and pressure gauges.

4.6.1.4 Tanks with internal diameter of 1,700 mm or greater shall be provided with manholes for internal inspection. The minimum size of the manhole shall be 458 mm (18 in).

4.6.1.5 All flanges shall be ANSI B 16.5 Class 300 or rated 300 lbs. All coupling connections shall be limited to 1-1/2-inch diameter, either half or full shall be low carbon steel rated 3000 lbs.

4.6.1.6 Spiral wound graphite filled stainless steel gaskets or metallic gaskets shall be used for flanged connections. Compressed asbestos gasket shall not be used.

4.6.1.7 Remote filling connections shall terminate with a manual shut-off valve and transfer hose half coupling protected immediately upstream of the valve as appropriate.

4.6.1.8 Transfer hoses shall be made of LPG resistant material and if steel wire braiding or steel wire reinforcement is used, it shall be of stainless steel. Hoses shall have electrical continuity between end couplings.

4.6.1.9 Filling connections are recommended to be fitted with internal spray pipes or used with vapor equalizing lines for pressure equalization between the delivery tanker and the storage tank during delivery.

4.6.2 Shut-off and emergency valves

4.6.2.1 All shutoff valves and accessory equipment (liquid or gas) shall be compatible with LPG and designed for not less than the maximum extreme pressure and temperature to which they can be subjected.

a) Valves for use with pressurized bulk tanks that can be subjected to tank pressure shall have a rated working pressure of at least 1.7 MPa (250 psi).

b) Cast-iron valves, piping, and fittings shall be prohibited on LPG tanks and their connections except for tank valves or fittings that are made of malleable or nodular iron.

4.6.2.2 All connections to tanks shall have shutoff valves located as close to the tank as practical.

a) Valves shall be accessible for operation and maintenance under normal and emergency conditions, either by location or by means of permanently installed special provisions.
b) Valves installed in unobstructed locations that are not more than 1.5 m (5 ft) above ground level shall be considered accessible.
c) Stairs, ladders, platforms, remote operators, extension handles, etc., shall be installed where valves are located 1.5 m (5 ft) or more above ground level.
d) Safety relief connections, liquid level gauging devices, and plugged openings shall be required to be accessible.

4.6.2.3 Type-approved emergency shutoff valves shall incorporate all the following means of closing:

a) Automatic shutoff through thermal (fire) actuation;
b) Manual shutoff from two or more remote locations; and
c) Manual shutoff at the installed location.

4.6.2.4 All liquid and vapor connections on tanks, other than pressure relief valves, liquid level gauging devices, and openings not larger than 1.4 mm or 0.055 in (No. 54 drill size) shall be equipped with one of the following:

a) A back-pressure check valve and either a manual valve or a remote-operated emergency shutoff valve;
b) The remote-operated emergency shutdown valve must be equipped with automatic shutoff using thermal (fire) actuation where the thermal element is located within 1.5 m (5 ft) of the valve; and
c) A quick-acting internal valve incorporating the means of closing specified in 4.6.2.3.

4.6.3 Pressure Relief Valves

4.6.3.1 Tanks shall be equipped with one or more pressure relief valves of sufficient capacity and having direct access to the vapor space of the vessel. The start-to-discharge pressure shall not be greater than the tank design pressure.

4.6.3.2 Pressure relief valves shall be of the internal spring-loaded or pilot-operated type and should be designed and fitted so as to prevent water accumulating on the discharge side.

4.6.3.3 Pressure relief valves shall be designed and fitted to ensure that in the case of ignition of discharged product, flame impingement on the tank is avoided.

4.6.3.4 The valve seat of the pressure relief valve shall preferably be within the tank, otherwise they shall be protected against possible impact damage. Shroud

protection should be designed so that distortion caused by impact will not prevent the relief valve from operating.

4.6.3.5 Each pressure relief valve should be plainly and permanently marked with the following:

a) Manufacturer's name
b) Month and year of manufacture e.g. 09/05
c) Nominal set pressure
d) Valve type number
e) Discharge capacity quoted in m^3/min. (ft^3/min.) of air at standard conditions.

4.6.3.6 All tank connections, e.g. inlets, liquid-level contents gauge connections, etc., excluding relief valve connections should be labeled to designate their purpose.

4.6.4 Excess flow valves

4.6.4.1 The flow rate for closure of excess valve should be less than likely to result from complete fracture of the line it is protecting but should prevent premature closing by sizing flow rate substantially above the normal design flow rate.

4.6.4.2 The connections or lines, including valves, fittings, and so forth, downstream of an excess-flow valve shall have a greater capacity than the rated flow of the excess-flow valve.

4.6.4.3 Openings from a tank or through fittings attached directly on the tank to which pressure gauge connection is made shall not be required to be equipped with an excess flow valve if such openings are not larger than 1.4mm or 0.055 in (No. 54 drill size).

4.6.4.4 Excess-flow and back-pressure check valves, where required by this standard, shall be located inside the tank or at a point outside where the line enters the tank. In the latter case, installation shall be made in such a manner that any stress beyond the excess-flow or backpressure check valve will not cause breakage between the container and such valve.

4.6.4.5 Excess-flow valves shall be designed with a bypass, not to exceed 1.01 mm or 0.04 in (No. 60 drill size) opening, to allow equalization of pressures.

4.6.5 Content gauges and level gauges

4.6.5.1 All tanks shall be fitted with a suitable contents gauge. Such gauges, if used for custody transfer purposes must be calibrated by a calibration laboratory.

4.6.5.2 If the contents of the tank are to be measured by volume with a rotary dip tube or magnetic gauge, one or more fixed maximum liquid level gauges as a check on these gauges should be provided.

4.6.5.3 Fixed maximum liquid level gauge should be set to 85 % of the total liquid volume of the LPG to be carried.

4.6.5.4 Any gauging device that relies on bleeding to atmosphere, such as rotary dip tube

or fixed tube shall be such that:

a) The bleed hole maximum opening is not larger than 1.4 mm diameter otherwise it shall be protected by a shut-off valve and a suitable excess flow valve.
b) The operational bleed screw shall always remain captive.
c) The gland is capable of being replaced without withdrawing the tank from service.

4.6.5.5 Each pressurized LPG bulk storage system shall be equipped with an approved liquid level gauging device in accordance with the following:

a) If the liquid level-gauging device is a float type or a pressure differential type, the container also shall be provided with an auxiliary gauging device, such as a fixed dip tube, slip tube, rotary gauge, or similar device; and
b) Unlisted gauge glasses of the columnar type shall not be permitted.

4.6.5.6 All gauging devices shall be arranged so that the maximum liquid level to which the container can be filled for butane, for a 50-50 mixture of butane and propane, and for propane is determinable.

4.6.5.7 Gauging devices that require bleeding of the product to the atmosphere, such as the rotary tube, fixed tube, and slip tube, shall be designed so that the bleed valve maximum opening is not larger than 1.4 mm or 0.055 in. (No. 54 drill size) unless provided with an excess-flow valve.

4.6.5.8 Gauging devices for tanks shall have a maximum allowable working pressure at least equal to that of the tanks to which they are attached.

4.6.5.9 Where used, the length of a fixed tube device shall be designed to indicate the maximum level to which the container can be filled for the product contained, based on the volume of the product at 4.4 °C (40 °F) at its maximum permitted filling density for aboveground tanks and at 10 °C (50 °F) for buried tanks.

4.6.6 Fixed maximum liquid level device

4.6.6.1 The device shall be of a type that allows vapor or liquid to bleed from a valve attached to a dip-tube to indicate when the maximum permitted level is reached during filling.

4.6.6.2 The computed length of the dip tube shall be determined based on the recommended maximum liquid level of 90 %.

4.6.6.3 The connection through the tank shall not be larger than 1.4 mm diameter unless fitted with an excess flow valve and shall be installed so that it is visible from the filling point.

4.6.7 Pressure gauge

All tanks should be equipped with a suitable pressure gauge connected to the vapor space of the tank. Pressure gauge connection hole to the tank shall preferably not be larger than 1.4 mm diameter and shall be protected by a suitable shut-off valve.

4.6.8 Contents gauge

4.6.8.1 All contents gauges should clearly indicate whether they read in % of water capacity or fractional LPG capacity, or actual contents in gallons, tons etc.

4.6.8.2 Any gauging device that relies on bleeding to atmosphere, such as a rotary tube, fixed tube or slip tube, shall be such that:

a) The bleed hole maximum opening is not larger than 1.4 mm diameter unless it is protected by an excess flow valve.
b) It cannot be completely withdrawn in normal gauging operations.
c) The gland is capable of being repacked without withdrawing the vessel from service.

4.6.8.3 Each pressurized LPG bulk storage system shall be equipped with an approved liquid level gauging device in accordance with the following:

a) If the liquid level-gauging device is a float type or a pressure differential type, the container also shall be provided with an auxiliary gauging device, such as a fixed dip tube, slip tube, rotary gauge, or similar device; and
b) Unlisted gauge glasses of the columnar type shall not be permitted.

4.6.8.4 All gauging devices shall be arranged so that the maximum liquid level to which the container can be filled for butane, for a 50-50 mixture of butane and propane, and for propane is determinable.

4.6.8.5 Gauging devices that require bleeding of the product to the atmosphere, such as the rotary tube, fixed tube, and slip tube, shall be designed so that the bleed valve maximum opening is not larger than 1.4 mm or 0.055 in. (No. 54 drill size) unless provided with an excess-flow valve.

4.6.8.6 Gauging devices for tanks shall have a maximum allowable working pressure at least equal to that of the tanks to which they are attached.

4.6.8.7 Where used, the length of a fixed tube device shall be designed to indicate the maximum level to which the container can be filled for the product contained, based on the volume of the product at 4.4 °C (40 °F) at its maximum permitted filling density for aboveground tanks and at 10 °C (50 °F) for buried tanks.

4.6.9 Temperature gauge

4.6.9.1 Temperature gauge when fitted shall be installed in suitable thermowell.

4.6.9.2 The thermo wells shall be in the form of blind tubes of suitable length and strength, oil filled, permanently welded to the tank and constructed in accordance with the tank design Code.

4.6.10 Pumps and Compressors

4.6.10.1 Pumps, compressors, etc. used shall be made of materials suitable to the grade of LPG and the range of temperatures and pressures the product will reach in service. Cast iron shall not be used unless they have adequate ductility and

resistance to brittle fracture. Ductile iron with an elongation at fracture of not less than 18 % is acceptable.

4.6.10.2 Positive displacement pumps must have a bypass or other suitable protection system against excessive pressure.

4.6.10.3 Pumps should also be protected by suitable strainers/filter devices.

4.6.10.4 Mechanical seals are preferable to packed glands.

4.6.10.5 Electric motors and other electrical equipment must be suitable for use in areas as classified in Table 7. Belt drives shall be anti-static type.

4.6.10.6 Where remote starters are installed, a flame-proof means of isolation with lockout should be fitted adjacent to the pump motor to facilitate servicing.

4.6.10.7 Pumps, compressors and their motors should be protected against accidental damage and the weather by suitable positioning and/or protection. They should not be sited beneath the tanks.

4.6.10.8 Any electrical equipment must be sited in accordance with the area classification shown in Table 7.

4.6.10.9 The location of pumps should be selected to minimize the risk of cavitation under the specified operating conditions.

4.6.10.10 Pumps should be located to facilitate ease of maintenance.

4.6.10.11 Each pump and compressor shall be recommended by the manufacturer for the LPG service intended.

4.6.10.12 Each pump and compressor shall be marked with its maximum working pressure.

4.6.11 Piping, Valves and Equipment

4.6.11.1 Piping, valves, and equipment shall be suitable for LPG service at the minimum design temperature and the maximum pressure.

4.6.11.2 The design and fabrication of piping systems shall be in accordance with ASME B31.3, Process Piping, except as modified by the provisions of this chapter and any applicable national pipeline regulations.

4.6.11.3 Where fire exposure to equipment is anticipated, the material shall be selected for fire exposure or protected from fire exposure.

4.6.11.4 Pressure-containing metal parts of equipment for application temperatures of –29 °C (–20 °F) or above shall be fabricated of one of the following materials:

a) Steel;
b) Ductile (nodular) iron in accordance with ASTM A 395, Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures, or malleable iron in accordance with ASTM A 536,

Specifications for Ductile Iron Castings, Grade 60-40-18 or 65-45-12; and

c) Malleable iron in accordance with ASTM A 47, Standard Specification for Ferritic Malleable Iron Castings; brass; bronze; or equivalent copper alloys.

4.6.11.5 Piping that can contain liquid LPG, that can be isolated by valving, and that requires hydrostatic relief valves, shall have as a minimum a design pressure of 2.41 MPa (350 psi) or the maximum discharge pressure of any pump or other source feeding that piping system, whichever is greater.

4.6.11.6 The piping specified in 4.6.9.5 shall be subjected to a pressure test, in accordance with 4.6.9.2, of no less than 130 percent of the design pressure same as the test requirement for the storage tank under ASME Section VIII Division 1.

4.6.11.7 Piping connections to the tanks for sizes over two (2) inch nominal pipe diameter excluding excess-flow valves shall be made by welding or with welded flanges.

4.6.11.8 Cast-iron valves, pipe, and fittings shall not be used in piping that carries LPG and LPG–air mixtures, except for tank valves or fittings made of malleable or ductile iron used within the limitations set forth in ASME B31.3, Process Piping.

4.6.11.9 Type-approved emergency shutoff valves shall incorporate all the following means of closing:

a) Automatic shutoff through thermal (fire) actuation;
b) Manual shutoff from two or more remote locations; and
c) Manual shutoff at the installed location.

4.6.11.10 Fusible elements used for closing emergency shutoff valves shall have a melting point not exceeding 121 °C (250 °F).

4.6.11.11 Gaskets used to retain LPG in flanged connections in piping containing liquid LPG and LPG vapor above 125 psi shall meet the following requirements:

a) They shall be resistant to the action of LPG;
b) They shall be of metal or other suitable material that is confined in metal that has a melting point over 816 °C (1500 °F) or shall be protected against fire exposure;
c) When a flange is opened, the gasket shall be replaced;

4.6.11.12 All piping, tubing, fittings, and valves shall be leak tested after assembly and proved to be free of leaks at no less than normal operating pressures. Tests shall not be made with a flame.

4.6.11.13 Automated remote monitoring of valves and equipment with a Supervisory Control and Data Acquisition (SCADA) system, enabling real-time tracking of critical operational parameters and remote control capabilities for emergency shutdown.

4.6.11.14 Provision shall be made for expansion, contraction, jarring, vibration, and settling.

4.6.11.15 Piping outside buildings shall be supported and protected against physical damage and corrosion.

4.6.11.16 Underground and submerged piping shall be protected and maintained to minimize corrosion.

4.6.11.17 The piping system shall conform to the provisions of a recognized piping standard i.e. ASME B31.3:2005, Process Piping or an equivalent internationally accepted Standard for Pressure Piping.

4.6.11.18 Filler and discharge pipes and manifolds

4.6.11.19 Piping connections between tank and manifold shall be designed to provide allowances for contraction, expansion, vibration, and settlement. Compression-type couplings shall not be permitted for this purpose.

4.6.11.20 Liquid manifold connections shall be located at nonadjacent ends of parallel rows of tanks.

4.6.11.21 The use of nonmetallic hose shall be prohibited for interconnecting stationary tanks.

4.6.11.22 In the design of the liquid piping system, shutoff or block valves shall be installed to limit the volume of liquid that could be discharged in the vicinity of tanks or important structures in the event of a liquid line failure.

a) Automatically or remotely controlled valves, or both, of the fail-safe type shall be used.
b) The mechanism for such valves shall be provided with a secondary control equipped with a fusible release [not over 121 °C (250 °F) melting point] that will cause the valve to close automatically in case of fire.
c) Fail-safe valves also shall be capable of being operated manually at the installed location.
d) A remote closing control shall be located to be accessible during a fire or other emergency.
e) Where installed in aboveground piping systems, fail-safe valves shall be arranged to limit the quantity that could be discharged within 91.4 m (300 ft) of a tank, important building, or line of adjoining property that can be built upon to a maximum of 1.89 m^3 (500 gal) of liquid.

4.6.12 Pipes, Tubings and Fittings

Metallic pipes and pipe fittings to an acceptable thickness suitable to withstand 2.5 times the maximum operating pressure may be used for LPG piping. Pipes shall preferably be wrought iron or steel, seamless and can be either low carbon steel or hot dipped galvanized low carbon steel. They may be threaded, flanged or welded provided they comply with the following requirements:

a) Piping subjected to pressure 125 psi and above:

Threaded – low carbon steel or hot dipped galvanized low carbon steel seamless pipe Schedule 80
Welded – low carbon steel or hot dipped galvanized low carbon steel seamless pipe Schedule 40 or heavier

b) Piping subjected to less than 125 psi:
Threaded – low carbon steel or hot dipped galvanized low carbon steel seamless or welded seam pipe Schedule 40 or heavier
Welded – low carbon steel or hot dipped galvanized low carbon steel seamless or welded seam pipe Schedule 40

4.6.12.1 Pipe fittings and flanges used shall be suitable for the pipe thickness used. Threaded fittings should only be used for joint sizes of 50 mm or less although threaded joints up to and including 80mm are accepted for proprietary items such as valves, pumps, meters, etc. Joints above these sizes should be made by welding or by welded flanges.

4.6.12.2 Pipe joints 50 mm or over in nominal size shall be welded or flanged. Pipes and fittings used shall be Sch. 40 or heavier. Joints less than 50 mm in nominal size may be welded, flanged or screwed with taper threads conforming to API standards. The pipes and fittings used should be Sch. 80 or heavier.

4.6.12.3 Pipelines in which liquid LPG may be trapped, e.g. between shut-off valves, shall be protected against excessive pressure caused by thermal expansion of the contents e.g. hydrostatic relief valve. If pressure-relieving devices discharge to atmosphere, the discharge should not endanger personnel or equipment.

4.6.12.4 Pipelines shall be adequately supported and have adequate flexibility to compensate for thermal expansion, contraction, or any operational stresses. Distances between pipe supports shall comply with Table 6.

Table 6 – Distance between pipe supports

Pipe size (15 mm)	Span (m)
15	2.0
20	2.5
25	3.0
40	3.5
50	4.0

4.6.12.5 Buried steel pipework shall be adequately protected against corrosion.

4.6.12.6 Valves and fittings shall be made of steel, hot stamping brass or nodular iron with equivalent strength and ductility over the design pressure and temperature

range. Cast iron valves and fittings other than those of nodular iron shall not be used.

4.6.12.7 Hose shall be suitable for the grade of LPG which they are to handle. They shall be designed to withstand a minimum bursting pressure of four times the maximum pressure they will carry in normal service.

4.6.12.8 Shut-off valves shall be incorporated at the ends of all pipelines to which properly identified hoses are connected.

4.6.12.9 All piping shall be color coded and properly identified and labelled. The company must have this coding incorporated in their safety and operation manuals. See example from ASME A13.1 below. For liquid LPG, the piping color should be blue while for vapor LPG the color should be yellow.

Table 7. Designation of Colors (ASME A13.1)

Fluid Service	Background Color	Letter Color	Color and Letter Sample
Fire quenching fluids	Safety red	White	Letters
Toxic and corrosive fluids	Safety orange	Black	Letters
Flammable fluids	Safety yellow	Black	Letters
Combustible fluids	Safety brown	White	Letters
Potable, cooling, boiler feed, and other water	Safety green	White	Letters
Compressed Air	Safety blue	White	Letters
To be defined by the user	Safety purple	White	Letters
To be defined by the user	Safety white	Black	Letters
To be defined by the user	Safety gray	White	Letters
To be defined by the user	Safety black	White	Letters

4.6.12.10 Flanges used must be machined and should preferably be provided with a raised face. Gaskets used in flanged connections shall be resistant to the action of LPG and preferably be 1.6 mm (1/16 in.) thickness.

4.6.12.11 Gaskets for flanged joints shall be resistant to liquid phase LPG. Gaskets shall be spiral wound, AISI 316, graphite-filled or PTFE filled gaskets. Gaskets of natural rubber or bonded with natural rubber shall not be used. Compressed Asbestos Fiber (CAF) gaskets are not acceptable.

4.6.13 Hoses and couplings

4.6.13.1 Hose must be resistant to LPG. If wire braid is used for reinforcement, it shall be of corrosion proof material such as stainless steel.

4.6.13.2 Hose assemblies shall be observed for leakage or for damage that could impair the integrity before each use.

4.6.13.3 Hose shall be fabricated of materials that are resistant to the action of LPG and shall be approved.

4.6.13.4 Hose, hose connections, and flexible connections shall comply with the following:

a) Hose shall be designed for a minimum bursting pressure of 12.1 MPa (1750 psi) [2.41 MPa (350 psi)] working pressure] and shall be marked with "LPG," with the working pressure in psi marked at not greater than 3m (10ft) intervals; and
b) Hose assemblies, after the application of connections, shall have a design capability of withstanding a pressure of not less than 4.83 MPa (700 psi).

4.6.13.5 Hoses must be electrically continuous throughout its length and the electrical continuity shall exist between the tank and the hose free-end coupling.

4.6.13.6 Hoses must be in one manufactured length without intermediate joints or couplers

4.6.13.7 Hose assemblies shall be inspected at least once a year.

4.6.13.8 Inspection of pressurized hose assemblies shall include the following:

a) Damage to outer cover that exposes reinforcement;
b) Kinked or flattened hose;
c) Soft spots or bulges in hose;
d) Couplings that have slipped on the hose, are damaged, have missing parts or have loosed bolts; and
e) Leakage.

4.6.13.9 Hose assemblies shall be replaced, repaired or continued in service based on the results of this inspection.

4.6.13.10 Leaking or damaged hose shall be immediately repaired, removed from service or replaced.

4.6.14 Weighbridges

Weighbridges are also known as truck scale; this is mostly employed for measuring bulk LPG conveyed into or out of a facility by truck or bobtail. Weighbridge is installed at a designated location in the facility, preferably on the entrance or facility access road.

4.6.15 Electrical system

The selection, installation and use of electrical apparatus including wiring and cabling in hazardous areas shall be in accordance to the required standard for the zone classification.

Area classification:

The areas detailed in Table 7 below are classified according to the degree of probability that flammable concentrations of gas (vapor) may arise. The hazardous area definitions are as follows.

Zone 0 An area in which an explosive gas-air mixture is continuously present, or present for long periods.

Zone 1 An area in which an explosive gas-air mixture is likely to occur in normal operation.

Zone 2 An area in which an explosive gas-air mixture is not likely to occur in normal operation, and if it occurs it will only exist for a short time.

4.6.16 Portable Gas Detector

A portable flammable gas detector shall be readily available.

4.7 Tank Farm

4.7.1 Bund walls shall not be constructed around LPG storage tanks since it interferes and impede the vaporization and dispersion of LPG in case of leak.

4.7.2 A diversion wall with a height not exceeding 380 mm may be required to avoid forming gas traps to direct possible leakage away from tank and source of ignition to a safe area for dispersion.

4.7.3 The use of continuous walls is not allowed around above ground LPG tanks as this will cause gas traps in the event of leak.

4.7.4 The ground under the above ground tank shall be graded to have a slight slope to prevent gas from accumulating under the tank in case of leak but will be directed away from the tank.

4.7.5 The ground directly under the above ground tank including an area at least 1 m away all around the periphery of tank shall be compacted and if possible concreted. The use of loose soil, grasses, pebbles or gravels under the tank are not recommended since these can accumulate gas under the tank, in case of leak.

4.7.6 Provision shall be made for handling run-off water during heavy rain and cooling water applied under fire conditions or during fire drill exercises.

4.7.7 The storage tanks shall be separated from the pipe racks or manifold by a separation or deflection wall of at least 0.6 m high and 5 m away from the nearest head or shell of tank.

4.7.8 No LPG storage tanks should be located within the bounded enclosure of:

a) a tank containing any other flammable liquid,
b) a tank containing liquid oxygen, other hazardous or cryogenic substance,
c) low pressure refrigerated LPG vessel, and
d) any heated storage tank e.g. fuel oil tank.

4.7.9 Provide automatic sprinkler systems or other advanced fire suppression methods

in high-risk areas within the tank farm to contain and minimize fire spread.

4.7.10 To prevent the formation of gas pockets, the vicinity of LPG storage tanks should be free from pits and depressions within the required separation distance.

4.7.11 Open drains or ducts located within the storage tank safety distance which would permit access and passage of LPG vapors must be fitted with a water trap or otherwise suitably sealed.

5 Types of LPG Bulk Storage Tanks

5.1 Spherical Tanks

Spherical tanks are used to store liquefied petroleum gas (LPG) and are designed to distribute pressure evenly. They are often made from low-alloy steel plates and are fixed pressure vessels at normal temperature.

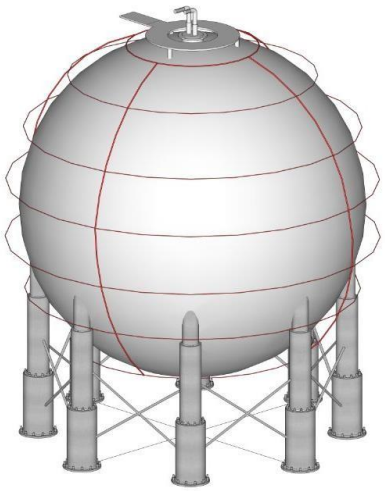

Figure 2. Spherical Tank

5.2 Cylindrical Tanks

Cylindrical tanks are used to store liquefied petroleum gas (LPG). They have hemispherical, ellipsoidal head or a combination of various heads. When installed above ground they may be mounded or semi mounded.

Figure 3. Cylindrical Tank

5.3 Refrigerated Tanks

Refrigerated tanks are storage options which have been used for decades to store substances that must be kept under certain temperature conditions. These kinds of tanks are used for liquified gases (with boiling points ranging from -126.6°C to -1.1°C) that are stored under very low or cryogenic temperatures.

Temperature of material in Refrigerated Tanks can be maintained if kept at a constant pressure. This phenomenon is referred to as “auto-refrigeration”. Refrigerated Tank comes with Boil-Off Gas Compressors used to recover boil-off gas and maintain the pressure and temperature of the Refrigerated Tank.

Refrigerated tanks are characterized by the following:

- Tank walls are cylindrical,
- Roofs are typically spherical domes,
- Bottoms are normally flat or slightly cone shaped.

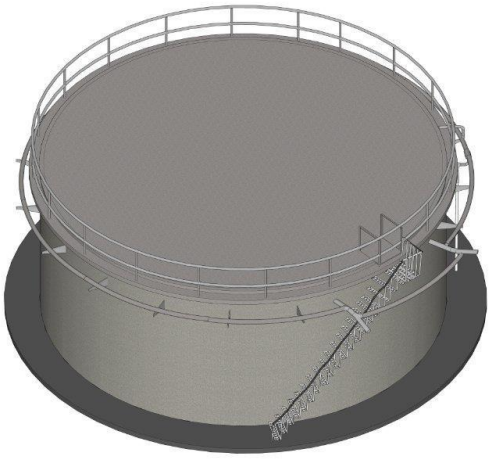

Figure 4. Refrigerated Tank

6 Facility Security

6.1 Each facility operator shall have a security system with controlled access, which

shall be designed to minimize entry by unauthorized persons.

6.2 A protective enclosure including a peripheral fence, building wall, or natural barrier shall be provided to enclose major facility components, such as the following:

a) LPG storage tanks
b) Flammable refrigerant storage tanks
c) Flammable liquid storage tanks
d) Other hazardous materials storage areas
e) Outdoor process equipment areas
f) Buildings that house process or control equipment
g) Onshore loading and unloading facilities

6.3 At least two exit gates or doors shall be provided for rapid escape of personnel in the event of an emergency.

6.4 Provisions shall be made for ready access to the facility by emergency personnel or services.

6.5 Illumination shall be provided as necessary in the vicinity of protective enclosures and in other areas to promote security of the facility.

6.6 Integrate continuous monitoring systems with centralized control to detect and report any deviations in pressure, temperature, or gas leaks to a remote control room for timely intervention.

6.7 Ensure protocols for leak detection include immediate isolation and evacuation measures, along with automated alerting systems to inform response teams.

6.8 Install vapor recovery systems to capture and recycle LPG vapor emissions from storage and transfer operations, reducing environmental impact.

7 Safety Practices

7.1 Tank Farm

7.1.1 Inspection of tank external surfaces

7.1.1.1 Certain types of corrosion may be found on external surfaces of a vessel

7.1.1.2 Attention should be given to metal surfaces in contact with concrete saddles.

7.1.1.3 Check not only for corrosion, but also for leaks, cracks, buckles, bulges, damage in the metal plates, and deformation and corrosion of any external stiffeners

7.1.1.4 Mechanical damage such as gouges and dents should be inspected as well

7.1.1.5 The depth and extent of any surface gouge should be measured when the gouge seem large enough to affect the strength of the vessel

7.1.1.6 All gouges should be reported

7.1.2 Ladders, Stairways, Platforms, and Walkways

7.1.2.1 Check for broken parts, cracks, tightness of bolts, the condition of flooring on platforms and walkways

7.1.2.2 Check for any water depressions in platforms, as water lying in depressions can accelerate corrosion

7.1.3 Foundations and Supports

7.1.3.1 Steel reinforced concrete or structural steel fireproofed with concrete, should be free of any spalling, cracking and settling

7.1.3.2 The crevice formed between a horizontal vessel and a cradle support should be carefully checked. Moisture lying in the crevice can cause rapid attack on carbon steel and on low-chrome-molybdenum steels

7.1.3.3 If the cradle is sealed with a mastic compound, the seal should be checked to make sure that it is intact

7.1.3.4 Cradles are often seal-welded to vessel shells to prevent moisture from accumulating in the crevice and causing corrosion

7.1.3.5 Check for water seepage between the concrete supports and the vessel shell. A concentration cell could develop there and cause rapid corrosion

7.1.3.6 Steel supports should be inspected for corrosion, distortion and cracking

7.1.3.7 Columns and load carrying beams should be inspected for buckling or excessive deflection

7.1.4 Anchor Bolts

7.1.4.1 The area of contact between the bolts and any concrete of steel should be scraped and closely examined for corrosion. Distortion of anchor bolts may indicate serious foundation settlement

7.1.4.2 Bolts and nuts should be properly tightened

7.1.5 Nozzles

7.1.5.1 If any settling of vessels has occurred, nozzles and adjacent shells areas should be inspected for distortion and cracking. Excessive pipeline expansions, internal explosions, earthquakes, and fires may also damage piping connections

7.1.5.2 Reinforcing plates around nozzles should be examined to assure they are intact

7.1.6 Grounding Connections

7.1.6.1 Check for grounding connection of vessel, stranded copper conductor should be bolted to the vessel and the other end bolted to an iron or copper rod placed deep in the ground

7.1.6.2 Check the validity of the grounding tests

7.1.6.3 Check for grounding resistance, recommended resistance of 5 ohms or less, and resistance is not to exceed 25 ohms

7.1.7 Auxiliary equipment

7.1.7.1 Check the gauge connections, float wells, sight glasses, and safety valves, undue vibration of these parts should be reported

7.1.7.2 Any vibrations should be arrested by adding supports

7.1.7.3 Check for proper construction of auxiliary equipment and connecting piping beyond vessel block valves as they can improperly modified during operations for contingency reasons

7.1.8 Protective Coatings and Insulations

7.1.8.1 Check for rust spots and blisters

7.1.8.2 Check for film lifting that has bulged already or has broken

i. The most likely spots to search for paint failures are in crevices, in constantly moist areas, and at welded or riveted vessels seams
ii. The bottom of vessels supported on skirts in humid locations are other likely points of paint failure

7.1.8.3 Check for corrosions and breakage on the clips, angles, bands and wires

7.1.9 Piping, Valves and Fittings

7.1.9.1 The frequency of inspections will vary with piping material, duty, location and experience. As a basic guideline, a visual external inspection for breakdown of coatings and subsequent corrosion is recommended to be undertaken annually

7.1.9.2 A selective internal inspection and/or wall thickness measurement should be taken every 10 years and pressure testing after component replacement.

7.1.9.3 Corrosion products should be removed by mechanical abrasion and the coating reinstated with a paint system compatible with the original.

7.1.9.4 The cladding of insulated pipe work should be inspected for signs of detachment and reinstated, as necessary

7.1.10 Corrosion Protection

7.1.10.1 Corrosion protection of the metal surfaces of equipment, pipelines and metallic structures may be achieved by coatings or cathodic protection (sacrificial anodes or impressed current) or a combination of the two.

7.1.11 Emergency Response Drills and Training

7.1.11.1 Conduct regular emergency drills for all staff, simulating potential leak, fire, and evacuation scenarios. Include training for fire extinguisher usage, emergency shutdowns, and evacuation routes. Ensure staff is certified in emergency response procedures through periodic refresher courses.

7.2 Loading Bays (Loading Gantry)

7.2.1 Flexible Transfer Hose

7.2.1.1 The design and construction of flexible LPG hoses should be to a recognized standard. These hoses should also be:

a) Properly identified
b) Protected from damage to or intake from foreign matter through their end fittings
c) Protected against external damage
d) Protected in transit, storage or when not in use from weathering or other physical damage
e) Checked at least every year for electrical continuity, and records maintained
f) Check for wear or kinks (together with all associated fittings) before every transfer
g) Repaired or replaced when worn or damaged
h) End couplings e.g. Acme threads etc., should also be checked at every year with suitable gauges

7.2.2 Loading arms / flexible hoses protection

7.2.2.1 If there is any likelihood of liquid LPG becoming trapped between the shut-off

valves in loading arms/flexible hoses, they must be protected against excess pressure due to thermal expansion of the liquid, e.g. by design or the use of Hydrostatic Relief Valves (HRV)

7.2.3 Static electricity protection

7.2.3.1 The transfer procedure must include the following as a minimum:

a) Discharge to earth of any accumulated static electricity from the road tanker before connecting the transfer hose, by bonding the tanker to an earthing point or to the tank to be filled
b) Bonding the tanker to the tank being filled before connecting the hose coupling and maintaining this bond throughout the transfer
c) Detachment of the electrical bond only after the liquid and where used the vapor balance connection have been disconnected

7.2.4 Safety Breakaway coupling

7.2.4.1 Breakaway coupling (Emergency Release Couplings) with integrated shut-off valves is used to avoid spillage and damage associated with drive and/or pull away incidents when loading and unloading. The couplings are designed to be the weakest link of the hose line or loading arm

7.2.4.2 Breakaway couplings may disconnect prematurely due to poor handling, needing to be reconnected using new shear/break spade bolts. Seals, bushings, and other parts exposed to product flow may need to be replaced after extensive wear but all parts, except for the shear bolts, will more than likely last longer than the hoses they are connected to. Shear/break spade bolts of the breakaway coupling may suffer fatigue and cause spurious activation of the coupling.

7.2.4.3 Recommended frequency of inspection as per manufacturer's recommendation

7.3 Weighbridges

7.3.1 Prior to loading/unloading, the LPG tanker/truck will proceed to the weighbridge for weigh-in then weigh-out right after loading/unloading. As the truck stops on top of the weighbridge, the load cells sense the weight and transmit these data to a display and to the control room for accounting.

7.3.2 Data recorded during weigh-in/ weigh-out: Tare Weight, Gross Weight, Net Weight

7.4 Handling and Transport of LPG Bulk Products

7.4.1 Driver Management

7.4.1.1 Driver Qualifications – Experiences, Licenses, Government clearances

7.4.1.2 Fitness to work program – Annual Physical Examination, alcohol and drug testing

7.4.1.3 Trainings – This includes refresher for the current drivers, and competency assurance, competency profiling, competency gap assessment and training program

7.4.1.4 Defensive Driving Program – defensive driving course, written examination and actual observed driving test

7.4.1.5 Driver performance and consequence management – Proactive Key Performance Indicators (KPIs) such as reports, meetings and emergency drills. Reactive KPIs such as incidents and driving violations, this also includes counselling and mentoring of drivers

7.4.2 Product Handling at LPG Plant

7.4.2.1 The driver must ensure that engine is switched off, hand brake is activated, and battery connection was isolated upon parking at the gantry

7.4.2.2 The driver must place wheel chocks in front and back of the same outside rear tire of the truck

7.4.2.3 Grounding cable clamp must be connected to the earthing clamp of the truck. Caps of liquid and vapor lines in truck's manifold are removed

7.4.2.4 Gantry flexible hoses are connected to the liquid and vapor lines, respectively, of truck's manifold, tighten them with the use of appropriate spanner. Check that ball valves of vapor and liquid loading lines at lorry manifold are open

7.4.2.5 Before conducting leak testing, ensure that the hose is pressurized and then prepare test liquid by mixing detergent and water. Let test liquid drip into the hose joints at both ends for both vapor and liquid hoses. Observe for leaks as indicated by the formation of bubbles or soapsuds at the joints. Rectify the leak by closing all valves at loading point and at lorry manifold, and then tighten the hose adaptor further by using the spanner

7.4.2.6 Ensure that vapor and liquid service line valves of the service tank, including the differential bypass valve and product pump are all lined-up. Once done, switch on the LPG product pump lined up for bulk-filling operations

7.4.2.7 If there is no change in the level of the liquid level of the truck, stop the product pump motor immediately and revalidate line-up process

7.4.2.8 If there is a change in reading indicating product flow into the truck, ensure that

gantry operator checks the content every 15 minutes

7.4.2.9 Ensure that contents, pressure and temperature of lorry do not exceed maximum safe levels as indicated on the truck shell

7.4.2.10 If product has reached the 85% preset level in the roto-gauge or 80% of the maximum safe level in the Slip-Tube, reset contents gauge to the maximum safe level of the lorry as indicated in the Lorry maximum Safe Level Setting

7.4.2.11 After truck has been loaded or unloaded, gantry operator shall switch off LPG pump

7.4.2.12 Gantry Operator shall ensure that driver closes the truck vapor and liquid control valves as well as the valves at the end of the LPG liquid and vapor flexible hoses

7.4.3 Product Handling at Customer Site

7.4.3.1 Sitting – The following precautions against accidental truck movement during transfer operations should be taken:

a) Sitting of transfer points on well-drained essentially level ground, preferably with a slight slope or camber in one direction to take any spillage away from the truck and prevent it from flowing and collecting under any fixed tanks or pipework
b) Place wheel chocks against all wheels (or provide other means to prevent vehicle movement) before transfer begins and remove only after transfer ends.

7.4.3.2 Truck position – The following criteria should be applied during transfer operations:

a) Truck should preferably position off the public highway whilst unloading
b) Where off-road parking impossible (e.g. at domestic sites), clear guidance on parking procedures to avoid causing obstruction to other road users, pedestrians etc. and to comply with legal requirements should be provided
c) All shut-off valves on both the truck and the tank should be readily accessible during transfer operations
d) Truck access to the discharge position should avoid the need for reversing. If necessary, arrangements should be made for the truck to be reversed in and driven out in the forward direction
e) During transfer operations, the truck should be positioned so that it can be readily driven away in an emergency.
f) There should be a clear line of sight between the truck and the tank being filled, and always during the operation the driver must be able to immediately stop the transfer, either normally when the tank is full or in an emergency. If

there is no clear line of sight, a second trained person should assist during the transfer operations

7.4.3.3 Operating restrictions – Loading / unloading operations should only be carried out when safe to do so and preferably be separated from other traffic movements. Diversions for passing vehicles and pedestrians (e.g. barriers, warning signs) should be used

7.4.3.4 Remote power shut-off – A remote switch should be fitted to tankers that rely on engine power to drive pumps or other equipment, allowing emergency engine shut-down from outside the cab

7.4.3.5 Hose routing – Hoses should not be routed across public areas such as pavements or footpaths unless it clearly will not endanger the public or there is absolutely no alternative, in which case warning notices should be placed on both sides of the hose. These should be readable from 6m and carry warnings such as: DANGER - NO SMOKING OR NAKED FLAMES. WARNING – LP GAS TRANSFER IN PROGRESS

7.5 Warning and Safety Signages

7.5.1 Safety Signs – The primary importance of displaying Safety Signs is to prevent injury and ensure staff and visitors are well aware of the possible dangers and hazards ahead in certain situations and/or environments. Below are the sample safety signages for LPG operations

7.5.1.1 Warning Signs (Yellow)

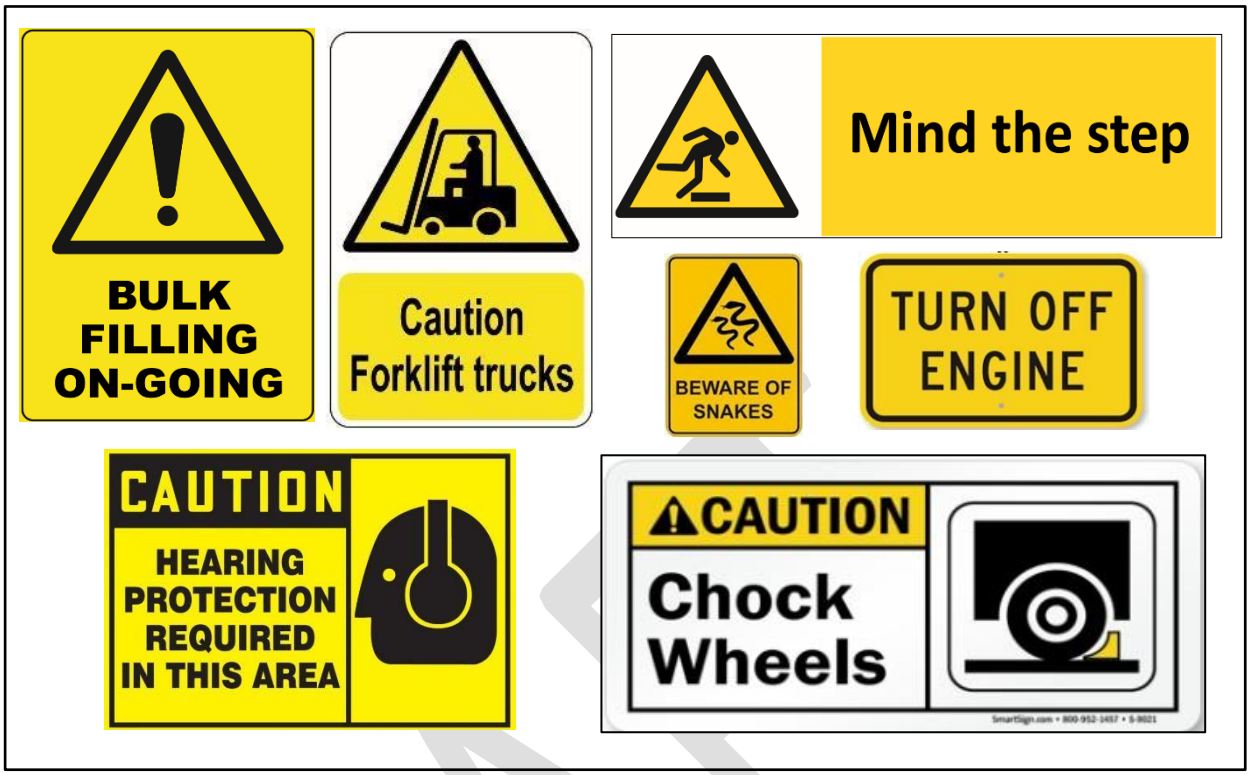

Figure 5. Sample Warning Signs

7.5.1.2 Prohibited Signs (Red)

Figure 6. Sample Prohibited Signs

7.5.1.3 Command/Directional Signages (Blue)

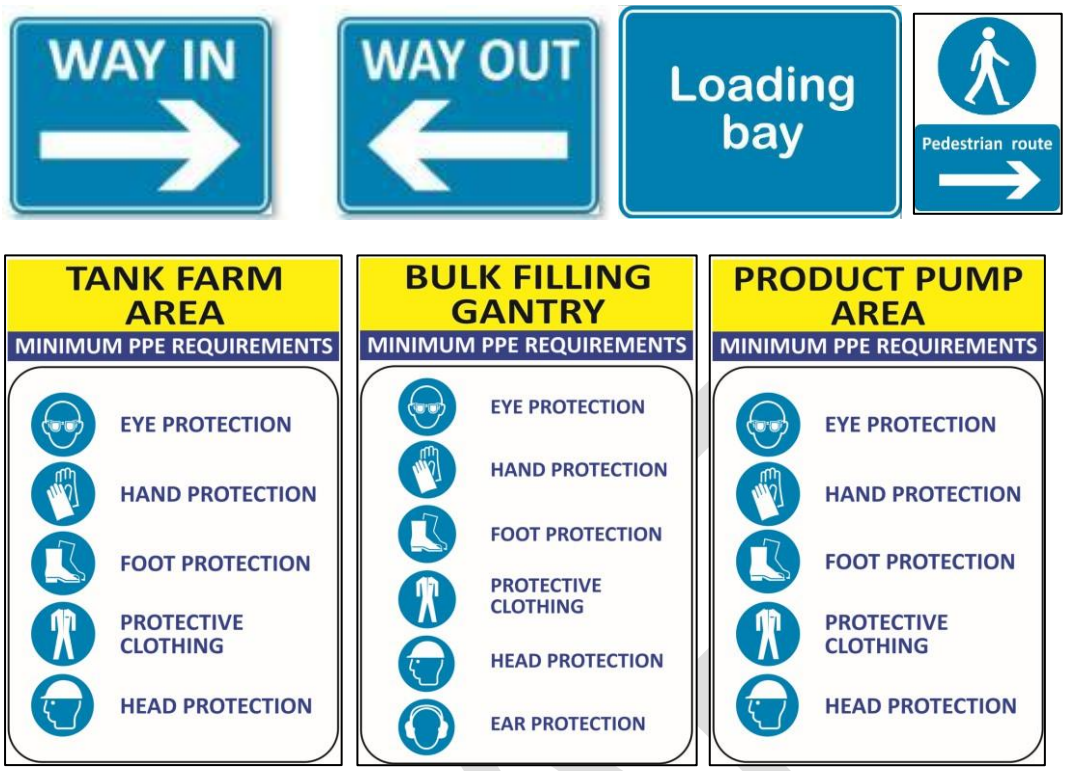

Figure 7. Sample Command/Directional Signages

7.5.1.4 Safety Signages (Green)

Figure 8. Sample Safety Signages

7.6 Personnel Safety

7.6.1 Minimum Requirement for Plant Operation

7.6.1.1 Safety Shoes – Steel toed safety shoes/boots

7.6.1.2 Helmet with Chin strap – Hard Hat, chin strap is mandatory when working at height (> 1.8 meters)

7.6.1.3 Cotton Hand Gloves – For routine non-hazardous tasks which require basic protection (e.g. seal capping, leak testing, light housekeeping jobs, climbing stairs, bathroom cleaning). Ideal for housekeeping jobs that involve handling of rough edges and surfaces.

7.6.1.4 Leather Hand Gloves (Palm design) – For maintenance work requiring heavy handling, housekeeping jobs that require more protection (e.g. handling sharp objects), moving metal pallets, cylinder handling, opening/closing valves. (mechanical, chemical, heat, abrasion)

7.6.1.5 Gloves Rubber/ Neoprene (Chemical) – For operations which has direct exposure to liquid LPG

7.6.1.6 Safety Glasses / Goggles - Safety glasses must be worn by operatives involved in any activity where they have been prescribed based on a risk assessment. This is applicable while doing pipe leak testing activities or working in a pressurized facility

7.6.1.7 Earmuff / Ear Plug – This is applicable in areas with noise exceeding 80 dB (e.g. product pump and compressor areas, generator set room, fire water pump and jetty operations).

7.6.1.8 Safety shirt (long sleeve) and pants – Long sleeved shirts and long trousers made from natural materials such as cotton should be always worn

7.6.1.9 Full body harness – Fall protection system is mandatory when personnel is working at height (> 1.8 meters) unless otherwise protected with platform and railings

7.6.1.10 Life Jacket – Life jacket is worn within areas where there is a risk of falling into the water, at Jetty areas or during Ship to Shore Operations

7.6.2 Training – Is an essential element of an effective safety management system. All those that work with LPG must be properly trained and competent for the activities undertaken. Enough people should be appointed and trained to carry out and supervise procedures and operations.

7.6.2.1 Training Program – It is the responsibility of company management to make sure that all staff involved in LPG operations clearly understand the characteristics of

LPG and its associated risks. Staff should be regularly trained and assessed in the knowledge and practice of normal operations, including as appropriate:

a) Company safety policy, drugs and alcohol policy
b) LPG Product knowledge
c) Safety in day-to-day operations
d) Use of personal protective equipment
e) First aid
f) Loading / unloading
g) Emergency procedures and shutdown
h) Firefighting
i) Inspection and maintenance

To be effective, training should be continuous, with a rolling schedule of refresher courses and where appropriate at least an annual emergency procedure practice.

7.6.2.2 Change Control – Any changes to plant, fittings or equipment or operating procedures must be correctly authorized and communicated to those affected. If necessary, retraining may be required

7.6.2.3 Individual staff training records giving details of initial induction training and periodic refresher training must be kept

7.6.2.4 Fire Instruction and Training – All staff involved in LPG operations should clearly understand the fire / leakage precautions and emergency procedures. Staff at operational sites must be regularly trained and assessed to ensure their knowledge and practice of actions to be taken in an emergency, including:

a) Emergency shut-down procedures
b) Dealing with LPG releases
c) Firefighting
d) The nature of LPG fires

7.6.3 Evacuation Plan – An Emergency plan specifies procedure for handling sudden or unexpected situations. The objective is to be prepared to prevent fatalities and injuries, reduce damage to buildings, structures and equipment

7.6.3.1 Photoluminescent Evacuation Plans and Directions – provides information for guidance and evacuation in all circumstances, even in total darkness

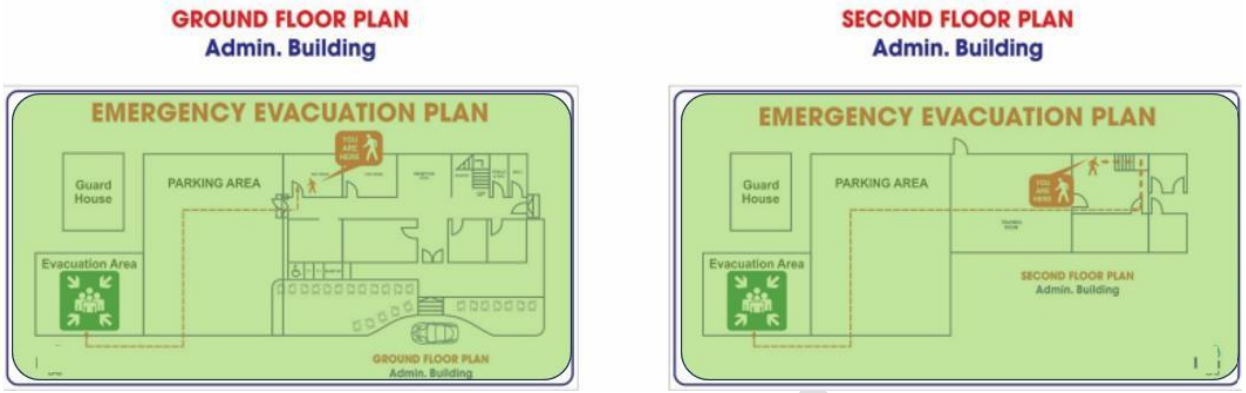

Figure 9. Sample Evacuation Plans

7.6.3.2 Assembly Area – Are designated safe areas where individuals and plant staff can congregate following an emergency evacuation. These points are essential components of any evacuation procedure, serving not only as a muster point for evacuees but also as a roll call location for emergency services to account for all individuals. Key features of Assembly area are as follows:

a) Size – Emergency assembly point must be big enough to accommodate all staff. If a workplace is especially large, more than one primary assembly point is recommended, especially if the premises has multiple exit points.
b) Access – Assembly points must be easily accessible and have an unobstructed pathway leading to them. Conduct a risk assessment on how far the employees/staff should be expected to travel, make the journey as quick and convenient for them as possible
c) Backup – If the assembly point is unable to be used on the day a fire strikes, ensure backup options are available. This is to ensure that the fire safety procedures can still go ahead with minimal confusion
d) Location – Large, wide and open areas are preferred for fire assembly points, but they should not be located where they may hinder the arrival of the emergency services e.g. driveways or car parks. Ensure that the assembly point is well-lit, well-signposted and with no dead ends.
e) Distance – The assembly point should be a suitable safe distance away from the building, far enough away to be clear of any possible smoke or heat being generated from the building. Too close to the building could mean your staff being affected by heat, smoke and falling debris, they could also be in the collapse zone should the building fall.

7.6.3.3 Safety Shower and Eye Wash

a) A safety shower or eyewash is a device designed to wash chemicals off a person in the event of a chemical spill. One can find them separately or as a combined unit. Safety shower/eyewash stations can be in loading bays

b) The area around a safety shower/eyewash station should be kept clear of obstructions. For a shower the user should be able to get under the shower head without difficulty.
c) For sink mounted swing out eyewash the counter space around the eyewash should be kept clear so the eyewash can be deployed without hitting obstructions.
d) Remember in an emergency the user may have obstructed vision due to chemicals in their eyes and moving quickly.

7.7 Truck Pre-Inspection Checklist

7.7.1 General Appearance

7.7.1.1 Body and Chassis must be in good condition

7.7.1.2 No major dents on tank that may affect the calibration

7.7.1.3 No Excessive corrosion

7.7.1.4 Tank paint is in good condition, no major cracks, bubbles, chipped or peeled off

7.7.1.5 Side and rear under-run guards provided on all sides

7.7.2 Cab interior

7.7.2.1 Seats correctly positioned with support and upholstered

7.7.2.2 Dashboard has no cracks or damage that may expose instrument wirings. Instruments, gauges, dashboard and cab lights must be working and safely secured.

7.7.2.3 Built in cigarette lighter in the dashboard is strictly prohibited, or disabled

7.7.2.4 Minimum instrument requirement are as follows:

a) Oil Pressure
b) Temperature Guage
c) Air Pressure
d) Speedometer / Odometer
e) Fuel and Ampere gauges

7.7.2.5 Flooring and Ceiling are leak proof and insulated

7.7.2.6 Doors and Windows

a) Hinges/locks and handles must be in good working condition
b) Side paddings are provided
c) Door windows must be clear, with working mechanism

7.7.2.7 Handbrake, gearshift and other levers accessible to driver must be in good working condition

7.7.2.8 Seatbelts

a) Two (2) sets must be provided
b) Seatbelts must be 3-pointing inertial or impulse type
c) Seatbelts anchor points must be firmly secured

7.7.2.9 10-lb dry-chemical fire extinguisher must be securely fixed inside the cabin, and within easy reach of the driver in case of emergency

7.7.2.10 Distracting items must be removed

a) Window curtains, posters and any unnecessary stickers in the windshield is strictly prohibited
b) No loose items and good housekeeping maintained inside the cab

7.7.2.11 Windshield

a) Clear, clean and without any cracks
b) Original wipers in good working condition
c) Washers if provided in good working condition

7.7.2.12 Access footholds to and from the cabin are rigid, non-slip and properly positioned

7.7.2.13 Sideview Mirrors

a) Provided on both driver and passenger sides
b) Adequate in size, properly positioned and well fastened
c) Front view mirror is provided for forward and semi forward control driver (flat-nosed) cabs

7.7.3 Engine

7.7.3.1 Easy to start, does not back-fire and stall

7.7.3.2 No leaks on fuel pipes/tanks

7.7.3.3 No major leaks on engine

7.7.3.4 No excessive engine vibration due to defective engine support

7.7.3.5 No radiator leaks, and no cracks on radiator hoses

7.7.3.6 Air intake

a) Stack type air intake is capped
b) No leaks in suction pipe/hose

7.7.4 Exhaust system

7.7.4.1 No leaks in piping and not excessively corroded

7.7.4.2 Mounting brackets/joints are firmly secured

7.7.4.3 Exhaust do not pass under product tank

7.7.4.4 Exhaust pipe guarded where physical contact with tank is possible

7.7.5 Steering

7.7.5.1 Steering wheel play does not exceed 1/5 of the wheel diameter

7.7.5.2 Stable steering, no excessive wiggle, vibration and noise

7.7.5.3 Power steering hoses are in good condition

7.7.5.4 Power steering reservoir full and no leaks in the system

7.7.5.5 Clutch/Gearbox

a) No slipping and noise when shifting gears
b) Engages smoothly in all gears

7.7.6 Brakes

7.7.6.1 Holds well evenly when applied

7.7.6.2 No excessive pedal movement

7.7.6.3 Pedals with non-slip pads

7.7.6.4 Brake fluid reservoir is always full

7.7.6.5 No leaks in brake system pipework

7.7.6.6 Air pressure gauge working

7.7.6.7 Low air pressure warning device working

7.7.7 Suspension

7.7.7.1 Leaf springs complete, no cracks

7.7.7.2 U-bolts, brackets holding, leaf springs complete, no missing nuts

7.7.7.3 Manages well on uneven/rough roads

7.7.8 Tires and Wheels

7.7.8.1 Thread depth not less than 2mm

7.7.8.2 Plies intact, no wide tear, holes, bulges and no visible ply

7.7.8.3 Recapped tires not fitted in front

7.7.8.4 Lock rings fits well and no advance corrosion

7.7.8.5 Good spare tire provided

7.7.9 Fifth Wheel (Tractors)

7.7.9.1 Mounting bolts, bracket pins, bushing in good condition

7.7.9.2 Turntable, lock pins in good condition

7.7.9.3 No cracks, damages on fifth wheel

7.7.10 Electricals

7.7.10.1 Parking lights, headlights, Left and right signal lights, backing lights, emergency/hazard lights must all in good condition and no exposed light bulbs due to cracked or broken lens

7.7.10.2 Horns (front and reversing) are in good condition

7.7.10.3 Battery

a) Battery Terminal connections are not loose
b) Battery is cover with a rigid or metal enclosure with rubber insulation

c) Top cover not touching the terminals.
d) Isolation switch provided to entirely cut-off the power

7.7.10.4 Wirings

a) Exposed/un-insulated electrical wirings are strictly prohibited
b) Jumper wires in lieu of fuses/fusible links are strictly prohibited
c) Wires must be neatly laid and arranged

7.7.11 Others

7.7.11.1 20-lb dry chemical fire extinguisher is in a readily accessible quick release holder fitted to chassis

7.7.11.2 Wheel chocks provided (4 pieces)

7.7.11.3 Early Warning Device is provided (2 pieces)

7.7.12 Bullet Tank

7.7.12.1 Pressure relief valve fitted

7.7.12.2 Pressure relief valves adequately guarded in case of roll over

7.7.12.3 Pressure setting painted near pressure relief valve

7.7.12.4 Temperature/Pressure gauges fitted and in good working condition

7.7.12.5 Level indicating instrument adequately guarded in case of roll over

7.7.12.6 Ladder, tank top access/walkways must be in good condition and with non-slip surfaces

7.7.12.7 Emergency shut-off valve installed at valve manifold with the lever placed ay the rear of the bullet, and in good working condition.

7.7.12.8 Emergency Shut-off valve marked conspicuously.

7.7.12.9 Lorry loading/unloading valves of ball valve type, should not be passing and no leaks

7.7.12.10 Truck valves with sealing provisions

7.7.12.11 Protection bars around valve manifold/lines must be provided

7.7.12.12 Requalification and calibration certifications are updated and readily available

7.7.12.13 Date of last requalification painted near bullet nameplate

7.7.12.14 Minimum temperature setting painted near temperature gauge

7.7.12.15 Maximum safe filling capacity painted near the level gauge (no more than 90%)

7.7.12.16 Bullet painted all around with reflectorized paint or sticker or similar material

7.7.12.17 Threads of loading/unloading line where loading arm/hose is connected not worn out

7.7.12.18 Truck loading/unloading lines fitted with dust caps

7.7.12.19 Fixed gauges fitted and must be in good condition

7.7.12.20 Grounding connection

a) Cable must no be frayed and in good condition
b) Cable is adequately connected to tank metal frame support, and not loose
c) Clamp is functional and not painted

7.7.13 Delivery Equipment

7.7.13.1 Meter – Calibration certificate updated and carried in vehicle

7.7.13.2 Discharge hose

a) Thread of end fittings not worn
b) No visible sign of external damage

7.7.13.3 Power Take-off (Pump)

a) No visible sign of leaks
b) Ball type valves installed
c) Electrical fittings of explosion proof/intrinsically safe type of electrically driven
d) Insulation of electrical power supply cable if carried with the lorry, should not be worn out

7.8 Pier Operations

7.8.1 Ship pre-arrival

7.8.1.1 Vetting of Vessel – Terminal shall ensure acceptable vessel dimensions for each berth as terminal has its own berthing restrictions

7.8.1.2 Terminal readiness - The Terminal shall perform a pre-arrival check prior to vessel arrival:

a) Availability of the jetty and facility operability
b) Availability of tank space or ullage
c) Security Level (Declaration of Terminal and Vessel Security Level)

7.8.1.3 Pre-Arrival Communications – The Terminal shall provide such information to the vessel prior to vessel arrival:

a) Berth Characteristics – Depth of water, range of sea water salinity, maximum permissible draft and maximum permissible air draft, availability and requirements of tugs and mooring craft, and mooring plan
b) Terminal Equipment – Number and size of hose connections and manifolds, number, diameter, and length of pipelines, arrangement of gangway landing space or terminal access equipment
c) Communication Prior to Arrival

i. Cargo specifications – Product and volume for discharge
ii. Ship specifications – Ships pumping flow rate, Tank stripping times, ship manifold numbers and hose connection flange sizes, cargo hose testing details (i.e. testing date, serial number), hose or line clearing method to be used
iii. Arrival and berthing details – Estimated Time of Arrival (ETA), arrival and departure draft, estimated loading and discharge time, over-the-tide calculations (depending on the terminal), Port or Starboard side to berth and security level

7.8.1.4 Staffing Plan

a) Shore Officer – Organization, and carrying-out the loading and discharge operation, staffing the loading and discharge team
b) Wharf Attendant
   i. Primary focal for ship to shore communication
   ii. Hose or loading arm connection and rigging
   iii. Monitor of pumping pressure and temperature
   iv. Monitoring of cargo hose, mooring ropes, and access ladder
c) Tank Farm Attendant
   i. Opening and closing of tank farm valves and manifold before commencement of pumping and tank switch over
   ii. Monitoring of the condition of tanks and pipelines inside the tank farm. If necessary, conducts water draining from tank
d) Tank Level Attendant
   i. Set-up of Batch Report

ii. Checking if product is going into the correct Tank and no receipt on other tanks
iii. Flow rate monitoring (min & max)
iv. Hourly Gross Reconciliation Report analysis
v. Monitoring of remaining volume and time (ETC)
vi. Reporting any abnormal circumstances to the Shore Officer
vii. Must be manned during the entire receiving operations

e) Line Patrollers
i. Regular pipeline checks during discharging
ii. Assisting wharf attendant with wharf duties

7.8.1.5 Jetty Pre-Arrival Checks: Marine Loading Arms

a) Terminals shall perform jetty pre-arrival inspections to ensure:
i. Facilities are ready for operations
ii. Equipment is functioning properly
iii. Jetty can safely accommodate the arriving vessel

The following pre-arrival checks shall be conducted, as applicable to the Terminal:

b) Visual inspection of Support jack, Hydraulic hoses and fittings, Swivel joints, Anchor, bolts, Purging, Vacuum breaker, Flange faces
c) Function test of the arm
d) Marine loading arms shall have a documented inspection program in the R&I plan:
i. An annual visual inspection and maneuvering through full operating envelope
ii. Wall thickness measurement at intervals not exceeding 5 years
iii. Pressure testing after seal change-outs or at an interval not exceeding 5 years.
iv. Range monitoring and alarm functions shall be tested at least every three months.
v. The integrity of insulation flanges on loading arms shall be tested at intervals not exceeding 12 months

7.8.1.6 Jetty Pre-Arrival Checks: Cargo Hoses

a) Check for any signs of physical damage of the hose and flanges, to verify the hoses if suitable for service and to ensure that hoses have been tested per manufacturer's recommendations
b) Ensure hose is marked with:
i. Maximum Allowable Working Pressure (MAWP)
ii. Date of latest pressure test
iii. Date and year of manufacture

c) Inspection and testing of hoses shall include:
   i. Visual check for deterioration/damage
   ii. Electrical continuity tests
d) When not connected to piping systems, hoses should be laid flat to avoid stress and kinks in the hose, and should be stored out of the sun
e) Cargo Hoses (Vessel/Ship Owned) should:
   i. Be a suitable type for the cargo being handled
   ii. Have an appropriate maximum allowed working pressure
   iii. Have a valid test certificate

7.8.1.7 Jetty Pre-Arrival Checks: Insulating Flange

a) Ensure good housekeeping and keep outside parts clean
b) Check that insulating flanges have not been painted or damaged
c) Not short-circuited by piping or other equipment
d) Marked valid resistance test result. The measure value after installation should be not less than 1,000 ohms

7.8.1.8 Jetty Pre-Arrival Checks: Breakaway Coupling

a) Examine for mechanical damage and seal condition
b) Verify equipment if functional and not damaged from previous vessel receiving
c) Recommended frequency of replacement as per manufacturer's recommendation

7.8.1.9 Jetty Pre-Arrival Checks: Bollards (Mooring Equipment)

a) Check for rusts affecting integrity of the bollards
b) Check for damage & uneven surfaces
c) Verify equipment if functional and not damaged from previous vessel as uneven or damaged surfaces may damage mooring ropes/lines
d) Mooring equipment shall be appropriate in size and number for the vessel types and sizes to use the berth
   i. Shall be maintained in good condition

ii. Safe Working Load (SWL) of each mooring point shall be marked and known to the berth operator

7.8.1.10 Jetty Pre-Arrival Checks: Fendering System

a) Ensure equipment if functional and not damaged from previous vessel
b) Visual inspection of fendering system shall include:
   i. Chains
   ii. Fittings
   iii. Structural members and hardware
   iv. Synthetic and elastomeric materials

7.8.1.11 Jetty Pre-Arrival Checks: Gang Ways

a) Verify the equipment if functional and not damaged from previous vessel
b) Visual inspection of gang ways shall include:
   i. Located in the area free from obstructions, safe to access in case of emergency
   ii. Safety net is adequate, and must cover the entire area of gang way
   iii. Ensure rollers are working properly

7.8.1.12 Jetty Pre-Arrival Checks: Cargo Transfer Equipment and Pipelines

a) Visual survey, inspection and leak testing of valves and pipelines, ensuring operational and ready to be lined up. This is to ensure the following:
   i. To verify piping and transfer equipment is operable, liquid tight, and is ready for service
   ii. To confirm cargo transfer equipment integrity which is critical to ensure safe and pollution-free cargo transfer operations
   iii. To avoid delays/demurrage due to equipment not being ready for the product receipt
b) Terminal shall maintain records on the design basis, operating conditions and maintenance of cargo transfer equipment.

7.8.1.13 Jetty Pre-Arrival Checks: Structural Surveys

a) Surveyed by subject matter experts / personnels
b) Survey frequency at most every 5 years
c) Records of the last structural survey shall be filed and available for review. If a third party such as a Port authority does the surveys, the Terminal shall obtain a copy of the survey records.

7.8.1.14 Jetty Pre-Arrival Checks: Hydrographic Surveys

a) Terminal shall maintain copies of updated records of water depths alongside berths and in the immediate vicinity
b) Survey frequency at most is every 5 years unless regulated by local authorities or there is history of siltation or scouring

7.8.1.15 Jetty Pre-Arrival Checks: Tools, Equipment, Bolts and Gaskets

a) Confirm that all needed tools and equipment are on hand and in good condition. To ensure availability of the said tools and equipment for receipt operations to avoid delays
b) Gaskets to be used are new. Re-use of gaskets is not allowed due to integrity issues.

7.8.1.16 Jetty Pre-Arrival Checks: Shore Manifold

a) Visual check of shore manifold valves. To verify that valves are in good condition and not damaged from previous operations.

7.8.1.17 Jetty Pre-Arrival Checks: Fire Fighting Systems

a) Verify that the firefighting systems are operational in case of emergencies. This includes fire pumps, fire extinguishers, fire alarm, and international ship-shore fire connection.
b) Visual check of international ship shore fire connection, and fire extinguishers
c) Test the fire pumps and fire alarms

7.8.1.18 Jetty Pre-Arrival Checks: Lightings for Jetty and Tank Farm

a) Test to be operating correctly, to be able to perform critical operations safely at night and to detect potential leaks.
b) Visual check on lighting fixture condition

7.8.1.19 Jetty Pre-Arrival Checks: Automatic Level Gauge (ALG) System / Tank Gauging System, ALG Alarms, and Independent High-Level Alarm (IHLA)

a) Check ALG system to be operational, to ensure safe and accurate monitoring of tank levels
b) Test the IHLA for all tanks to ensure safety critical barriers are functional, and can receive product in the tank

7.8.1.20 Jetty Pre-Arrival Checks: Radio Communication

a) Check if radios are working correctly, to ensure that ALG system is working for proper monitoring of product receipt into tanks and to confirm the operability of alarm systems for emergency situations.
b) Check if radios are fully charged and spare batteries are available

7.8.1.21 Jetty Pre-Arrival Checks: Jetty Access Ladder and Life Buoy

a) Visually check if access ladder and life buoy are in good condition and free from any damages, this is to ensure that such emergency equipment are available in case of a man overboard scenario.
b) Life Buoy shall indicate the source (i.e. terminal location)

7.8.1.22 Jetty Pre-Arrival: Ship/Shore Safety Checklist

a) The Ship/Shore Safety Checklist (SSSC) Pre-Arrival checks (Forms 1A, 1B and 2) detail the basic safety checks required to be covered prior to the arrival of the vessel.
   i. Completed by trained personnel to confirm the necessary level of compliance
   ii. SSSC Pre-Arrival Part 1A is to be accomplished by the vessel and a copy is to be shared to the terminal
   iii. SSSC Pre-Arrival Part 2 is to be accomplished by the terminal and a copy shall be provided to the vessel.
b) SSSC Form 1A
   i. Pre-arrival information is exchanged
   ii. International shore fire connection is available
   iii. Transfer hoses are of suitable construction
   iv. Terminal information details reviewed
   v. Pre-berthing information is exchanged
c) Part 2
   i. Pre-arrival information is exchanged
   ii. International shore fire connection is available
   iii. Transfer equipment is of suitable construction
   iv. Terminal information booklet transmitted to tanker
   v. Pre-berthing information is exchanged
d) Where corrective action is needed, the Terminal may not agree to operations commencing or, should they have been started, may require them to be stopped
e) In carrying out their full responsibilities, both representatives shall assure themselves that the standards of safety on both sides of the operation are acceptable

7.8.1.23 Vessel Pre-Receipt Preparation

a) The vessel receipt preparation is necessary prior to vessel arrival to ensure that:
   i. All necessary product handling equipment is operational
   ii. Receiving tank(s) have sufficient ullage
b) A Vessel Pre-Receipt procedure shall be developed and implemented, as follows:
   i. Product and quantities, specified in the Supply Scheduler's Vessel Arrival Advise. This is to ensure batch will fit in the tank(s), and the right product is on board per the nomination.
c) Tanks and pipelines to be used, valves to be opened and closed. This is to ensure that tank(s) and pipes are available for use.
d) Product level in tanks, sufficient ullage (Shore Tank Ullage Computation). This is to ensure the tanks can safely receive the total volume at or below the Normal Fill Level.

7.8.2 Ship pre-arrival

7.8.2.1 Time and Activity Recording

a) Maintain a full- and independent-time record of all activities of the transfer operations
b) From vessel arrival to departure
c) The Port Performance – statement of facts timesheet should be jointly signed by the Terminal and Vessel.

7.8.2.2 Vessel Time and Activity Reporting

a) If requested to sign the Vessel's record of events, the Terminal shall sign "for receipt only"

7.8.2.3 Mooring Operations

a) Communication between vessel and shore before arrival is required so that the Terminal and/or vessel's agent can make necessary arrangements such as the ordering of pilots, tugs and mooring gangs
b) Terminal Authorized Person – Shall always be in attendance on the jetty during mooring of a vessel
   i. Directing the mooring crew with the instructions of the vessel's master or pilot
   ii. Indicating the shore manifold to be used
   iii. Ensuring that the shore and vessel manifolds are aligned
   iv. Ensuring that the moorings deployed conform to pre-arranged mooring plans
   v. Monitoring the overall operation to ensure no damage is caused to the berth or fittings.

c) During mooring operations, only personnel involved should be allowed on the jetty
d) Terminal's Responsibility – Once the vessel is moored, the Terminal has the responsibility to
    i. Ensure that the vessel remains securely moored and in the correct position, and ensure that any necessary corrective action is taken
    ii. Monitor environmental conditions regarding established operational limits and share relevant information with the vessel

7.8.2.4 Single Point Moorings (SPM)

a) Operating procedures shall be in the place that defines the complete operation. From joining of berthing master until he departs the vessel on completion of cargo operations
b) Terminal shall comply with the extensive industry guidance published by Oil Companies International Marine Forum (OCIMF)
    i. Hose arrangement and design considerations
    ii. Chain/cable criteria and mooring equipment requirements
    iii. Operations and maintenance procedures
c) Records shall demonstrate that the recommended procedures, tests and inspections are carried out

7.8.2.5 Mooring Plans

a) Mooring plans for each berth and each size of vessels shall be kept up-to-date and documented
    i. Sketch layout of the berth
    ii. Positioning and Safe Working Load (SWL) of the mooring points/buoys/bollards
    iii. Positioning of fenders
    iv. Lay-out and number of the mooring lines
    v. Maximum allowed displacement
b) Designed to meet or exceed the environmental limits of the berth.
c) Agreed with pilots and understood by jetty operators, vessel's master and mooring contractors.

7.8.2.6 Environmental Limits

a) Terminals shall establish environmental limits for each berth, based on the terminal port details, defining the thresholds for stopping cargo transfer, disconnecting cargo connections and removing the vessel from the berth.
    i. Wind Speed
    ii. Wave Height
    iii. Swell Conditions
    iv. Current Speed and Direction

b) These limits shall consider the Safe Working Load (SWL) of the mooring system components
c) Environmental limits shall be documented and passed to the vessel at the pre-transfer conference and be recorded on the Ship/Shore Safety Check List.

7.8.2.7 Ship/Shore Safety Checklist: Checks After Mooring

a) The Ship/Shore Safety Checklist (SSSC) Checks after Mooring (Forms 3 and 4) detail the basic safety checks required to be covered after mooring has been completed.
    i. Completed by trained personnel, competent to confirm the necessary level of compliance
    ii. The SSSC Form 3 shall be completed by the vessel and a copy of this will be shared to the terminal.
    iii. The SSSC Form 4 shall be completed by the terminal and a copy of this will be shared to the vessel

7.8.2.8 SSSC Form 3 – Checks after mooring

a) Fendering is effective
b) Mooring arrangement is effective
c) Access to and from the tanker is safe
d) Scuppers are plugged
e) Cargo system sea connections and overboard discharges are secured
f) Very high frequency and ultra-high frequency transceivers are set to low power mode
g) External openings in superstructures are controlled
h) Pumproom ventilation is effective
i) Medium frequency/high frequency radio antennae are isolated
j) Accommodation spaces are at positive pressure
k) Fire control plans are readily available

7.8.2.9 SSSC Form 4 – Checks after mooring

a) Fendering is effective
b) Tanker is moored according to the terminal mooring plan
c) Access to and from the terminal is safe
d) Spill containment and sumps are secure

7.8.2.10 Safe Access to Vessel

a) Vessel access gangways can be Terminal or Vessel supplied.
b) The Terminal is responsible for ensuring safe access to the Vessel

c) ISGOTT requires there to always be safe means of access with guard rails and safety nets as appropriate
   i. The number of access points should be sufficient to allow timely evacuation of all personnel on board.
   ii. Gangway should be always monitored
d) Requirements prior to boarding the ship
   i. Securely moored, gangway is secured, and safety net is properly rigged
   ii. Personnel is equipped with a life vest. Prior to use, inspect life vest: Inflator indicator should be green, and should not be expired.
   iii. Environmental Criteria within acceptable limit
   iv. Cleared by the Quarantine authorities (indicated when ship lowers the square yellow flag)
e) Risks in boarding the ship
   i. Ship could move
   ii. Gangway not secured resulting in injury to personnel
   iii. If Quarantine has not cleared the ship due to a health problem on board, and everyone on the ship will be quarantined.
   iv. Delay, dispute or ban by authorities resulting in extra demurrage fees

7.8.2.11 Notice of Readiness

a) Document from the vessel states the date and time at which the vessel arrived in the port and was ready in all respects for the intended operation
   i. If a vessel is delayed in proceeding directly to the berth, the NOR may be tendered when it arrives at anchorage
b) Terminal shall sign “for receipt only” once presented with NOR
   ii. May be the basis of any claims
   iii. Indicate the date and time the NOR is received in hand, not the date and time of initial notification.

7.8.2.12 Ship/Shore Safety Checklist (SSSC) Pre-Transfer Conference

a) The Ship/Shore Safety Checklist (SSSC) Pre-Transfer Conference (Forms 5A, 5C, 6, & 7A, and Declaration) and Safety Letter detail the basic safety checks required to be covered prior to any vessel operation.
   i. Completed by trained personnel, competent to confirm the necessary level of compliance
   ii. The SSSC Form 5A contains the terminal and tanker pre-transfer conference checklists. Form 5C will only be required if the vessel will involve LPG-related operations
   iii. The SSSC Form 6 describes the agreements to be able to perform vessel operations as safely as possible. This would involve security protocols, flow rates and max environmental factors.

iv. The SSSCL Form 7A involves the general pre-transfer checks.
v. The SSSCL Declaration will also have to be accomplished to ensure that all SSSCL documents are available to both the vessel and terminal
vi. Before the start, the Terminal Representative together with a Ship's Officer, will make a routine inspection of the ship to ensure that the questions on the SSSC can be answered in the affirmative.
vii. Where corrective action is needed, the Terminal may not agree to operations commencing or, should they have been started, may require them to be stopped
viii. In carrying out their full responsibilities, both representatives shall assure themselves that the standards of safety on both sides of the operation are acceptable.

b) SSSC Form 5A Tanker and Terminal – Pre-Transfer Conference

i. Tanker is ready to move at agreed notice
ii. Effective tanker and terminal communications are established
iii. Transfer equipment is in safe condition
iv. Operation supervision and watchkeeping is adequate
v. There are sufficient personnel to deal with an emergency
vi. Smoking restrictions and designated smoking areas are established
vii. Naked light restrictions are established
viii. Control of electrical and electronic devices is agreed
ix. Means of emergency escape from both tanker and terminal are established
x. Firefighting equipment is ready for use
xi. Oil spill clean -up material is available
xii. Manifolds are properly connected
xiii. Sampling and gauging protocols are agreed
xiv. Procedures for cargo, bunkers and ballast handling operations are agreed
xv. Cargo transfer management controls are agreed
xvi. Cargo tank cleaning requirements, including crude oil washing, are agreed
xvii. Cargo tank gas freeing arrangements agreed
xviii. Cargo and bunker slop handling requirements agreed
xix. Routine for regular checks on cargo transferred are agreed
xx. Emergency signals and shutdown procedures are agreed
xxi. Safety data sheets are available
xxii. Tank venting system and closed operation procedures are agreed
xxiii. Vapor return line operational parameters are agreed
xxiv. Measures to avoid back-filling are agreed, where vapor return line is always open
xxv. Portable very high frequency and ultra-high frequency radios are intrinsically safe

c) SSSC Form 5C Tanker and Terminal – Liquified Gas. Checks Pre-Transfer
   i. Water spray system is operational
   ii. Appropriate personal protective equipment is identified and available
   iii. Remote control valves are operational
   iv. Cargo pumps and compressors are operational
   v. Maximum working pressures are agreed between tanker and terminal
   vi. Gas detection equipment is appropriately set for the cargo
   vii. Cargo system gauge operation and alarm set points are confirmed
   viii. Emergency shutdown systems are tested and operational
   ix. Cargo handling rate and relationship with valve closure times and automatic shutdown systems is agreed
   x. Maximum/minimum temperatures/pressures of the cargo to be transferred are agreed
d) SSSC Form 6 Tanker and Terminal – Arrangements Pre-transfer
   i. Tanker maneuvering readiness
   ii. Security protocols
   iii. Effective tanker/terminal communications
   iv. Operational supervision and watchkeeping
   v. Dedicated smoking areas and naked lights restrictions
   vi. Maximum wind, current and sea/swell criteria or other environmental factors
   vii. Pressure surge control
   viii. Cargo transfer management procedures
   ix. Routine for regular checks on cargo transferred are agreed
   x. Emergency signals
   xi. Vapor return line
   xii. For gas tanker only: cargo tank relief valve settings

7.8.2.13 Static Electricity

a) Static Electricity: The electricity produced by movement between dissimilar materials through physical contact and separation.
b) Marine transfers shall begin at initial pumping rate during the pressurization of the terminal piping system to ensure dissipation of static in the product, and during the initial tank and pipeline/piping integrity and operational checks.
   i. Initial and maximum flow rate should be discussed, agreed to and documented during the pre-transfer conference.

c) Electrical Isolation
   i. Insulating flanges are needed for electrical isolation to protect against the risk of electric arcing due to high currents (ship/shore at the manifold during connection and disconnection the shore hose or loading arms.

ii. Possible sources of high currents are:
- Cathodic protection
- Stray currents
- Static electricity

iii. Necessities for Insulating Flange Installation
- Insulating flanges must not be painted
- Test lug – if not existing, plan for the installation if other work is in progress
- Testing requirement – a leakage current across the flanges will allow sparking between the ship and shore during hose connection or disconnection

d) Visual Inspection of Insulating Flange – Surveillance Inspection – by Terminal Manager or Shore Office

i. Check for signs of damage of insulating sleeves, washers, and gasket
ii. Check deterioration of protected wrapping if any
iii. Check and remove presence of bridging (water, dirt foreign bodies, paint)

7.8.3 Vessel Discharge Operations

7.8.3.1 Vessel Pre-Receipt/Loading

i. Planning the entire transfer operation to anticipate what is expected to occur and to adequately monitor and adjust

7.8.3.2 Vessel Start Up Receipt/Loading

a) Safely start-up the product movement as agreed during by the Pre-Transfer Conference

7.8.3.3 Vessel Ongoing Receipt/Loading

a) Monitoring of the tank receipts throughout the vessel transfer to validate the receipt is progressing as expected and to adjust or intervene if necessary.

7.8.3.4 Vessel End of Receipt/Loading

a) Validation that the tank receipt plans occurred as expected.

7.8.3.5 Flowrates – Factors affecting flow rates:

a) Ship’s pumping pressure and capacity to pump at required pressures
b) Pipe diameter
c) Pipeline length (capacity)

d) Previous experience records
e) Data provided by the ship

7.8.3.6 Vessel Start Up Receipt

a) Activities to safely start-up the product movement as agreed during by the Pre-Transfer Conference
b) Shall include the following steps
    i. Line Up Checks
    ii. Terminal and Vessel Confirmations
    iii. Start Up and Immediate Checks
    iv. Maximize Flow Rate
c) Terminal approves increasing the flow rate up to agreed maximum rate after:
    i. Tank and pipeline/piping integrity check
    ii. Operational checks
    iii. Tank and vessel compartment movements checks
    iv. Satisfactory product quality tests
    v. Static generation risks are alleviated

7.8.3.7 Vessel On Going Receipt

a) Monitoring of the tank receipts throughout the vessel transfer to validate the receipt is progressing as expected and to adjust or intervene if necessary
b) Hourly gross reconciliation checks validate the gross volume that was shipped was received in the planned tank, at the estimated flow rate, as per the plan.
    i. Volumes the vessel has discharged
    ii. Volumes received in the Terminal tank(s).
c) Verify the expected and actual transfer rates and adjust documented end times accordingly. To keep the estimated end time accurate in the documentation.
d) Validate the intended tank(s) is the only tank(s) receiving product, and there is no unintended tank movement in other tanks. To validate that only the intended tank(s) is receiving product throughout the transfer
e) Investigate all abnormal conditions such as:
    i. Significant Hourly reconciliation variations
    ii. Jetty and line pressures exceeding the plan
    iii. Flow rate discrepancies
    iv. To ensure the vessel transfer is progressing as planned and expected.

f) Comparison of the expected receipt volume and available ullage in the receipt tank(s). To ensure all tanks can accommodate the ongoing planned transfer volume
g) In case tank switches are part of the plan, additional oversight of the tank switch is recommended.
h) Periodic visual inspections of piping and tank systems as necessary, Hoses and loading arms, Piping and pipelines, Submarine line, Tanks. To validate tank farm, Terminal Piping, and Jetty piping remains leak free and operations are progressing as expected.

7.8.3.8 Vessel On Going Receipt – Hourly Gross Reconciliation

a) Validates the gross volume that was shipped was received in the planned tank, at the estimated flow rate, as per the plan.
b) Comparisons should be made hour to hour, and accumulatively over time
c) Tolerance should be based on historic Terminal performance and equipment
d) Discrepancies shall be immediately investigated and acted on
    i. Potential reasons:
        - Leaks in the pipeline
        - Unintended transfer to other tanks
        - Unsynchronized gauging time for vessel compartment and terminal tank.
e) Appropriate actions
    i. Re-take the hourly figures and recalculating the variance
    ii. Check hoses, pipelines, and flanges
    iii. Stop the transfer to do a full investigation.

7.8.3.9 Vessel On Going Receipt – Automatic Tank Gauging (ATG)

a) Some ATG systems have the capability to set reminder trip levels and volume change trips as “Operational Alerts”.

7.8.3.10 Vessel On Going Receipt – Ship/Shore Safety Checklist Repetitive Check

a) The Ship/Shore Safety Checklist (SSSCL) Repetitive Checks (Forms 8 and 9) detail the basic safety checks required to be covered during regular intervals of any vessel operation.
    i. Joint monitoring intervals appropriate to local site conditions shall be based on the outcome of a risk assessment of the site and agreed between both parties during the pre-transfer conference, at intervals not exceeding 6 hours.
    ii. The SSSCL Form 8 contains the repetitive checks to be accomplished by the vessel which should be shared to the terminal.

iii. The SSSCL Form 9 contains the repetitive checks to be accomplished by the terminal which should be shared to the vessel.
iv. At regular intervals, the Terminal Representative together with a Ship's Officer, will make a routine inspection of the ship to ensure that the questions on the SSSC can be answered in the affirmative.

b) SSSC Form 8 Tanker - Repetitive Checks During and After Transfer
i. Cargo tank atmospheres are at positive pressure
ii. Mooring arrangement is effective
iii. Access to and from the tanker is safe
iv. Scuppers are plugged
v. External openings in superstructures are controlled
vi. Pumproom ventilation is effective
vii. Tanker is ready to move at agreed notice period
viii. Fendering is effective
ix. Communications are effective
x. Supervision and watchkeeping is adequate
xi. Sufficient personnel are available to deal with an emergency
xii. Smoking restrictions and designated smoking areas are complied with
xiii. Naked light restrictions are complied with
xiv. Control of electrical devices and equipment in hazardous zones is complied with
xv. Emergency response preparedness is satisfactory
xvi. Electrical insulation of the tanker/terminal interface is effective
xvii. Tank venting system and closed operation procedures are as agreed
xviii. Individual cargo tank inert gas valves settings are as agreed
xix. Cargo tank high level alarms are operational

c) SSSC Form 9 Terminal – Repetitive Checks During and After Transfer
i. Mooring arrangement is effective
ii. Access to and from the terminal is safe
iii. Fendering is effective
iv. Communications are effective
v. Supervision and watchkeeping is adequate
vi. Sufficient personnel are available to deal with an emergency
vii. Smoking restrictions and designated smoking areas are complied with
viii. Naked light restrictions are complied with
ix. Control of electrical devices and equipment in hazardous zones is complied with
x. Emergency response preparedness is satisfactory
xi. Tank venting system and closed operation procedures are as agreed

7.8.3.11 Vessel End Receipt

a) Document receipt information:
   i. Receiving tank(s) actual product level, volume, temperature
   ii. Time receipt ended
   iii. To verify end levels and to compare these end levels to the estimated end levels.
   iv. Confirm all tank and piping valves are returned to their normal position and isolated from the marine transfer. To ensure all valves are returned to their “non-receipt” position.
   v. Confirm all hoses or loading arms are adequately drained, disconnected from the vessel and secured. To ensure hose and loading arms are properly stored and isolated
   vi. If tanks are on hold for Product Quality (PQ) and/or Quantity verification, tanks are to be isolated from sales. To ensure a tank is not pre-maturely released for product sales.

7.8.4 Vessel post-discharge

7.8.4.1 Vessel Tank Inspection – After Discharge

a) Once the ship has finished stripping ashore
   i. Close jetty and tank valves
   ii. Check if the vessel if agreed quantity/volume is discharge through:
      - Use automatic or other gauging systems
      - When independent cargo inspectors are employed, this duty may be entrusted to them
      - When there is product remaining on board, the vessel compartments should be gauged.

7.8.4.2 Hose / Arm Draining and Disconnection

a) After vessel tank/compartment inspection:
   i. Drain the hoses/arms back to the vessel (receipt) or terminal (loading)
   ii. Close vessel and shore manifold valves
   iii. Disconnect hoses or arms
   iv. Securely blank cargo manifolds and hoses

7.8.4.3 Quality – After Discharge

a) Terminal must verify the quality of product received
   i. Sampling
   ii. Contamination checks

iii. Communication requirements

b) Additional requirements or tests may be specified by the Supply Department
   i. Density
   ii. Appearance

7.8.4.4 Quantity – After Discharge

a) Calculate shore tank receipts shall be compared with the Bill of Lading figures

7.8.4.5 Quantity – After Discharge

a) Allow tanks to settle for at least 30 minutes after completion of receipt, to:
   i. Static to dissipate
   ii. Product surface to stabilize
   iii. Free water and solid contaminants to settle
b) Close tank inlet and outlet valves
c) Drain water from tank (if any)
d) Record the tank level, pressure and temperature (manually or via Automatic Tank Gauging System)
e) Calculate the volume received

7.8.5 Post-sailing Inspection

7.8.5.1 To ensure the terminal is properly secured

7.8.5.2 To check for damage to the terminal during the previous operations

7.8.5.3 To allow maximum time to make repairs prior to the next vessel arrival

7.8.6 Post-Sailing Inspection: Wharf & Equipment Clean-up

7.8.6.1 Post-discharging Wharf & Equipment Clean-up

a) Clean, repair, service, re-stock and store fire-fighting equipment
b) Return testing equipment

8 Resiliency Statement

Any new downstream oil facility shall be constructed and operated with high regard to the latest design and operational requirement to address natural events such as earthquakes, fault movement, storm surge, flooding, or typhoon conditions as recognized by competent

government agencies most likely to affect the general area where the facility shall/is to be located.

8.1 All stakeholders in the Downstream Oil Industry (DOI) must have a Resiliency Compliance Plan (RCP) in accordance with the adoption and mainstreaming of resiliency programs in the planning, project implementation and operations of the energy sector implemented by Task Force on Energy Resiliency (TFER).

8.2 Effective risk assessment shall put into account, but not necessarily be limited to the following:

a. Identify and analyze risk involved
b. Assess risk potential and impact
c. Identify controls to mitigate and reduce risk
d. Implement the control measure as planned

8.3 As a guide, a facility owner may use the template below in the conduct of its individual facility risk assessment:

Hazard/Risk Assessment Table

Description of Hazard/Risk	***Possibility of Occurrence**	****Severity of Impact**	**Control Measure (Include Engineering, Administrative and PPE)**
Name of Person who conducted the assessment		Signature	Date
Name of Supervisor		Signature	Date

**rated as low, medium or high*
***rated from 1 to 5, 1 being the lowest in terms of severity of impact and 5 being highest*

9 Energy Efficiency and Conservation Statement

The downstream oil industry, particularly LPG facilities, may adopt energy-saving strategies to substantially reduce energy consumption and lower operating costs, in alignment with the mission and vision of DOE for a more sustainable energy future.

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