PETROLEUM AND NATURAL GAS REGULATORY BOARD

NOTIFICATION

New Delhi, the _____

G.S.R.____.-In exercise of the powers conferred by section 61 of the Petroleum and Natural Gas Regulatory Act, 2006 (19 of 2006), the Petroleum and Natural Gas Regulatory Board hereby makes the following Regulations, namely:-

1. Short title and commencement.

(1) These Regulations may be called the Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Petroleum Installations) Regulations, 2017.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. **Definitions**

(1) In these regulations, unless the context otherwise requires,

a. "Act" means the Petroleum and Natural Gas Regulatory Board Act, 2006;
b. "Board" means the Petroleum and Natural Gas Regulatory Board established under sub-section (1) of section 3 of the Act;
c. "Bonding" means the process by which two electrical conducting bodies are connected using a conductor to maintain electrical continuity to prevent sparking.
d. "Clean agent" means electrically nonconductive, volatile or gaseous fire extinguishing medium that does not leave a Residue upon evaporation and meets the requirements given in the latest NFPA 2001 on clean agent fire extinguishing systems in line with environmental considerations of Kyoto and Montreal Protocol & latest MOEF regulations (Ministry of Environment & Forest).
e. "corrosion" means all forms of wastage, and includes oxidation, scaling, mechanical abrasion and corrosion;
f. "design" includes drawings, calculations, specifications, models codes and all other details necessary for the complete description of the pressure vessel and its construction;
g. "design pressure" means the pressure used in the design of equipment, a container, or a vessel for the purpose of determining the minimum permissible thickness or physical characteristics of its different parts. Where applicable, static head shall be included in the design pressure to determine the thickness of any specific part.
h. "Dyke" means an area that may be defined through the use of structure or the topography at the site for the purpose of containing any accidental spill of petroleum products.
i. "Earthing" means the provision of a safe path of electrical current to ground, in order to protect structures, plant and equipment from the effects of stray electrical current, and electrostatics discharge.
j. "Effluent Treatment Plant (ETP)" means a mechanism and process used to treat waters that have been contaminated due to presence of Oil / sludge / Grease / chemicals / sewage generated of different activities / operations in Petroleum Installations.
k. "Emergency Shutdown System" means a system that safely and effectively stops whole plant or an individual unit before unrecoverable incidents occurs.
l. "Explosive mixture" means a mixture of combustion agent (oxidising product gas, vapour, liquid or solid) and a fuel (oxidisable product - gas, liquid or solid) in such proportions that

it could give rise to a very rapid and lively oxidization reaction liberating more energy than is dissipated through conduction and convection.

i. “Lower explosive Limit (LEL)” means the minimum concentration of a vapour in air (or other oxidant) below which propagation of flame does not occur on contact with an ignition source. This is usually expressed as volume percentage of the vapour in air.
ii. “Upper Explosive Limit (UEL)” means the maximum concentration of a vapour in air (or other oxidant) above which propagation of flame does not occur on contact with an ignition source. This is usually expressed as a volume percentage of vapours in air.

m. “Failsafe” means design features which will maintain or result in safe operating conditions in the event of a malfunction or failure of power, instrument air, components or control devices.
n. “fittings” means the safety fittings that are directly fitted on the pressure vessel including safety relief valves, excess flow valves and level measuring devices.
o. “Fixed-Length Dip Tube” means a pipe that has a fixed open end fitted inside a container at a designated elevation that is intended to show a liquid level.
p. “flammability range” means the difference between the minimum and maximum percentage by volume of the gas in mixture with air that forms a flammable mixture at atmospheric pressure and ambient temperature’
q. “Flash Point” means the lowest temperature at which the liquid yields vapour in sufficient concentration to form an ignitable mixture with air and gives a momentary flash on application of a small pilot flame under specified conditions of test as per IS: 1448 (Part-I).
r. “Hazardous Fluid” means a liquid or gas that is flammable or toxic.
s. “Hazardous Area” means the locations classified according to Zone System which defines the probability of the hazardous material, gas or dust, being present in sufficient quantities to produce explosive or ignitable mixtures which require special precautions for the construction, installation and use of electrical apparatus as below :

i. “Zone 0” means ignitable concentrations of flammable gases or vapours which are present continuously or for long periods of time.
ii. “Zone 1” means ignitable concentrations of flammable gases or vapours which are likely to occur under normal operating conditions.
iii. “Zone 2” means ignitable concentrations of flammable gases or vapours which are not likely to occur under normal operating conditions and do so only for a short period of time.

t. “Intrinsically Safe” means a circuit or part of a circuit is intrinsically safe when any spark or thermal effect produced normally (that is, by breaking or closing the circuit) or accidentally (for example, by short circuit or earth fault) is incapable, under prescribed test conditions, of causing ignition of a prescribed gas or vapour. An intrinsically safe apparatus is one in which all electrical circuits are intrinsically safe.
u. “Non- Hazardous area” means an area in which an explosive gas atmosphere is not expected to be present in quantities such as to require special precautions for the construction, installation and use of electrical apparatus.
v. “Ignition Source” means any item or substance capable of an energy release of type and magnitude sufficient to ignite any flammable mixture of gases or vapours that could occur at the site.
w. “Maximum Allowable Working Pressure” means the maximum gauge pressure permissible at the top of equipment, a container or a pressure vessel while operating at design temperature.
x. “NDT” means Non Destructive Testing methods like Dye Penetration Inspection, Wet Fluorescent Magnetic Particle Inspection, Ultrasonic thickness checks, Ultrasonic Flaw Detection, Radiography, Hardness Test and other relevant Inspection procedures carried out to detect the defects in the welds and parent metal of the pressure vessel

y. “Oil water separator (OWS)” means a system designed to separate gross amount of oil and suspended solids from the oily water effluent generated due to different activities/operations in Petroleum Installations.

z. “onshore” means areas other than offshore which shall form the scope of these regulations. Feeder lines from / to jetty or other storage points shall also form a part of the onshore pipelines;

aa. "petroleum" means any liquid hydrocarbon or mixture of hydrocarbons and any inflammable mixture (liquid, viscous or solid) containing any liquid hydrocarbon, including crude oil and liquefied petroleum gas, and the expression 'petroleum product' shall mean any product manufactured from petroleum;

Petroleum products are classified according to their closed cup flash points as given below:

i. Class-A Petroleum: Liquids which have flash point below 23^{o}C.
ii. Class-B Petroleum: Liquids which have flash point of 23^{o}C and above but below 65^{o}C.
iii. Class-C Petroleum: Liquids which have flash point of 65^{o}C and above but below 93^{o}C.
iv. Excluded Petroleum: Liquids which have flash point of 93^{o}C and above.
v. Liquefied gases including LPG do not fall under this classification but form separate category.

bb. “Petroleum Installation” means a depot / terminal having facilities for storing, handling, distribution, transportation, loading / unloading of petroleum, oil and lubricants.

cc. “pressure vessel” means any closed metal container of whatever shape, intended for the storage and transport of any compressed gas which is subjected to internal pressure and whose water capacity exceeds one thousand liters and includes inter connecting parts and components thereof upto the first point of connection to the connected piping and fittings, but does not include containers wherein steam or other vapour is or is intended to be generated or water or other liquid is or is intended to be heated by the application of fire or the products of combustion or by electrical means, heat exchangers, evaporators, air receivers, steam type digestors, steam type sterilizers, autoclaves, reactors, calorifiers, pressure piping components such as separators or strainers and vessels containing a liquid under a blanket of compressed inert gas;

dd. “Pumpable Capacity (Net Capacity)” means the capacity of the tank during operation after subtracting the volume of tank bottom contents up to the top of pump out nozzle from safe filling capacity of the tank.

ee. “Safe Capacity of a Tank” means the capacity of the tank up to the maximum safe filling height (safe filling level) of the tank as per statutory requirements. The safe fill level shall be established for each specific tank that will depend on the type of tank, diameter, its internal configuration and condition, rate of filling and the operating practices.

ff. “Safety relief device” means an automatic pressure relieving device actuated by the pressure upstream of the valve and characterized by fully opened pop action, intended to prevent the rupture of a pressure vessel under certain conditions of exposure ;

gg. “Shall” indicates a mandatory requirement.

hh. “Should” indicates a recommendation or that which is advised but not mandatory.

ii. ““Slop” means off-specification products obtained from market, during any disturbance in operation and draining etc. from various equipment / tanks / pumps containing oil -water mixture are called slops. This does not include interface generated during pipe line transfer operations.

jj. Source of ignition” means naked lights, fires, exposed incandescent materials, electric welding arcs, lamps, other than those specially approved for use in flammable atmosphere, or a spark or flame produced by any means;

kk. “Stabling Line” means an additional railway line / spur reserved for additional rake / stabling.

ll. “Water capacity” means capacity in litres of the pressure vessel when completely filled with water at 15^0 C.

(2) Words and expressions used and not defined in these regulations, but defined in the Act or in the rules or regulations made there under, shall have the meanings respectively assigned to them in the Act or in the rules or regulations, as the case may be.

3. Application.

Definitions, layout, design, standard operating procedures, maintenance, inspection, competence assurance, fire protection, safety management plan and vehicle management system of Petroleum Installations shall be in accordance with the requirements of these regulations.

These regulations do not cover the requirements in respect of LPG installations.

4. Scope.

(1) Requirements of these regulations shall apply to all existing and new Petroleum Installations.

(2) These regulations covers safety in design, material and equipment, piping system components and fabrication, installation and testing, commissioning, corrosion control, operation and maintenance and safety of Petroleum Installations.

(3) These regulations also cover engineering considerations in design and installations including fire protection and safety systems.

(4) These regulations do not cover the requirements in respect of LPG installations.

5. Objective.

These standards are intended to ensure uniform application of design principles in layout, material and equipment selection, construction, operations, maintenance etc., as mentioned in “Application” above for safe operation at the facilities associated with Petroleum Installations.

6. The standard.

Technical standards and specifications including safety standards (hereinafter referred to as standards) for Petroleum Installations are as specified in Schedule-I which cover layout, design, standard operating procedures, maintenance, inspection, competence assurance, fire protection, safety management plan and vehicle managment ssytem.

7. Compliance to these regulations.

(1) The Board shall monitor the compliance to these regulations either directly or through an accredited third party as per separate regulations on third party conformity assessment.

(2) Any entity intending to set up a Petroleum installation shall make available its detailed plan including design consideration conforming to these Regulations to PESO for their approval.

(3) If an entity has laid, built, constructed, under construction or expanded the Petroleum

Installation based on some other standard or is not meeting the requirements specified in these Regulations, the entity shall carry out a detailed Quantitative Risk Analysis (QRA) of its infrastructure. The entity shall thereafter take approval from its highest decision making body or its Board for non-conformities and mitigation measures. The entity's Board approval along with the compliance report, mitigation measures and implementation schedule shall be submitted to PNGRB within six months from the date of notification of these regulations.

8. Default and Consequences.

(1) There shall be a system for ensuring compliance to the provision of these Regulations through conduct of technical and safety audits during the construction, commissioning and operation phase.

(2) In case of any deviation or shortfall in compliance to these Regulations, the entity shall be given time limit for rectification of such deviation, shortfall, default and in case of non-compliance, the entity shall be liable for any penal action under the provisions of the Act or termination of operation or termination of authorization.

9. Requirements under other statutes.

It shall be necessary to comply with all statutory rules, regulations and Acts in force as applicable and requisite approvals shall be obtained from the relevant competent authorities for Petroleum Installations.

10. Miscellaneous.

(1) If any dispute arises with regard to the interpretation of any of the provisions of these regulations, the decision of the Board shall be final.

(2) The Board may at any time effect appropriate modifications in these regulations.

(3) The Board may issue guidelines consistent with the Act to meet the objective of these regulations as deemed fit.

Schedule – 1 - Technical Standards and Specifications including Safety Standards for Petroleum Installations

(See regulation 6)

Contents

1.0 INSTALLATION LAYOUT

1.1 LAYOUT PHILOSOPHY

Following philosophy should be adopted in layout of an installation:

i. Presence of ignition source shall always be contemplated beyond the boundary wall of installation.

ii. Quantative Risk Analysis / Assessment shall be carried out at the layout stage with an objective to arrive at any specific mitigation measures required for Hazards identified. Risk reduction / mitigation measures shall be given due credit.
   a. Risk assessment shall include Unconfined Vapour cloud explosion (UVCE). The outcome shall guide in preparation of onsite / off site emergency plan.
   b. Quantitative Risk Assessment (QRA) shall be done when ever major addition(s) in facilities or major changes in the surrounding areas, operating parameters, product grade takes place or once in every five years whichever is earlier.

iii. Approaches from the highway / major road should be provided for normal / emergency movement with minimum road width of 3.5 mtrs for one way movement.

iv. Roads inside the hazardous area of Installation shall be restricted to vehicles required for operational, maintenance and safety/security reasons and allowed only with proper safety fittings and authorization from location in-charge/designated safety officer. except tank trucks coming inside for filling / decantation."

v. Alternative access shall be provided for each facility so that it can be approached for fire fighting in the event of blockage on one route.

vi. Road widths, gradient and turning radii at road junctions shall be designed to facilitate movement of the fire-fighting vehicle envisaged in the event of emergency. Minimum road width of 3.5 M should be maintained for each way. The turning radius at the gantry shall be designed to facilitate the smooth movement of the tank trucks (including trailer mounted).

vii. Rail spur should be located close to the boundary of the installation to minimise road/pipe crossings and blockage of roads during shunting. The rail spur should be designed in line with the Railway Guidelines.

viii. Layout should consider the space requirements for

   a. Maintenance and inspection of each equipment / facility.
   b. Dedicated area for construction/ fabrication activities..
   c. Future expansion for addition of facilities.

ix. Vehicles with spark ignition engine shall not be allowed in the hazardous area. Vehicles with internal combustion engine (compression ignition) such as tank truck (fuelled by HSD) required to be permitted for business shall have Petroleum and Explosives Safety Organization (PESO) approved tank body with approved spark arrestor fitted on the vehicle.

x. Physical segregation of hazardous and non hazardous areas shall be provided. Layout drawing indicating hazardous and non hazardous area segregation /demarcation shall be available. Hazardous area segregation/demarcation shall be as per IS 5572:2009.

1.2 LAYOUT OF FACILTIES

To prepare a layout, information should be collected on all applicable affecting aspects and not limiting to following:

i. Storage tanks, utility requirements.

ii. Town planning

iii. Product receipt / dispatch and mode of transport (Rail, Road, Pipeline and Tanker/Barge).

iv. Warehouses, storage areas for bitumen / asphalt, lube etc and other open storage areas like scrap yards and dumping ground.

v. Chemicals / Toxic chemicals storage, Sludge, hazardous waste storage / disposal facilities etc.
vi. Service buildings, fire station and allied facilities.
vii. Site topography including elevation, slope, and drainage.
viii. Meteorological data.
ix. Bathymetric data (high tide level, surge wave height etc.) for installations in coastal areas.
x. Seismic data and probability of Tsunami in coastal areas.
xi. Highest flood level in the area, water table, natural streams/ canals.
xii. Approach roads for functional areas.
xiii. Aviation considerations to and from adjacent facilities.
xiv. Environmental considerations including water treatment plant and reuse of treated water, rain water harvesting and roof top solar system with connectivity to grid.
xv. Statutory requirements.

1.2.1 GENERAL CONSIDERATION

While locating the various facilities the following should be considered:

i. Tank farm, loading / unloading gantry, utilities, Effluent Treatment Plant (ETP) / mechanised OWS, Drains and culverts and approach roads should be suitably constructed to prevent flooding.
ii. Control room should be located in a non-hazardous area, upwind (Majority of the year) of hydrocarbon storage and handling facilities and at a distance from potential leak sources. It shall not be located on a lower level than surrounding plants and tank farms. There shall be no structure in close vicinity that would fall on the control room in case of a blast. Control Room should be situated at such a place in the layout from which most of the facilities/activities of the location are visible.
iii. In case it is unavoidable to comply with inter distance requirements for control room, the control room shall be made blast resistant.
iv. The control room for Pipeline Tap off Point (TOP) (if applicable) at the same location of the same company, shall be in the same building where the Control room for Depot/installation is located
v. Utility block(s) shall be located outside the hazardous area.
vi. Overhead power transmission lines shall not pass over the Installation including the tank truck parking areas. Horizontal clearance shall be in line with the Central Electricity Authority.
vii. High Tension (HT) line and HT sub-station(s) shall be terminated / located outside the hazardous area (For Distance refers table-1).
viii. Tank truck movement inside the installation shall be kept to minimum and for this purpose the truck loading / unloading facilities should be located at a safe distance near the gate meant for its movement and should be oriented to provide one-way traffic pattern for entrance and exit. Tank truck in the gantry shall always be in drive out position for easy escape in case of emergency.
ix. Rail loading / unloading facilities should be located along the boundary of the installation. In case Tank wagon (TW) unloading facilities are located outside of installation boundary that shall also have a boundary wall as per MOHA / Government Guidelines.
x. Drain shall be provided around the TT gantry loading platform area to collect product due to accidental spill over / leakage and shall be routed to OWS/ETP. The drains shall always be maintained clean.
xi. Effluent Treatment Plant should be located at a distance as per table 1. This should be closer to disposal point by the side of the boundary and at lower grade to facilitate gravity flow of effluent.
xii. Roads should be provided in a symmetric manner to serve all areas requiring access for the operation, maintenance and fire fighting.
xiii. Smoking booths shall not be provided in PETROLEUM Installations. However, drinking water, booths can be provided at prominent work stations like TLF, TW siding etc.
xiv. Firewater storage & firewater pump house should be located upwind of hydrocarbon storage area with straight approach from outside area to enable easy receipt of mutual aid and make up water.

xv. The provision shall be made to receive water from other sources including mutual aid / sharing of water directly into fire water storage tanks.

xvi. All buildings which are not related to terminal operation should be located at upwind of hydrocarbon storage & handling facilities. These shall be located outside the hazardous area. These areas include administration, canteen with a separate entry. Special care need to be taken for canteen location where any spark or open flame is likely to exist.

xvii. Congestion inside the hazardous area because of buildings, structures, pipelines, trees etc. shall not be allowed. The location of such addition of facilities in existing installation shall be decided based on Risk Assessment.

xviii. Room for storing hydrocarbon samples shall be provided with bottom exhaust for release of flammable vapours. The racks and flooring should be made of fire resistant material. Electrical fittings as well as electrical equipment shall be flame-proof. Adequate number of portable fire extinguishers should be placed.

xix. The additives/ blue dye etc. shall be stored at the designated / segregated area as per respective Material Safety Data Sheet.

xx. Special precautions should be taken as required where ambient temperatures or the handling temperatures are higher than the flash point of the product or where product handled is artificially heated to a temperature above its flash point.

1.2.2 LAYOUT OF STORAGE TANKS

1.2.2.1 Dyked Enclosures:

a. Petroleum storage tanks shall be located in dyked enclosures. Each dyke shall have roads all around for access for normal operation and maintenance as well as for emergency handling. Aggregate capacity (Combined safe capacity) of tanks located in one dyked enclosure shall not exceed following values:

   i. 60,000 KL for a group of fixed roof tanks.
   ii. 120,000 KL for a group of floating roof tanks

   Safe Capacity limits do not apply to a single tank in a dyke.

   Fixed cum floating roof tanks shall be treated as fixed roof tanks. However in case these tanks are provided with windows opening on the shell and these windows will not get blocked in any case, then these should be considered as floating roof tanks.

   If a group of tanks contains both fixed and floating roof tanks, then it shall be treated as a group of fixed roof tanks for the purpose of above limits.

b. Dyked enclosure shall be able to contain the complete contents of the largest tank in the dyke in case of any emergency. A free board of 200 mm above the calculated liquid level or 10% of calculated dyke capacity whichever is higher shall be provided for fixing the height and capacity of the dyke.

   Enclosure capacity shall be calculated after deducting the following volumes:

   i. Volume of the tanks other than largest tank up to enclosure height without free board.
   ii. Volume of all tank pads.
   iii. Volume of fire breaks walls.
   iv. Volume of pipes/supports/steps etc.

c. The height of tank enclosure dyke (including free board) shall be at least 1.0 M and shall not be more than 2.0 M above average inside grade level.

   i. Tank farm area shall be covered through CCTV surveillance system and same shall be continuously monitored.

ii. The dyke wall made up of earth, concrete or solid masonry shall be designed to withstand the hydrostatic load and shall be impervious.
iii. Dyke enclosure area (inside area of the dyke) shall be also impervious to prevent the ground water pollution.
iv. Dyke enclosure (entire area of the dyke) shall have impervious layer of suitable material such as EPDM (ethylene propylene di-monomer) liner / polyethylene sheet to prevent the ground water contamination in addition to brick/stone pitching / PCC etc.
v. The dyke and the enclosures will be inspected for cracks, visible damage etc. every six months (pre and post monsoons) and after every major repair in the tanks / dykes etc. so as to keep it impervious.
vi. The dyke area shall have proper slope outward of tank pad towards the inner periphery of the dyke enclosure to prevent reverse flow.
vii. Earth-pits shall be provided outside of Dyke area and strips buried under the earth except at termination points from a shortest possible distance. The earthing lay out diagram of each facility shall be displayed near each facility for reference.
viii. For excluded petroleum, the capacity of the dyked enclosure should be based on spill containment and not for containment on tank rupture. The minimum height of dyke wall in case of excluded petroleum shall be 600 mm.
ix. Pump stations and piping manifold should be located outside dyke areas by the side of roads.
x. Horizontal above ground tanks mounted on pedestals shall meet separation distances and shall have dyked enclosure.
xi. In case of Under Ground Tanks :

a. Kerb wall of minimum 300 mm height shall be provided in the UG tank Farm Area to contain accidental overflow.
b. A minimum of 3 M clear distance around the tank shall be maintained (from structures / boundary wall etc).
c. Vents shall be located / terminated at a distance of 15 M from electrical hazards.
d. Pressure / Vacuum vents for Class - A product and free vents for other class of products shall be provided. Vent shall be at minimum 4 M height from the grade level.
e. The open end of free vent pipe shall be covered with two layers of non- corrodible metal wire gauze having not less than 11 meshes per linear centimetre and shall be further protected from rain by hood or by suitably bending it downward.
f. The petroleum products shall enter a tank through closed piping system / coupled electrically continuous and sound hose.
g. Under Ground tanks for Ethanol service shall be provided with Silica Gel Traps in the Vents to prevent moisture ingress.
h. The manholes should be 30 cm above the grade level.
i. Corrosion control measures shall be undertaken

1.2.2.2 Grouping of Storage tanks

a. Grouping of tanks in a dyke: Storage tanks should be grouped in a dedicated dyke according to their respective classification of petroleum product.

b. In case, different class of products are stored in any combination of product classification, the following shall, be applicable.

i. Grouping of petroleum products for storage shall be based on the product classification. Class-A and Class-B petroleum may be stored in the same dyked enclosure. When Class–A and Class–B are stored in common dyke, the fixed water spray system shall be provided on all tanks except for small installations as mentioned in clause 5.1.2 (g) and the Rim seal fire detection and extinguishing system shall be applicable only to floating roof tanks on Class – A service.
ii. Class-C petroleum should preferably be stored in separate enclosure.
iii. However, where Class-C petroleum is stored in a common dyke along with Class-A and/or Class-B petroleum, the fixed water spray system shall be provided on all Class C tanks irrespective of diameter except for small installations as mentioned in clause 5.1.2 (g).

c. Excluded petroleum shall be stored in a separate dyked enclosure and shall not be stored along with Class-A, Class-B or Class-C petroleum.
d. Tanks shall be arranged in maximum two rows so that each tank is approachable from the road surrounding the enclosure. This stipulation need not be applied to tanks storing excluded petroleum class.
e. Tanks having 50,000 KL capacities and above shall be laid in single row.
f. Tertiary containment: Provision shall be made for Tertiary containment. The objective of Tertiary containment is to prevent escape of spills due to failure of secondary containment for any reasons and will not allow such spill over to outside of the boundary of the installation that may lead to any damage to outside.

   To meet the objective, all installations shall be provided with boundary wall with gates and sluice gates on drain. Pipe line openings etc shall be sealed. Efforts should be made to minimize such opening/s for drainage.

1.2.2.3 Fire walls inside dyke enclosure

a. In a dyked enclosure where more than one tank is located, firewalls of minimum height 600mm shall be provided to prevent spills from one tank endangering any other tank in the same enclosure.
b. A group of small tanks each not exceeding 9 meters in diameter and in all not exceeding 5,000 KL in capacity shall be treated as one tank for the provision of firewall.
c. For excluded petroleum product storage, firewall of height not less than 300 mm shall be provided by limiting the number of tanks to 10 or the capacity of group of tanks to 5,000 KL whichever is lower.

1.2.2.4 General

a. The tank height shall not exceed one and half times the diameter of the tank or Maximum 20 m whichever is less.

b. All Piping from / to any tank including connected sprinkler / foam line shall comply the following:

   i. Shall not pass through any other dyked enclosure.
   ii. Shall run directly to outside of dyke to minimise piping within the enclosures.
   iii. Shall not pass through other tank areas / fire walls.

   Piping layout design inside tank dyke area should ensure easy accessibility for any operations in the tank farm wherever necessary, well designed, cross-overs shall be provided to cross the pipelines running within the dyke area. Elevated Catwalks connecting the tank manifold to the dyke wall above the height of the dyke wall shall be provided for safe access and exit in case of normal / emergency situations. The catwalks shall run at the same level and terminate directly outside the dyke.

c. No part of the dyked enclosure shall be below the level of surrounding ground immediately around the outside of dyke area.
d. The minimum distance between a tank shell and the inside toe of the dyke wall shall not be less than half the height of the tank.
e. Properly laid out road shall be provided for easy access on all four sides of each dyke.

1.2.2.5 Protection of facilities

a. Properly laid out roads around various facilities shall be provided within the depot/terminal for smooth access of fire tenders etc. in case of emergency.
b. The boundary wall shall be constructed as per the directives of the Ministry of Home Affairs or any other Government directive. In any case the boundary wall shall be of minimum 3 M height from either side of boundary wall with V/U shaped barbed wire fencing on the wall with 600 mm diameter concertina coil on top.

c. There shall be a pedestrian patrolling track along the inside perimeter of the boundary wall for security patrolling. Security watchmen tower (if provided) shall have clear access.
d. The emergency gate shall be away from the main gate for evacuation of vehicles and personnel in emergency and shall always be kept available and free from obstruction.
e. CCTV shall be installed in depot / terminal locations covering entry / exit gate, periphery of installation and all critical operating areas (viz. Tank farm, TT/TW operating area, product pump house, fire water pump house etc) which shall be monitored continuously.
f. The CCTV monitoring station shall be provided in control room, Security cabin and in-charge room. The CCTV data shall be stored for a minimum period of 60 days or in line with prevailing IB norms.
g. Proper sized TT parking area based on fleet size shall be provided with following facilities:

    i. Well laid out hydrant system with alternate double headed hydrant post and water or water cum foam monitors covering the parking area.
    ii. Segregation of parking area through chain link fence/boundary wall.
    iii. Separate entry and exit gate with access control.
    iv. Parking lane demarcation / slotting to ensure independent & quick evacuation in emergency.

h. Hydrocarbon (HC) detectors shall be installed near all potential leak sources of class “A” petroleum products i.e tank dykes, tank manifolds and pump house manifold. These detectors shall be placed in a way that entire possible source of leaks and collection of products is continuously detected and alarm is set at 20% of lower explosive limit of class A. (Refer clause 9.1.a for details)

1.2.2.6 Separation distances

i. Minimum separation distances between various facilities described above shall be as per Table-1. The table shall be read in conjunction with the notes specified with the table.

ii. The layout shall also take into account findings/recommendations Risk Analysis / Assessment study, which shall be carried out at all the stages of facility development process.

1.2.2.7 Separation Distances between tanks / offsite facilities

The following stipulations shall apply for the separation distances for above ground tanks storing petroleum products.

i. For larger installation, minimum separation distances shall be as specified in Table- 2 and Table-3. The tables are applicable where total storage capacity for Class-A and Class-B petroleum products is more than 5000 KL or the diameter of Class-A or Class-B product tank is more than 9 meters.

ii. For smaller installation, minimum separation distances shall be as specified in Table-4. This table is applicable where total storage capacity of Class-A & Class-B is less than 5000 KL and diameter of any tank storing Class-A and Class-B petroleum product does not exceed 9 meters. Table-4 shall also be applicable for the installation storing only Class-C petroleum.

iii. Excluded petroleum should be treated as Class-C petroleum for the purpose of separation distances and Table–4 shall be applicable for their separation distances.

iv. Separation distances between the nearest tanks located in separate dykes shall not be less than the diameter of the larger of the two tanks or 30 meters, whichever is more.

TABLE – 1
SEPARATION DISTANCES BETWEEN FACILITIES

S.No.	From/To	1	2	3	4	5	6	7	8	9	10	11	12
1	Control Room (Note –1)	X	Note-2	Note-3	30	45	12	X	6	15	30	X	15
2	Storage Tanks Class-A	Note-2	Note-4	Note-4	Note-4	30	60	30	T2	60	50	60	60
3	Storage Tank Class-B	Note-3	Note-4	Note-4	Note-4	30	60	30	T2	30	50	30	30
4	Storage Tank Class-C	30	Note-4	Note-4	Note-4	30	60	30	T2	30	50	15	30
5	Bulk Loading / unloading PETROLEUM (Rail /Road)	45	30	30	30	Note-5	60	Note-6	T2	30	30	30	30
6	Fire water storage and pump house	12	60	60	60	60	X	30	X	12	50	6	6
7	Rail Spur-stabling line	X	30	30	30	Note-6	30	X	20	6	50	6	15
8	Boundary wall around installation	6	T2	T2	T2	T2	X	20	X	6	15	15	6
9	Service buildings	15	60	30	30	30	12	6	6	X	50	12	6
10	OWS / effluent Treatment Plant / Oil sludge pit	30	50	50	50	30	50	50	15	50	X	45	30
11	Electrical Sub Station	X	60	30	15	30	6	6	15	12	45	X	6
12	Utilities (Broad Definition)	15	60	30	30	30	6	15	6	6	30	6	X

General Notes to Table-1:

a) All distances are in meters. “T” indicates the table number to be referred.

b) All distances shall be measured between the nearest points on the perimeter of each facility except (i) In case of tank vehicle loading / unloading area where the distance shall be from the centre of nearest bay.

c) Service building shall have minimal manning and normally no hot work would be done there.

d) “ X ” means any distance suitable for constructional or operational convenience

e) Fire station shall be in safe area or at least 60 m from other facilities

Specific notes to Table-1:

Note-1: These distance norms are applicable to the locations where product receipt is through cross country pipelines. At all other locations, the building / room housing the automation equipments /system shall be treated as utility building for the purpose of separation distance.

Note-2: Shall be 60 meters for non-blast construction and 30 meters for blast resistant construction.

Note-3: Shall be 45 meters for non-blast construction and 30 meters for blast resistant construction.

Note-4 : Separation distances between the nearest tanks located in two dykes shall be equivalent to the diameter of the larger tank or 30 M, whichever is more. For distances within a dyke, it shall be as per Table-2 and Table-3

Note-5: Separation distance between i) Tank truck gantry and tank wagon gantry shall be 50m. ii) Distance between two Tank trucks gantries shall be 15 M. iii) Distance between two tank wagon gantries shall be 50 M.

Note-6: Separation distance between tank truck gantry and rail spur-stabling line shall be 50 M.

TABLE - 2
SEPARATION DISTANCES BETWEEN TANK / OFFSITE FACILITIES

Applicable for large installations where total storage capacity for Class-A and Class-B petroleum products is more than 5000 kl or the diameter of Class-A or Class-B product tank is more than 9 meters.

	Tanks / Facility	1	2	3	4	5	6
1	Storage Tank for Petroleum Class A / Class B.	T3	T3	30	30	8	0.5 D Min 20 m
2	Storage Tank for Petroleum Class C	T3	X	30	X	X	0.5 D Min 20 m
3	Tank vehicle loading / Unloading for petroleum class A or class B	30	30	X	X	8	20
4	Tank Vehicle loading / unloading for Class C	30	X	X	X	X	10
5	Flame proof Electric Motor	8	X	8	X	X	X
6	Boundary wall	0.5 D Min 20 m	0.5 D Min 20 m	20	10	X	X

TABLE– 3
SEPARATION DISTANCES BETWEEN STORAGE TANKS WITHIN A DYKE

(For large installations where total storage capacity for Class-A and Class-B petroleum products is more than 5000 cum or the diameter of Class-A or Class-B product tank is more than 9 meters)

	Item	Between floating Roof Tanks Class –(A&A) or (A&B)or (B&B)	Between fixed Roof Tanks Class –(A&A) or (A&B) or (B&B)	Between fixed and Floating roof Tanks Class-(A&A) or (A&B) or (B&B)	Between Class C Petroleum Storage tanks
1	All tanks with Diameter up to 50 meters	(D+d) / 4 or Min 10 m	(D+d) / 4 or Min 10 m	(D+d) / 4 or Min 10 m	(D+d) / 6 or Min 6 m
2	Tanks with Diameter exceeding 50 meters.	(D+d) / 4	(D+d) / 3	(D+d) / 3	(D+d) / 4

General notes to Table – 2 & 3

a) All distances are in meters.

b) "x" indicates suitable distance as per good engineering practices to meet construction, operational and maintenance requirements

c) D & d stands for diameter of larger and smaller tanks.

d) In Table – 2 all distances shall be measured between the nearest points on the perimeter of each facility except in the case of tank vehicle loading/unloading area where the distance shall be measured from the centre of each bay.

e) In Table –3, Distances given are shell to shell in the same dyke.

f) For different combination of storage tanks, the stringent of the applicable formulae shall be considered for minimum separation distance.

g) The distance of storage tanks from boundary wall is applicable for;

- Floating roof tanks having protection for exposure
- Tanks with weak roof-to-shell joint having approved foam or inert gas system and the tank diameter not exceeding 50 meters

h) Distances mentioned in table-2 are for electric pump motor located outside dyke. However, for side entry mixer attached to tank shell, the motor can be mounted on the tank shell.

i) For the facilities not covered in Table- 2, refer Table-1.

TABLE – 4
SEPARATION DISTANCES BETWEEN TANKS/OFFSITE FACILITIES

(For small installations where total storage capacity of Class-A & Class-B is less than 5000 kl and diameter of any tank storing Class-A and Class-B petroleum product does not exceed 9 meters. This table shall also be applicable for the installation storing only Class-C Petroleum **and** Excluded Petroleum)

		1	2	3	4	5	6	7	8	9	10
1	Storage Tank Class A	0.5D	0.5D	0.5D / 6.0	15	15	15	3	15	15	15
2	Storage Tank Class B	0.5D	0.5D	0.5D / 6.0	9	4.5	4.5	3	4.5	D Min 4.5	D Min 4.5
3	Storage Tank Class C	0.5D / 6.0	0.5D / 6.0	X	9	4.5	X	X	X	0.5D Min 3.0	0.5D Min 3.0
4	Tank truck Loading / unloading Class – A	15	9	9	X	9	9	3	9	9	9
5	Tank truck Loading / unloading Class – B	15	4.5	4.5	9	X	4.5	1.5	4.5	4.5	4.5
6	Tank truck Loading / unloading Class – C	15	4.5	X	9	4.5	X	X	X	3	3
7	Flame proof Electric motors	3	3	X	3	1.5	X	X	3	X	X
8	Non Flame proof Electric motors	15	4.5	X	9	4.5	X	3	X	X	X
9	Office building, stores, amenities	15	D Min 4.5	0.5 D Min 3.0	9	4.5	3	X	X	X	X
10	Boundary wall	15	D Min 4.5	0.5D Min 3.0	9	4.5	3	X	X	X	X

General notes to Table –4:

a) All distances are in meter and the table specifies the minimum requirement.

b) “x” indicates suitable distance as per good engineering practices to meet construction, operational and maintenance requirements

c) “D” indicates the diameter of the larger tank.

d) Distances given for the tanks are shell to shell in the same dyke.

e) Where alternate distances are specified (like 0.5 D / 6.0), the minimum thereof shall be used.

f) All distances shall be measured between the nearest points on the perimeter of each facility except in case of tank truck loading /unloading area where the distance shall be from the centre of each bay.

g) Pig launcher/receiver at liquid hydrocarbon handling pipeline installations should be located at least 5 m from boundary wall

h) Distances mentioned in the Table-4 for electric pump motor located outside dyke. However for side entry motor attached to tank shell, the mixer can be mounted on the Tank Shell.

2.0 DESIGN CONSIDERATIONS

i. External Floating roof tanks (EFRT) with single deck pontoon roof or Double deck or Internal Floating Roof Tanks shall be designed as per API STD 650.
ii. Atmospheric/low pressure fixed roof tanks shall be designed as per API STD 650 or API STD 620.
iii. Selection of type of tank generally depends on ambient conditions and the product handled.
iv. The external floating roof storage tanks with Pan Roof shall not be used as these are considered unsafe.
v. IFRT and EFRT shall be provided with double seal with minimum vapour recovery of 96%.
vi. Primary seal shall be liquid or shoe mounted for EFRT and vapour mounted for IFRT. Maximum seal gap width should be 4 cm and maximum gap area should be 200 cm2/m of tank diameter.
vii. Secondary seal shall be rim mounted. Maximum seal gap width should be 1.3 cm and maximum gap area should be 20 cm2/m of tank diameter.
viii. Tank bottoms shall be of cone up or cone down (''Apex down'').

2.1 TANK APPURTENANCES

i. Ladders and Handrails: Individual tank shall be provided with access to the roof. A platform with railing should be provided from the top of the stairway to gauge well and roof ladder. On floating roof tanks, non-sparking self levelling tread type rolling ladder with suitable double earthing connection are to be provided.
ii. Stairs: Stairs should be made of grating. All staircases shall have resting/landing platform for every 5m height.
iii. Manholes: Number of manholes shall depend on diameter of the tank as per API 650.
iv. Walkway on the Roof : Walkway with handrail on the roof of the tank should be provided to facilitate inspection/checking of vents/ flame arrestor etc. so that movement of personnel on roof is safer.

2.2 TANK FARMS / MANIFOLDS

2.2.1 Tank Farm Drains

i. The dyke drain shall be provided along the inside periphery of the dyke enclosure wall. In case circular drain around tank pad is provided, the same needs to be connected to the peripheral drain.
ii. The outlet from dyke shall have the provision to either divert to the effluent Treatment plant / OWS or to main storm water drain.
iii. Dyke drain Valves shall be provided with position indication and alarm system in the event of opening the valve.

2.2.2 Tank Manifold

i. The number of inlet/outlet connections to the tank shell should be kept minimum.
ii. Tank body valves on process lines (inlet, outlet & recirculation) of all storage tanks storing class –A & B products shall be remote operated shut off valve. Mitigation measures due to sudden closure of shut off valve shall be incorporated in the design.
iii. The second valve which is motor operated valve (MOV) on inlet, outlet and recirculation lines should be outside the dyke.
iv. Tank body valves including remote operated shut off valves should remain shut after closure of day operations.
v. For positive isolation a suitable Valve other than Hammer Blind shall be provided so that under no circumstances the product is exposed to atmosphere from the valve. In any case Hammer blind valves of any type shall not be used in the depot/terminals.

vi. ROSOV shall be fail safe and fire safe (shall close in case of signal failure). The actuator shall be fail-safe. The cables leading to the control room shall be fire resistant.

vii. ROSOV shall have only close operation from control room or at a strategic remote location.

viii. The Open/Close push buttons of ROSOV shall also be provided in field i.e. just outside the dyke. These push buttons shall have distinctive feature so that opening is different than action required for closing (e.g. pull type and push type). The push button assembly shall be mounted at a place where it is easily visible and accessible to the operator.

ix. MOV /DBBV shall have open & close remote operation from control room and at field outside of dyke.

x. Tank manifold(s), if provided, shall be located outside the dyke area. The floor underneath the manifold shall be paved and have Kerb walls and connected to oil water drainage system leading to ETP / OWS.

xi. Thermal safety valve (TSV) / Expansion line shall be provided for blocked portion of pipe line(s) to take care of the thermal expansion of product due to rise of temperature.

xii. TSV outlet line or expansion line shall be connected back to tank / tank inlet /outlet line before ROSOV with suitably positioned isolation valve(s). One isolation valve on TSV outlet line or expansion line shall be installed close to the tank shell / inlet / outlet line to the maximum extent possible.

xiii. The expansion lines to be connected at roof tops in case of CRVTs and through combined gauge well in case of FRVTs and shall be extended inside upto the tank bottom to avoid freefall of product through vapour space with provision of siphon breaker on top. Expansion lines should be provided with class 800 flanged gate valves.

xiv. Termination of expansion line on tank roof top shall not be allowed as free fall through vapour space is unsafe.

xv. However, at existing locations where ever the above provision does not exist, the same shall be provided on all tanks during scheduled tank maintenance / cleaning.

xvi. Any electrical fittings and fixtures inside the dyke shall be as per the hazardous area classification. However such fittings and fixtures except for actuators of ROSOV/MOVs/HC detectors/ PESO approved ex-proof water flow switch /ex-proof pressure transmitter should be above the dyke height.

2.2.3 Tank Settlement

Settlement of tanks takes place over a period of time and a depression is formed on tank pad along the circumference. The same should be effectively made up with proper slope to avoid rain water accumulation and subsequent corrosion of the bottom plate. Where large settlement is anticipated, supporting arrangement for the connected piping shall be suitably designed to take care of the settlement.

2.3 TANK HEATERS

Tank heating can be accomplished either by steam heating or electric tracing or hot oil circulation. Heating flues using fired burners is not permitted.

2.3.1 Heaters

Tank heaters shall be designed to hold the product at the specified storage temperature when tank is filled up to safe filling height. For design calculations, it is necessary to specify average wind velocity and minimum ambient temperature over extended period of time.

2.3.2 Steam Heating

Man way heaters consist of a tube bundle, usually of hairpin type, fixed through a manhole of the tank. Manway heater shall be designed so that its removal can be done without the requirement of person entering in the tank.

Steam coils should have no flange connections inside the tank. Provision should exist in condensate outlet lines to check for oil leak. Gradient of the coil bundle inside the tank should be such that condensate accumulation is avoided.

2.3.3 Electric Heating

Electric tracing of one or more courses of shell can be provided. However, the classification and thermal rating of electric tracing should be verified before application. The electric conduits and cabling should conform to Classification of Areas for Electrical Installations.

2.3.4 Crude tanks may be provided with side entry swivel angle type mixers.

2.4 DRAINS FROM THE TANKS

2.4.1 Bottom Drains

i. Drains should be provided in all tanks for draining water and also for emptying out the tank for cleaning. Besides, these are also useful for draining water after a hydro test or initial flushing during a start-up operation. Number and details of the drains shall be as per the applicable tanks design standard.

ii. Each drain line shall have minimum two isolation valves separated by spool piece (s) and pipe extended beyond tank pad up-to drain point. One of these valves shall be of quick closing type. Ends of each drain point should have provision of blind flange / capping arrangement.

2.4.2 Floating Roof Drains

i. Roof drain shall be of robust design to prevent oil coming out during draining operation. Maximum hourly rainfall rate during the past 15 years shall be considered for designing the number and size of drains for open floating roof tank. Rain water should not be taken directly into the tank.

ii. The roof drain system shall have provision for connection to the drain through a suitably designed robust system and shall include a suitable outlet valve.

iii. Due care to be taken while designing to ensure the system integrity and performance when roof is resting on the low legs.

iv. The inlet of roof drain(s) shall have a check valve to prevent product from flowing to the roof in the event of failure of the system.

2.4.3 Emergency Roof Drain

Emergency drain for floating roof tank shall be provided on the roof to take care of disposal of water in case of choking / malfunctioning of the primary roof drain. It shall have water seal arrangement to prevent oil spill on the roof.

2.5 VENTS

2.5.1 Open Vents

Flash Back Arrester (Flame arrester) should be fitted to Vents as per IS 11006:2011. For sizing the vents API STD 2000 is to be referred. However, following are the basic guidelines need to be considered.

a. Maximum and minimum ambient temperatures
b. Vapour pressure of the product at operating/design temperature
c. Maximum pumping in and out rates. In the event of change in any operating parameters involving change in pumping rates complete end to end system check shall be done in line with Management of Change for details refer annexure(4) and (5).
d. Blending components likely to be handled in the tank

2.5.2 Breather Valve

i. The breather valves for the blanketed tanks and low pressure tanks shall be provided as per API STD 650 and API STD 620 respectively. The tank breathes - in air when the tank pressure is lower than the atmospheric pressure and breathes - out when tank pressure is greater than the set pressure.

ii. Pressure and Vacuum Relieving Valves (PVRVs) provided on cone roof tanks usually have 20% accumulation. While designing, it is necessary to ensure that under full relieving conditions, the design pressure/vacuum in the tank is not exceeded. Set pressure of PVRV must be decided according to API STD 2000.

iii. Breather vents/flame arrestors are known to fail through the formation of crystalline waxy / heavy hydrocarbon deposits or ice on the seats of valve diaphragms or inside the nozzle connection upon which the valve is mounted. Breather vents/flame arrestors are not recommended on these services, instead only open vents should be provided.

iv. Where tanks are blanketed, breathing-in will be from the blanketing gas system. Necessary control valve shall be provided for supply of blanketing gas at constant pressure. The tank shall be provided with a safety valve by way of lift disc/diaphragm or any other suitable device. Gauge hatch and other manholes shall be of gas tight construction.

2.5.3 Emergency Vents

Emergency Vents shall be provided for the tanks as per API STD 2000.

2.6 DIP HATCH / SAMPLING

i. Dip hatch or gauge hatch is used for gauging the height of the liquid in a tank as well as to take out samples for testing. Gauge hatch shall be non-sparking (or lined with non-sparking material) and self closing type.
ii. Gauge well pipe should be provided with slots.
iii. The gauge well shall be properly supported by means of angles/strips with bottom plate of the tank. The above arrangement also makes the tank safer with respect to dissipation of static charge accumulation.

2.7 INSTRUMENTATION

2.7.1 Safety Integrity Level (SIL)

The SIL classification study shall be carried out to determine the required SIL level. SIL of the safety instrumented function for the tank including overfill protection shall be meeting the requirement of Part 1 of IEC 61511. The SIL level of the entire interlock loop shall also meet the requirement of IEC 61511.

2.7.2 Level controls on Tanks

For all storage tanks storing Class A/B products, following instruments / alarms shall be provided.

i. High Level (H), High High Level (HH) alarms : The tanks shall have provision of level instruments for sending audio visual alarms to the control rooms. All the alarms shall be of different type so that the “H” level alarm, “HH” alarms can be distinctively identified.
ii. Level for “H” and “HH” alarms shall be decided based on site specific operating parameter i.e diameter of tank, flow rate and operators response time for corrective measures to stop product level reaching curb angel/maximum floating position. However these levels shall be lower than the level corresponding to PESO approved safe filling capacity.
iii. Independent level switch shall be provided at the “HHH” which in any case shall not be above the level corresponding to PESO approved safe filling capacity of the tank.

iv. The level switch shall enable initiation of action for closure of the respective inlet valve i.e. ROSOVs, MOVs and product pumps so that the entire receipt operation closes on safe mode and the product does not over flow.

v. Two nos independent level instruments shall be provided out of which one instrument shall be of radar gauge type. Each of the instruments shall have provision both for “H” and “HH” alarms. Provision shall be made in the system configuration for transmitting only two signals (one for “H” and one for “HH”). The signals i.e “H” & “HH” from each level instrument shall be available parallel in the control room using OR gate PLC logic.

vi. Over spill Level switch: An independent hardwired level switch like Vibrating Fork etc. shall be provided for actuating remote operating shut off valve. Over spill level switch should be connected to remote operating shut off valve through safety PLC for SIL loop compliance.

vii. For tanks storing class –C products two nos independent level instruments shall be provided out of which one instrument shall be of radar gauge type. Each of the level instruments shall have provision for both “H” and “HH” alarms. Signal transmitting shall be as explained above.

viii. This clause as above shall be applicable to all new locations and the storage tanks constructed after publication of this standard. In respect of the existing locations, provision shall be made for installing additional level instruments whenever the tanks are taken out of service for cleaning / maintenance schedule at the earliest opportunity.

ix. There shall be exchange of signals between the receiving and dispatch location in case of receipt of product through cross country pipe lines. Provision shall be made for monitoring of level of the receiving tank along with pressure in the pipe line and ROSOV status and to ensure safe shut down of the system in case of any abnormal situation.

x. Care need to be taken for tanks receiving product from ship/ cross country pipeline at high flow rates for surge pressures due to sudden closures of valves and accordingly where ever required, suitably designed Surge relief system /pump tripping to be provided.

2.7.3 Tank farm management system integration

TAS (terminal automation system) including TFMS (tank farm management system) shall be integrated with software for back up at remote location (DRC) with provision for recording of all critical events in the system. Back up data shall be retained for a minimum period of 30 days. In the event, the backup data is proposed to be stored within the same installation; the room for storing the backup data shall be blast resistant at a secured place.

2.7.4 Temperature and Insulation

When product storage temperatures are likely to be higher than 100 degree C, a remote temperature indicator with alarm should be provided in addition to local indicators. For tank capacity higher than 5000 kl a minimum of two numbers of local temperature indicators should be so located (within 500 mm above the inlet/outlet nozzle) as not to sense the direct heat of the coil.

Insulation shall be provided for heat conservation. The tanks having higher surface temperature shall have insulation upto minimum 2 mts high for personal protection. Also, patch insulation should be provided on the shell along with spiral stairway and provision for inspection.

2.8 PIPING / VALVES / FLANGES

2.8.1 Piping

i. Piping shall be designed for handling of hydrocarbon liquid as per “ASME B 31.3: Process Piping” or ASME B 31.4 (for cross country pipelines only entering the terminal) or API 5L or equivalent as applicable.

ii. Pipe joints should be welded as far as practicable with full penetration weld. Number of flanged or threaded joints should be kept to a minimum.

iii. In case sampling point is provided on receipt line for operational requirement, the same should be provided outside of dyke in the manifold.

iv. Sectionalizing of the pipe lines with isolation valves and arrangements for injection /draining of water shall be provided for facilitating hydro-testing of the pipe lines.

v. Buried piping shall be protected against physical damage and corrosion with suitable protective coating.

vi. At road crossings, in addition to protective coating, pipes should pass through secondary encasing with properly sealed at both the ends.

vii. The pipe lines should be provided with low point's drains and high point vents to facilitate emptying / hydro-testing etc. Ends of each drain point shall have provision of blind flange/capping arrangement.

viii. Jetty lines should be provided above ground properly spaced and approachable to maintain the lines.

2.8.2 Valves

Steel valves conforming to relevant API standards shall be used. Cast iron valves should not be used.

2.8.3 Fittings

i. Steel flanges and flanged fittings shall conform to relevant ASME / ASTM / ANSI or equivalent.
ii. Slip on or weld neck flanges should be used.
iii. Screwed flanges for sizes 50 mm or smaller may be used.
iv. Steel flanges should conform to the applicable provisions of ASME B 16.5 or equivalent.
v. Steel screwed fittings and couplings shall conform to ASME B 16.11 or equivalent.
vi. Steel unions shall have ground metal to metal seats. Gasket type unions shall not be used.
vii. Plugs shall be of steel. Cast iron or brass plugs shall not be used.
viii. Electrical continuity across flange joints shall be maintained by providing metallic gaskets or jumpers.

2.9 BULK LOADING / UNLOADING OPERATIONS

2.9.1 Loading / unloading Pumps

i. Pumps conforming to relevant API standards shall be used.
ii. Product pumps shall be provided with suitable sized strainers on suction and NRVs on discharge lines. All drain points of strainers shall be provided with double isolation valve and ends having provision for blind flange / screw capped
iii. Pumps shall be located in an exclusive paved area with drainage facilities routed to OWS / ETP.
iv. Tank lorry loading / unloading pump house shall be positioned at an elevated level and shall be well ventilated on all four sides.
v. Open roof Pump house are to be provided with suitable IP protection for the equipment.
vi. In case of sunken pump house for Tank Wagon unloading facilities Pump house shall be so positioned that it ensures proper ventilation and efficient disposal arrangements of accumulated products.

vii. To avoid wide variation in pressure, leading to a 'kick' or 'hammering' in header and hoses, it is necessary to choose pumps with flat characteristic curves.
viii. Locations having automation shall be provided ESD feature through Automation system.
ix. Dedicated pumps for individual products shall be provided. Minimum one stand by pump for each product shall be provided.
x. Separate pumps shall be provided for Tank truck loading/unloading and wagon loading/unloading.

xi. All closed sections of pipings shall be provided with thermal safety relief device to relieve pressure due to ambient temperature rise. Thermal Safety relief device may vent into a tank or piped to OWS located in safe area. When connected to tank, TSV shall be provided with isolation valves. One isolation valve shall be installed close to the tank shell to the maximum extent possible.

2.9.2 Tank truck and tank Wagon Loading Gantries.

i. Loading points shall have quick shut-off valves viz. Cast steel Plug or Ball Valves.
ii. No vehicle shall be loaded at a rate exceeding (volumetric flow rate corresponding to linear velocity one meter per second at the delivery (at the least dia fitting) and of the filling pipe until the filling pipe is completely submerged in petroleum and thereafter the loading rate should be gradually increased but it shall at no point of time exceed six meters per second at the delivery end of the filling pipe.
iii. Location should be provided with facilities where loading and unloading of Tank trucks is possible in a closed loop system i.e top/ bottom loading provisions with Vapour Recovery System
iv. Where flow indicators / totalizers are provided for gantries, vapour eliminators shall be incorporated.
v. The provision for Kerosene and MS / Naptha loading in TT (tank truck) loading gantry shall not be in the same bay
vi. For safety reason the level adjustment in the tank lorry compartments should be done through suitable system wherein product is not exposed in open atmosphere at any point of time.
vii. In case of loading hoses, only neoprene impregnated hoses having electrical continuity between nozzle and flange shall be used.
viii. All tank wagons and tank trucks shall have a fill pipe extended up to the bottom to avoid splash filling.
ix. However, splash filling is permissible for asphalt loading in tank truck or tank wagons.
x. Where bottom loading is done, deflector plates in the trucks to be ensured.
xi. Bottom flameproof lighting shall be provided for night time checking of wagon bottom leaks and also for proper sealing and inspection wherever loading/unloading during night is required to be done.
xii. Loading gantry shall be provided with at least one suitable explosion-proof telephone / paging device for communication with pump house in normal & emergency operations. In addition, operating personnel shall be provided with intrinsically safe walky-talky suitable for use in oil installations.
xiii. Tank wagon and truck loading gantries shall be suitable for all weather conditions.
xiv. Tank Truck loading gantries shall be provided with safety harness to protect the operating crew against fall from height.
xv. Swing type loading ladders with counter weight & hand railing shall be light in construction. Neoprene packing shall be provided at the bottom rest to avoid spark generation due to impact.
xvi. Proper handrail arrangement shall be provided on platforms & stairs for safe movement of personnel.
xvii. Adequate safe escape ladders including from over head platform shall be provided at intervals on the gantry for emergency use. Escape ladders shall be prominently identified from distant view.
xviii. Protection against pressure surge in the loading header due to sudden change in loading rate need to be considered. Provision of shock absorber as one of the surge protection method at suitable locations on rail/road loading header should be considered.

xix. Provision shall be made for quick isolation of main product headers in case of emergency. For this purpose, suitable type hand operated valves or remote operated valves shall be considered as per the site conditions and overall automation system in the installation.
xx. Loading gantry area including areas below railway lines shall be paved for smooth draining and collection of spillages into drains.
xxi. Open drains along the railway line/gantry shall be covered with gratings so as not to endanger movement of personnel.
xxii. All trucks entering truck loading gantry shall be PESO approved and provided with approved spark arrestor/ flame arrestors at the exhaust.

xxiii. Oil and water collected from loading/unloading areas shall be routed to Oil water separator system / Effluent Treatment Plant or similar facility. A slop tank should be earmarked for storing separated oil.

xxiv. The tank truck gantry shall be so designed that all the compartments of the tank truck are filled at one bay only. The layout shall ensure that all operations are planned in a manner so that no zigzag movement of the tank truck around the gantry should take place.

xxv. For tank wagon gantry where placement of tank wagon is by electrical LOCO, traction line must terminate 15 M short of the first loading /unloading point at all Installations.

xxvi. For placement, brake van / dummy wagons shall be used. Separate segregation gate shall be provided at terminating point and area between boundary wall and segregation gate should be declared de-licensed.

xxvii. Main railway track shall be isolated from wagon gantry siding at least 15 meters from 1st loading/unloading point by providing insulation joint at terminating point and loco shall stop before the insulation joint.

xxviii. Sampling points shall be provided at the farthest end of the gantry as per requirement of Industry Quality Control Manual (IQCM).

2.10 Design layout for handling of sick wagon

When a wagon is found leaking during loading, provision shall be kept for safe handling of such wagons. These methods should include:

i. Arresting of leaks using cold weld as a first aid measure till the wagon is unloaded safely at the gantry itself. In no case such wagons to be used for transportation.

ii. A dedicated drain header(s) for instantaneous unloading of such sick wagons. Alternately, the existing headers may be utilized for immediate decantation of product from sick wagons by providing suitable arrangements in the manifold.

iii. A portable pump with flame proof / explosion proof motors and other electrical fittings to be used with suitable flexible hose connection for quick withdrawal of products into sump tanks. Such drained products to be handled further as per IQCM (Industry Quality Control Manual)

2.11 Design Layout for handling slop

2.11.1 Collection and Drainage

A network of drainage system shall be provided to collect oil drains from various equipments, gantry areas, pump houses etc. They should also collect surface drains from places where oil spillages are likely to occur. The drainage shall lead to OWS / ETP as the case should be.

2.11.2 Mechanised OWS

The receiving sump of the OWS shall have suitable arrangement for skimming off upper layer of accumulated oil. Provision shall be made for directing the collected oil to the slop tank.

2.12 Layout and Selection of electrical equipment

i. Electrical equipment including the lighting system shall conform to hazardous area classification. The hazardous area shall be classified as per IS: 5572. The electrical fittings / equipment in the respective classified area/ zone shall be of a type suitable for the particular area/zone as per classification in line with IS: 5571.

ii. Electrical equipment shall be selected, sized and installed so as to ensure adequacy of performance, safety and reliability. The equipment in general shall conform to relevant Indian Standards and shall be suitable for installation and satisfactory operation in the service conditions envisaged.

iii. The protective system shall be designed to ensure Protection of Personnel and plant equipment against damage which can occur due to internal or external short circuits, overloading, abnormal operating conditions, switching, lightning surges, etc accordingly, relays and protective devices shall be suitably selected and installed. All the protective relays

for the Generator, Transformer, Motors and Switchgears shall be tested at least once in a year and test records maintained.

iv. The outer PVC sheath of all cables used inside the dyke shall be fire retardant type conforming to category AF as per IS: 10810. The minimum Oxygen Index shall be 29.

v. All cables shall be laid in proper cable trenches/ cable trays suitably designed to ensure their protection and identification at all times.

vi. All power and control cables shall have extruded inner and outer sheaths. Cables should be Aluminium /Copper Conductor, PVC / XLPE insulated, PVC sheathed, armoured type.

vii. Instrument and signal communication cables shall not be laid in the same trench/tray along with electrical cables. The overall cable layouts shall be designed for minimum interference between signal and power cables.

viii. Cable route markers shall be installed at every 30 metres intervals all along the cable routes and also at cable joints and locations where the direction of cable trench changes.

2.12.1 Earth resistance

i. Earth resistance can be directly read through an earth resistance tester which has associated Test, auxiliary Current and Potential electrodes. This instrument which is a combination of ohmmeter and generator works on ‘fall of potential’ principle. Test voltage is derived from the generator of the earth resistance tester. Earth resistance also can be measured through Direct Earth Clamp Tester (DECT).

ii. The testing of the Earth Pits shall be done six monthly one in dry and once in wet weather and records maintained.

iii. Removable link shall be provided to allow measurement of an earth electrode-resistance.

iv. The resistance value of an earthing system to general mass of the earth should not exceed.

   a. 4 Ohms for electrical systems and metallic structures
   b. 7 Ohms for storage tanks
   c. 1 Ohm for main earth grid, and bonding connections between joints in pipelines and associated facilities.
   d. 2 Ohms for each electrode to the general mass of the earth.

v. Earth resistance can be directly read through an earth test Megger which has associated Test, auxiliary Current and Potential electrodes. This instrument which is a combination of ohmmeter and generator works on ‘fall of potential’ principle. Test voltage is derived from the generator of the Megger.

2.12.2 INSTALLATION EARTHING

i. Installation earthing design shall be carried out in accordance with the requirements of Central Electricity Authority Regulations -2010 and IS: 3043 or equivalent system recognised by statutory authorities under the petroleum act / electricity act All earth connections should be visible for inspection to the extent possible. The earthing system shall have an earthing network with required number of earth electrodes connected to it.

ii. Earthing system shall be designed for the following:

   a. System neutral earthing.
   b. Protective Equipment Earthing for personnel safety.
   c. Protection against Static discharges.
   d. Lightening Protection
   e. Earthing for Data Processing system

2.12.2.1 Electrically independent earth electrodes:

i. Earth electrodes shall be located at such a distance from each other so that the maximum current likely to flow through one of them does not significantly affect the potential of the other.

ii. The Lightning Arrestor (LA) of the Two Pole/ Four Pole structure shall be connected to two distinct earth pits. The strips shall run on insulators / isolators so as not to come in contact with the Pole structure. Connections shall be made to the pit directly and then pits will be connected to each other to form a grid. The Grid of LA shall be distinct and shall not be connected to any other earth Grid.

iii. The Two Pole / Four Pole structure shall be earthed with two distinct earth connections. The Gang Operated Switch shall also be earthed.

iv. Fencing of Two Pole /Four Pole, Transformer yard shall be earthed and also electrical continuity between various structures the fencing shall be ensured.

v. The Neutral of the Transformer shall be earthed with two distinct earth pits separately. Connections will be made to the pit directly and then pits will be connected to each other to form a grid. This Grid shall be distinct and shall not be connected to any other earth Grid.

vi. The Neutral of the Diesel Generator shall be connected to two distinct earth pits separately. Connections shall be made to the pit directly and then pits will be connected to each other to form a grid. This Grid shall be distinct and shall not be connected to any other earth Grid.

vii. The transformer body shall be earthed at two points separately leading to earthing system.

viii. All Metallic non-current carrying parts of all electrical apparatus shall be earthed to ensure that the exposed metallic parts do not become dangerous by attaining high voltages i.e. exceeding 650 volts in case of faults.

ix. All the electrical equipment operating above 250 volts shall have two separate connections to the earth. (Sub Station Panels, Motors, FLP JBs etc).

x. All Steel structures, loading platform / gantries etc shall have two separate and distinct connections. Connections will be made to the pit directly and then pits will be connected to each other to form a grid.

xi. Product Storage Tanks etc shall have two separate and distinct connections. Each connection will be made to the respective earth pit directly. There after these earth pits should be inter-connected to form a dedicated grid for Tank Farm. The number of earth pits / connections to be increased for large tanks so that the distance between the connections does not exceed 30 meter on the tank perimeter.

2.12.3 Bonding

i. All flanged connections shall be effectively bonded by strips of suitable material.
ii. Continuity between rail spur and gantry in tank wagon loading / unloading gantry shall be ensured by checking at a suitable frequency. The gantry structure to be suitably earthed in earthing pits of standard specifications. Tank wagon siding to be insulated from main running track.
iii. In tank truck loading and unloading gantry, 6 mm Sq. braided copper wire with one end firmly bolted to the Loading Unloading Arm / hoses and the other end provided with G.I / Copper / Non corrodible metal crocodile clips are to be used, the crocodile clips being attached to the tank-truck under loading or discharging. (For External Bonding of Loading unloading arms/hose with the Tank Truck).
iv. For sampling jars to be inserted into product tanks, use only manila or sisal ropes.

2.12.4 Static earthing

i. Static earthing (earthing for static charge dissipation) shall be provided at Tank Lorry / Wagon Filling / Decantation Gantries, to prevent building up of Static Charges.
ii. Earthing connections for static charge dissipation, electrical system, structure and instrumentation system shall be separate from each other. However, these separate leading strips can be connected with main grid below the ground.

2.12.5 Lightning Protective System

i. Lightning protection shall be provided for the equipment, structures and buildings which are higher than 20 meters or as per the risk index analysis worked out as per IS 2309.
ii. Self-conducting structures (having min thickness 4.8 mm) do not require lightning protection with aerial rod and down conductors. They shall be connected to the earthing system at two points of the base.
iii. If lightning arrester is provided an independent earthing network shall be provided for lightning protection.

2.12.6. Earthing for data processing system

i. Low noise earthing are required for critical data processing equipments. These are to be independent of any other earthing of the Building. RFI (Radio frequency interference) suppression filters fitted to the data processing equipment may produce high earth leakage current. In such cases failure of protective earth connection may lead to high touch voltages.
ii. Where ever isolation transformers are used the output neutral of the transformer shall be independently earthed so as to ensure that the Earth-Neutral Voltage is less than 1 volt.

2.12.7. Minimum Permissible Sizes of the Earthing Conductors

Size of the conductor shall be selected based on the fault current that is required to be dissipated during emergencies.

2.12.8. No of earth pits

This is minimum requirement and additional earth pits shall be made such as to maintain Grid Values below 1 Ohm.

Equipment	**Nos**
Earthing for Lightning Arrestor	2 Nos independent
For Di / Four Pole Structure, GO, Fence	2 Nos (All metal bodies connected)
Neutral of the transformer	2 Nos independent
Neutral of the DG Set	2 Nos independent for each DG Set
Body of DG Set / control panel for DG Set	2 Nos
Sub-station –PMCC Room	4 Nos
Fire Pump House	2 Nos
Air Comp House	2 Nos
All structures Shed of Pump House / Fire Engine / Loading unloading Gantry / Air Compressor / Engg Store etc.	2 Nos for each structures
Static Earth for Loading / unloading Gantry (Tank Truck) operations.	2 Nos earth pits for 8 bay gantry.
Static Earth for Loading unloading Gantry (Tank Wagon) operations.	Min. 4 nos. earth pits for each (single/two spur) gantry. For rail track as per railway norms.
All 3 Phase Motors / FLP lights in each shed	2 Nos
High Mast Tower (HMT)	2 Nos for each HMT
Admin Blocks	2 Nos
Data Processing	One for Metallic body parts of

	equipments and one for neutral of isolation-transformer
Inspection Platform / Watch Tower / Weigh Bridge	1 Nos each
Water Storage Tanks (Fire Water Tank)	2 per tank
Product Storage Tank	Minimum 2 nos and further as defined in Cl. B above.

2.12.9 General

i. Fail safe Interlock / change over switch shall be provided between the Grid Power and the DG power to ensure that the equipments get supply from one source only.
ii. Insulation mats shall be provided in the Sub Station, control panels etc.
iii. Relays/Cables shall be tested once in a year and records maintained.
iv. Transformer oil shall be tested once in a year and records maintained.

2.12.10 Emergency Feeder

i. Emergency Feeder shall host the following equipments:
ii. Jockey Pump, Critical lighting, Fire Siren, Bore well, Gate Barrier, safety instrumentation and interlocks such as CCTV, Hydro Carbon detector, Dyke drain valve system, UPS of automation, supply to essential fire fighting equipment.

2.13 INSTALLATION LIGHTING

i. Sufficient lighting shall be provided so as to enable terminal operators to move safely within the accessible areas of installation and to perform routine operations. In the event of normal power failure, emergency lighting shall be provided in critical areas.
ii. Normal lighting system shall be on 415/ 240V AC supply. Emergency lighting shall be provided in critical areas like Sub-Station, D G Room, Control Room, Security cabin(s).
iii. Under normal operation, both emergency and normal lighting shall be fed by normal power source. On failure of normal supply, emergency lighting shall be available until the start of D.G.
iv. Lighting shall be provided for the various facilities in the Depot/Terminal as per good engineering practice. .
v. The Illumination in the operational areas including inside the dyke and manifold shall be such that adequate visibility is there at all times for emergency and normal operations.
vi. Lighting requirements provided during the failure of power supply is intended broadly to,
vii. Facilitate carrying out of specified operations, for safe shutdown of the installation.
viii. Gain access and permit ready identification of fire fighting facilities such as fire water pumps, fire alarm stations etc.
ix. To gain access to escape route for safe evacuation of operating personnel.
x. Depending on the nature of job activities carried out, the minimum illumination levels for various areas shall be as follows:

Area	**Lux Level**
Main roads (Gate entry /exit , roads around TT gantry	20
Secondary roads (along storage tanks & Periphery etc)	10
Tank farm area	20
Pump / Compressor / Dosing Sheds / Fire Pump House	100
Main Operation Platforms & Access Stairs (TT and TW gantry, Tank manifold)	100
Ordinary Platforms	20
OWS / ETP Area	60
Sub Station / PMCC room	150
Transformer yard / HT Di pole area	100
Battery room , Charger/UPS rooms	100
Control Room bldg./ laboratory	150

Lube Warehouse	100
Admin Building	200
Security Cabin / Watch Booth	100
Stairs	80
Corridors	70
Tank truck Parking area	40

Notes :

a. The lighting fixtures on various circuits shall be suitably designed so that failures of any one circuit do not result in complete darkness.
b. Switches controlling the lighting fixtures and exhaust fan shall be installed outside the battery room.
c. Switches of lighting panels installed in hazardous area, shall have a pole to break the neutral, in addition to the poles for phases.

3.0 Safe Operating Practices

i. Operational safety aspects for Petroleum Product terminal / depot shall be built into the design which should also be reviewed during the construction phase from safety / maintenance point of view. Only skilled and trained personnel shall be deployed for effective operation, inspection, maintenance etc. for the installation.

ii. The operating procedures shall provide plant specific instructions on what steps to be taken or followed while carrying out Startup, Normal operation, Temporary operation, Normal shut-down and Emergency operation and shut-down.

iii. Manuals of operating procedures shall be made available to the employees. Training shall be imparted to the operators on operating procedures and should be certified as competent.

iv. When changes are made in facilities, operating procedures should be reviewed as part of the management of change procedure. In addition, operating procedures should be reviewed periodically to verify that they reflect current and actual operating practices. Operating manuals should be certified as updated by authorized / competent person every year.

3.1 Safe Operating Practices shall include the following

i. Terminal/depot Control room where ever provided shall be manned on continuous basis during operations and in emergency.

ii. "No Person" shall be allowed to smoke, carry matches, lighters, flammable material or any other appliances capable of producing ignition or explosion inside the licensed area of the installation.

iii. Mobile phones and any other source of ignition shall not be allowed inside the Petroleum Installation operational areas where petroleum products are stored pumped and handled.

iv. Site specific Standard Operating Procedures (SOPs) for each operation/activity shall be developed and complied with.

v. SOPs shall be periodically reviewed, updated and records maintained especially whenever any changes / modifications to the facilities are made as per Management of Change procedure (MOC).

vi. The critical operating steps based on "SOPs" shall be displayed on the board near the location wherever applicable. In local language also and shall be made simple and user friendly.

vii. All operations shall be carried out under supervision of designated personnel.

viii. All precautions shall be taken to ensure isolation of sources of ignition during maintenance (such as welding, cutting, etc.) from potential sources of flammable vapours. Presence of vapour at location of maintenance and its surrounding shall be constantly monitored by suitable portable device for flammable gas detection.

ix. Maintenance or repair work or entry into confined space including closed drains or manholes shall be carried out in accordance with the Work Permit System.

x. Non Sparking tools shall be used to carry out the maintenance jobs in operational areas where flammable materials are handled or stored.

xi. Check list for operators for monitoring and checking safety system & equipment shall be prepared, followed and records maintained thereof.

xii. Roads inside the hazardous area of Installation shall be restricted to vehicles required for operational, maintenance and safety/security reasons and allowed only with proper safety fittings and authorization from designated officer.

xiii. Vehicles with internal combustion engine (compression ignition) such as tank truck required to be permitted for business shall have Petroleum and Explosives Safety Organization (PESO) approved spark arrestor fitted on the vehicle. Vehicles with spark ignition engine shall not be allowed inside hazardous area.

xiv. TTs to be parked in drive-out position in parking area having separate entry and exit gates.

xv. All electrical equipment shall be maintained to ensure its integrity and type of protection as well as electrical area classification.

xvi. Suitable interlocks shall be provided for tripping / alarm / remote valves operation based on the events e.g low level, high level, high high level, high pressure, low pressure etc.

xvii. The contents of the dyke drain generated from draining of tanks, any other spillage or effluent containing oil shall be diverted to Oil Water separator (OWS) / Effluent Treatment Plant for safe disposal.

xviii. Personnel protective equipment such as safety shoe, hand gloves, apron, safety goggles, safety belt, helmet, ear muff, dust respirator, self contained breathing apparatus (SCBA), resuscitator, fire proximity suits etc. as applicable shall be worn while carrying out operations in normal and emergency situations.

xix. Intrinsically safe VHF handsets shall be used in operating areas.

xx. Manning level in the shift shall be adequate to ensure coverage for normal and emergency operations.

xxi. The PETROLEUM Installation shall have provisions for handling leakage or spills at high risk areas, tank lorries and tank wagons.

xxii. Hydrocarbon Gas detection system shall be installed with audio / video alarm system in the control room as well as in the effective risk zones / areas.

xxiii. All personnel who are handling petroleum products shall be suitably trained on use of firefighting, equipment and first aid. Through training shall be incorporated to all personnel on various levels of emergency response.

xxiv. All other contract personal and supervisors entering the premises shall have basic safety training and should be aware about emergency duty and knowledge of the emergency exit route at all work locations.

xxv. The PETROLEUM Installation shall have effective CCTV system covering the entry / exit gate roads, periphery of installation and all critical operating areas (viz. Tank farm, TT/TW operating area, product pump house, Fire water pump house and TT Parking area etc) which shall be monitored continuously.

xxvi. The CCTV monitoring station shall be available in Control room, Security cabin and Depot in-charge room. The CCTV data shall be stored for a minimum period of 60 days.

3.2 Tank Farm area

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i. Ladders and Handrails of the product tank shall be free from any obstruction and to be in impeccable condition. The platform and railing on the top of the stairway to gauge well and roof ladder should have free access. Walkway with handrail on the roof of the tank should be inspected / checked, so that movement of personnel on roof is safe.

ii. The tank farm management system shall be integrated with Enterprise Resource Planning (ERP) / Terminal Automation System (TAS) with provision of recording & display of real time inventory levels and ensure the effectiveness at regular interval. Whenever the system is by pass, all necessary record is being maintained.

iii. Dyke drain Valves shall be provided with position indication and alarm system in the event of opening the valve. The dyke drain shall be provided along the inside periphery of the dyke enclosure wall. In case circular drain around tank pad is provided, the same needs to be connected to the peripheral drain. The outlet from dyke shall have the provision to either divert to the effluent Treatment plant / OWS or to main storm water drain.

iv. Dyke drain valves shall be in closed condition and shall be operated only under supervision of an authorized person and log book maintained. Piping through dyke wall if any shall be sealed to make dyke impervious.

v. All electrical fittings and fixtures inside the dyke shall be as per the hazardous area classification and its integrity maintained.

vi. The dyke and the enclosures shall be inspected for cracks, visible damage et**c.** every six months (pre and post monsoons) and after every major repair in the tanks / dykes etc. so as to keep it impervious.

vii. All the tanks inside such dyke shall have fire fighting system / water sprinkler system, irrespective of the tank diameter and the system shall be in operating condition. Ensure “No” chocking of water spray nozzles.

viii. The dyke area shall have proper slope outward of tank pad towards the inner periphery of the dyke enclosure to prevent reverse flow.

ix. The Remote Operated Shut Off Valve (ROSOV) and Motor Operated Valve (MOV) of the tanks and pipeline manifold (inlet, outlet & recirculation) of all storage tanks storing class A & B products shall be operational and should remain shut after closure of day operations.

x. ROSOVs and MOVs shall be fail safe and fire safe (shall close in case of signal failure). The actuator shall be fail-safe. The cables leading to the control room shall be fire resistant. These ROSOVs shall be operational from the field and also from control room.

xi. Thermal safety valve (TSV) / Expansion line shall be connected for blocked portion of pipe line(s) to take care of the thermal expansion of product due to rise of temperature. Temperature Safety Valves (TSV's) downstream valves shall be always kept open and its discharge should be routed to slop collection system. Alternatively the discharge may be connected to a common header and back to the tank through NRV.

xii. The area floor underneath of the pipeline manifold shall be paved and the Kerb walls \ drain connected to oil water drainage system leading to ETP / OWS.

xiii. Product storage Tanks must be periodically inspected and checked for leakages / sweating. Repairs must be immediately carried out, whenever scaling / pitting are observed.

xiv. Movement of floating roof must be smooth during operation. Free movement of rolling ladder must be ensured by proper lubrication of moving parts and ensure free movement of wheels.

xv. Floating roof deck must be kept clean and free from all foreign materials / dust etc so as to avoid clogging of roof drain sump.

xvi. Tank farm area shall be covered through CCTV surveillance system and monitored.

xvii. Water seal must be maintained in the emergency drain in floating roof tanks & it shall be ensured that adequate water is maintained in the water pot of the emergency drains.

xviii. Proper earthing and bonding shall be maintained and ensured at all times for the tank body, electrical continuity from shell to ladder and from ladder to floating roof.

xix. SOPs for entry on floating roof/ confined spaces for maintenance and inspection (when the tank is with product for normal operation) shall consider the following:
   a. Floating roof is levelled, free of oil and excessive water and is at higher operating level.
   b. Adequate manpower with a canister mask / breathing apparatus etc.
   c. A life line with safety belt to be used for entering into confined space. The other end of the line held by the standby at the top of platform.

xx. No gauging or sampling of tanks shall be undertaken during thunder or hail storms.

xxi. Water draining from tanks should be done under close supervision as per approved SOPs.

xxii. Receipt and withdrawal rate from the tanks shall be limited to the design parameters of the tank as below. The flow velocity at tank inlet shall not exceed 1 m/s until the inlet is completely submerged.

xxiii. Breather vents provided on cone roof tanks shall be checked to ensure normal operation and ensure its effectiveness.

xxiv. Special attention shall be given during receipt as well as transfer from the floating roof tanks when roof is in semi floating condition i.e. operating in erroneous zone.

xxv. Safety shoe (Conductive type) shall be worn while gauging, sampling or taking temperatures.

xxvi. Tank dip pipes shall be extending to tank bottom. If dip pipes are not provided, give a relaxation time of 30 minutes after receipt / discharge before sampling/gauging.

xxvii. Synthetic fibre cord shall not be used for sampling, dipping, gauging etc. If the sampling, gauging, dipping, etc., equipment is a conductor, the cord must be conductive, e.g. a metal wire. Metal chains shall not be used instead.

xxviii. Ensure that gauge tapes and other sampling equipments are of non sparking type.

xxix. During receipt, tank level shall be monitored at regular intervals. Effective communication shall be provided in the tank farms. .this may include public announcement system /Page phone / loud speakers/VHF/ paging etc. This system can also be utilised for communication during emergency.

xxx. Cleaning of tanks should be carried out as per plan in line with the approved SOPs. Gas oil spray and steam shall not be used for cleaning of Class A & B tanks.

xxxi. Earthing and bonding connections shall be ensured during the entire operating process. The earthing system shall be checked for bonding and earth continuity as prescribed and records maintained thereof.

xxxii. Hydrocarbon (HC) detectors shall be installed near all potential leak sources of class “A” petroleum products i.e. tank dykes, tank manifolds and pump house manifold. These detectors shall be placed in a way that entire possible source of leaks and collection of products is continuously detected and alarm is set at 20% of lower explosive limit of class A.

xxxiii. Fire fighting system provided for above ground Tanks shall be operational, the effectiveness of the system to be ensured checked periodically for operation as per design capacity.

xxxiv. The tank farm must be kept clean and shall be free from dry vegetation.

xxxv. OWS system shall be maintained clear by periodic cleaning. End of the vent of Inspection chamber of the OWS system shall be provided with wire mesh. The accumulated oil from the OWS sumps shall be collected and sent to slop tanks at regular intervals.

xxxvi. Disposal of sludge collected during cleaning of the tanks shall be done as per the applicable guidelines.

xxxvii. The product storage tanks shall have level indicators as well level alarms and interlocking with MOV and ESD. The effectiveness of the system \ interlocking shall be checked regularly. The interlocking / ESD shall not be bypassed. In case of any such exigency, the approval from authorised person shall be taken with requisite precautions and records maintained thereof.

3.3 Bulk handling

3.3.1 Tank Truck (TT) Loading / Unloading

Transportation of petroleum products by road is regulated by PESO through The Petroleum Rules 2002 (the latest applicable version) and Central Motor Vehicle Rules, 1989, Carriage by Road Act, 2000/Rules 2011 and Legal Metrology Act 2009.

3.3.1.1 Before Commencement of Loading / Unloading

i. Open source of ignition shall not be allowed in any part of the PETROLEUM Installation operational area including tank lorry loading / unloading area.

ii. Check for following in a tank truck as per statutory regulations before accepting it for filling:
   a. Provision of PV vent, emergency vent, Master valve and other safety fittings.
   b. Fire screen between cabin and tank is provided. For this purpose, cabins with metallic back cover without any opening will be considered as fire screen.
   c. Provision of 2 nos. of Fire Extinguishers of ISI mark (1 no. X 10/9 kg DCP and 1 no. 1 kg CO2 /DCP /equivalent approved fire extinguisher).
   d. Spark arrestors of the approved designed shall be welded with the exhaust in front of the vehicle. The vehicle shall have valid Explosive License and RTO certificate along with PESO approved drawings of the tank.
   e. Availability of brazed copper strip for earthing / bonding connection.
   f. Tank trucks should be equipped with ABS.

iii. The Double pole master switch shall be put off immediately after parking the truck in the position. No electrical switch on the truck shall be turned "on" or "off" during the loading operation.

iv. Wheel choke shall be placed at wheels to prevent accidental movement of the truck. Hand breaks should also be applied during the entire loading / unloading operation.

v. The first process after positioning the truck shall be to provide appropriate earthing. After the loading / unloading operation, erthing shall be disconnected just before the release of the truck.

vi. Vapour Space of 3% of its capacity shall be kept in each tank truck in respect of Petroleum Class A and B products and 2% vapour space in tank trucks in respect of Petroleum class C.

vii. No repairs shall be made on the Tank Lorries, while it is in the loading/unloading area.

viii. Personnel deployed in the loading / unloading area shall make use of Personal Protective equipment and wear all throughout the working period.

ix. Loading \ unloading area pipeline manifold shall have provision of quick shut-off valves.

x. No tank vehicle shall be loaded at a rate exceeding (volumetric flow rate corresponding to linear velocity) one meter per second at the delivery (at the least dia fitting) and of the filling

pipe until the filling pipe is completely submerged in petroleum and thereafter the loading rate should be gradually increased but it shall at no point of time exceed six meters per second at the delivery end of the filling pipe.

xi. Oil and water collected from loading/unloading areas shall be routed to Oil water separator system / Effluent Treatment Plant or similar facility. A slop tank should be earmarked for storing separated oil.

xii. The tank truck gantry shall be so designed that all the compartments of the tank truck are filled at one bay only. The layout shall ensure that all operations are planned in a manner so that no zigzag movement of the tank truck around the gantry should take place.

xiii. The maximum safe carrying capacity in weight of Petroleum that can be carried in a tank vehicle shall not exceed the difference between the unladen weight of the vehicle and the maximum gross weight permitted for the class of vehicle under the appropriate transport regulations.

3.3.1.2 During Loading / Unloading Operation

i. Move truck to the loading / Unloading bay and position the TT in the loading/ unloading bay and place wheel chokes at front and rear wheels of the vehicle. Keep the TT in neutral mode with hand brakes. .

ii. Certified ISI Mark fire extinguishers shall be placed near the tank trucks, during loading / unloading operations at a designated marked place.

iii. Stop the engine of TT and “Switch off” Master switch, so that the TT can not be started incidentally and the TT electrical supply shall be disconnected totally.

iv. The TT driver and cleaner shall be outside the vehicle to meet any exigency, and “no” person shall be in the driver's cabin.

v. Provide earthing connections of the vehicle at specified point on tanker tank to the fixed grounding system.

vi. Ensure TT manifold valve are closed and capped.

vii. Open vent cap of the Tank lorry.

viii. Test the connections for any product leakages.

ix. Loading of TTs shall be through dedicated loading arms and through flow meters. The correctness of the mass flow meter shall be ascertained periodically. Splash loading shall be avoided.

x. Start the loading operations with initially loading rate shall not be exceed 1 m/s till fill pipe is completely submerged with petroleum products and there after gradually increased loading rate but shall not be exceed 6 m/s (should preferably not exceed 4 m/s).

xi. The quantity loaded into the truck can be assessed by :
    a. Liquid level through manual dipping.
    b. Filling through Flow meter.

xii. Filling / transfer operations shall be suspended immediately in the event of :
    a. Uncontrolled leakage occurring.
    b. A fire occurring in the vicinity.
    c. Lightning and thunder storm.

xiii. The personal working engaged in loading unloading operation, shall use fall protection system designed for the purpose.

xiv. An authorized person of the company shall supervise the filling operation and respond immediately in the event of an emergency.

xv. Trucks meant for loading may be inducted in line with approved acceptance checklist. Filling Checklist. Records need to be maintained

3.3.2 Tank Wagon (TW) Loading/ Unloading

Before Commencement of Loading / Unloading

i. Ensure that the loco is at least at a distance of 15 metre from the first loading / unloading point when the wagons are being placed / removed in the gantry for loading or unloading.

ii. Main railway track shall be isolated from wagon gantry siding at least 15 meters from 1st loading/unloading point by providing insulation joint at terminating point and loco shall stop before the insulation joint using adequate no. of dummy wagons.

iii. The loading / unloading operation shall be carried out under close supervision of authorized person.

iv. After the wagons have been placed at the gantry for loading / unloading breaks are to be applied before detaching the loco.

v. Open source of ignition shall not be allowed in any part of the area where product transfer operations are being carried out. Use of mobile phone is prohibited in the zone / area.

vi. Ensure that all fittings on the tank wagons are checked physically i.e. before & after loading / unloading.

vii. Always use gantry platform for movement from one wagon to other wagon. Movement from wagon to wagon is prohibited.

viii. The first operation after positioning the wagon shall be to provide appropriate earthing of all the tank wagons. Ensure that electrical continuity of the system is intact by providing bonding in flanges and checking of continuity.

ix. Ensure all the fire fighting equipment's are in good working condition, and the fire fighting ring main system is pressurized and maintained.

x. The loading unloading system / equipment's shall not operate more than its designing capacity.

xi. Any non-routine work in the operational area shall be permitted with work permit only.

xii. Every individual working in the Tank Wagon operating area must be familiar with all the firefighting equipment, their care and their use in the event of fire.

xiii. Use of right kind of equipment to handle loading / unloading operation. After using the equipment / material or tools shall not be placed at rail track.

xiv. Maintenance jobs on rail track during placement / removal of rake are strictly prohibited.

xv. Oil and water collected from loading/unloading areas shall be routed to Oil water separator system / Effluent Treatment Plant or similar facility. A slop tank should be earmarked for storing separated oil.

xvi. Open drains along the railway line/gantry shall be covered with gratings so as not to endanger movement of personnel.

xvii. Vapour space of not less than 4.0 % of its capacity shall be kept in each wagon for dangerous product and 2.5% for non-dangerous product in each wagon.

xviii. Tank wagon loading/ unloading operations shall be suspended immediately in the event of uncontrolled spill, or fire in the vicinity.

xix. Like-wise, before the wagons are moved from the spur, brakes on all the wagons shall be released.

xx. The railway siding railway track shall be properly insulated from the main line and grounded, vis-a-vis main rail track.

xxi. Wagon to be checked for mechanical condition, dents, and leaks. Report of defective wagons to be provided to Railways.

xxii. All drain and vent point in pipe line shall be kept closed and caped.

xxiii. Good housekeeping to be ensured all the time in Railway siding / gantry. And all the personal working in the area shall wear Personal Protective equipment.

3.3.2.1 During Tank Wagon Loading Operation:

i. Accept the tank wagons for loading only after the railway staff declares the tank wagons are fit for loading / unloading operation.

ii. Before loading of a wagon, a bonding connection shall be made before opening of manhole cover and shall remain in place until filling is completed and all dome covers have been closed and secured.

iii. Dip tape or sampler shall not be lowered during loading time or just after completion of loading in a wagon to permit relaxation of charges.

iv. No Wagon shall be loaded at a rate exceeding (volumetric flow rate corresponding to linear velocity) one meter per second at the delivery / (at the least smallest pipe fitting) and of the filling pipe until the filling pipe is completely submerged in petroleum and thereafter the loading rate shall be gradually increased but it shall at no point of time exceed six meters per second at the delivery end of the filling pipe.

3.3.2.2 During Tank Wagon Un-Loading Operation

i. Ensure health of unloading pumps required for unloading of wagons..

ii. Ensure mobilization of required hoses, gaskets, adapters, nuts, bolts etc at the site.

iii. Ensure correct line up from unloading pump discharge to product tank.

iv. Record all seals numbers, density and DIP in “sick wagon unloading register.

v. Confirm the correctness of the line up hoses and product pipeline connections. Recheck and ensure product exchange shall not take place.

vi. Ensure earth continuity from Wagon to unloading point by providing required copper jumpers at flange joints.

vii. Measure the initial dip of the tank wagon prior to unloading.

viii. Record the initial dip of the tank wagon and the designated tank dip prior to unloading.

ix. Open air vent valve and filling pipe cover for air breathing

x. Open the master valve and bottom valve of the tank wagon.

xi. Monitor the physical dip of the product in the Tank wagon, particularly towards end of the unloading.

3.3.3 Handling & Unloading of Sick Tank Wagon

i. In case of minor leak, try to arrest the leak at the site with the help of railway staff only through cold repair methods only.

ii. When a wagon is found leaking during loading/ unloading, provision shall be kept for safe handling of such wagons. As a first aid measure arresting of leaks using cold weld compounds at gantry itself, in no case such wagon to be used for transportation.

iii. If the leak is minor and not stopped by TXR staff/Maintenance then make arrangements to decant the wagon into Product Tank.

iv. If the leak is major then immediately inform the concerned Railway staff and in the mean time try to contain the spill using container / drums.

v. Connect the un-loading hose(s) to wagon’s unloading flange and nearest sick wagon unloading point of the gantry.

vi. Product should be then transferred to suitable storage and leakage shall be arrested by cold repair methods. In case leakage cannot be arrested, wagon shall be declared sick in concurrence with the railways staff and emptied out completely.

vii. A dedicated drain header(s) for instantaneous unloading of such sick wagons. Alternately, the existing headers may be utilized for immediate decantation of product from sick wagons by providing suitable arrangements in the manifold.

viii. A portable pump with flame proof / explosion proof motors and other electrical fittings to be used with suitable flexible hose connection for quick withdrawal of products into sump tanks. Such drained products to be handled further as per IQCM (Industry Quality Control Manual)

3.3.4 Tank Wagon Unloading in Slop Tank

i. Ensure earth continuity from Wagon to unloading point by providing required copper jumpers at flange joints. Appropriate earthing connection shall be made before the start of unloading activity.
ii. Ensure that required ullage is present in the slop vessel to accommodate the quantity to be unloaded from the sick tank wagon. Check the dip of product in the slop vessel physically and record it.
iii. Ensure mobilization of required hoses, gaskets, adapters, nuts, bolts etc near the sick wagon.
iv. Ensure that the all other stub/branch pipe of the sick wagon unloading header throughout the gantry are properly blinded.
v. Record the product specification & density and DIP in "sick wagon unloading register."
vi. Confirm the correctness of the line up to the slop vessel.
vii. Connect the un-loading hose(s) to wagon's unloading flange and nearest sick wagon unloading point of the gantry.
viii. Open air vent valve and filling pipe cover of wagon for air breathing.
ix. Open the master valve and wagon bottom valve of the wagon.
x. Continuously monitor the dip level of the wagon during unloading operation.
xi. Check and ensure that there is no leakage of product from other flanges of the unloading header in the gantry area.
xii. Monitor level of product in the slop vessel.
xiii. Monitor the physical dip of the product in the Tank wagon, particularly towards end of the unloading.
xiv. Check the emptiness of the wagon.
xv. Disconnect the flexible hose carefully; decant the remaining material of the hose into slop vessel.
xvi. Close bottom valve as well as master valve of the tank wagon.
xvii. Place the unloading hoses and other material at designated place.
xviii. Check the closing stock / physical dip of product in slop vessel and record it.
xix. Reconcile the quantity unloaded from Tank Wagon and quantity received in the slop vessel.

3.4 Transfer of Product through Pipeline

Where ever pipe line transfer is envisaged between various entities, a mass flow meter with integrator shall be installed on receipt line at both ends i.e. dispatch and receipt ends. Signal shall be provided in the control rooms of both dispatching and receiving companies / locations for monitoring.

The following safe practices to be followed:

i. Gauging procedure shall be completed and line shall be made through.
ii. Physical inspection shall be carried out up to the exchange manifold for any leakage/damage etc.
iii. Monitoring systems such as SCADA shall be installed in cases of cross country pipeline transfers.
iv. Seal the pressure relief lines of receipt nozzles of product tanks connected to the same common receipt header.
v. After ensuring that there are no leaks, pumping shall be commenced
vi. Pumping shall be commenced initially at low flow rate and only after stabilizing of flow, the flow rate may be increased.
vii. Product shall not be pumped beyond safe filling height of the tank. Necessary interlocks in the automation shall be put in place to ensure this.
viii. After completion of the receipt, pumps must be stopped
ix. In case of Emergency Shutdown, care shall be taken so that back pressure is not developed in the pipelines and pump head.

x. Sampling shall be carried out as per provisions of Industry Quality Control Manual(IQCM)
xi. Pipe Line transfer (PLT) shall not be taken simultaneously in more than one tank.
xii. In case product is required to be taken into more than one tank, tank shall be switched over after completion of operation in first tank, close all valves to the first tank, make line through for the second tank as per procedure.

3.5 Marine Loading / Unloading

i. Marine facilities handling petroleum products shall have clearly marked out escape route, and at the same time have sufficient access to fire fighting
ii. Fire fighting facility for a marine facility handling petroleum products shall be provided as per design standard.
iii. Vessels berthed at the wharf shall be fastened with mooring ropes, ensuring that the vessel is well secured to the wharf.
iv. Before commencement of loading / discharge of the vessel, shore and vessel representatives to jointly sign off safety check list covering all aspects of the vessel loading / discharge. Safety Check list to also cover emergency evacuation measures in event of emergency on shore and on board the vessel
v. Clear communication channel to be established between vessel and shore terminal.
vi. Loading pumps capable of building up pressures that exceed the safe working pressure of cargo hose or loading arms shall be provided with bypasses, relief valves, or other arrangements to protect the loading facilities against excessive pressure. Relief devices shall be tested at least annually to determine that they function satisfactorily at their set pressure.
vii. Vessel tanks nominated for loading petroleum products shall have oxygen content below 8% to ensure safe loading operation. This has to be ensured in all vessel tanks nominated for loading, before the any product loading can commence into any of the vessel tanks.
viii. Loading / unloading arms / hoses connected to the vessel for loading / unloading shall have facility for emergency shut off and break away.
ix. Loading / unloading quantity and rates to be monitored on an hourly basis and corresponding ship and shore figures to be hourly compared.
x. Loading / unloading arms / hoses to be inspected hourly for leakages during the operations
xi. Vessel to ensure and confirm to shore on hourly basis, the status of various vessel tanks to ensure that no product migration is taking place between vessel tanks
xii. Abnormalities observed during operations to be immediately communicated between ship & shore. In case of abnormality in operations, operations shall be stopped immediately. Operations to only commence after conditions have been restored to normal. Abnormalities considered are :
    a. Large differences between vessel and shore tank hourly quantity.
    b. Variation in product densities from the certified density of the product under operation.
    c. Leakages observed on board vessel / shore pipelines / hoses or spillage observed in the sea water.
xiii. Mechanical work shall not be performed on the wharf during cargo transfer, except under special authorization based on a review of the area involved, methods to be employed, and precautions necessary.

3.6 Ethanol Handling

In case ethanol is used for blending with Motor Spirit at the petroleum installation, facilities for storing and handling of ethanol shall be provided. All practices as being followed in handling Class `A' Petroleum Products are required to be adhered to while handling Ethanol and Ethanol Blended Motor Gasoline.

3.6.1 Receipt, storage and handling of ethanol

i. Ethanol shall be received at depots in dedicated tank trucks. All care shall be taken to prevent ingress of water into the compartments during transportation
ii. The fittings in tank trucks used for transportation of Ethanol to receiving locations shall be the

same as used for storage and handling of Class 'A' Petroleum products.

iii. Ethanol can be stored in above ground or underground tank(s) depending on local requirement.

iv. The unloading operations shall be carried out through special Nitrile rubber or any other compatible hoses. Hose shall have external bonding wire to ensure electrical continuity.

v. Ethanol being hygroscopic in nature, utmost precaution needs to be taken to ensure that there is no ingress of water or humidity. Both the ends of the hoses after use shall be capped. 80 mesh strainers shall be provided before the pump / tank inlet as the case may be.

vi. Appropriate recommended dosage of Metal Deactivator and Corrosion inhibitor shall be added during the decantation of Ethanol from tank truck into the storage tank, so as to ensure homogeneity of additives with ethanol in the storage tank.

vii. Storage tanks and allied facilities for Ethanol shall be positively segregated. The tank shall be absolutely free from water at all times.

viii. Ethanol, being hygroscopic, will absorb moisture from the air, Silica Gel trap must be provided in the vent pipe of the tank to prevent ingress of moisture into the tank. Regular check on the Colour of silica gel shall be maintained (Blue Colour) and shall need immediate replacement on showing signs of saturation by way of change of colour.

ix. Ethanol storage tanks shall be cleaned once in two years or more frequently depending on the need.

x. Storage tank openings / pipeline fittings shall be airtight and the threaded connections if any shall be tightened with the help of Teflon paste or Teflon tapes. Bolted connections shall have gaskets of Teflon.

xi. To ensure uniform doping of Ethanol with Motor Gasoline, on line doping of Ethanol shall be carried out through a closed system, with proper interlocks, while maintaining efficacy of mixing Ethanol in the right proportion of % v/v as per specification.

xii. An 80-mesh filter shall be provided on the delivery side of Ethanol storage tank i .e. between pump and tank lorry filling (TLF) Gantry point.

xiii. Safety requirements as prescribed in Material safety data Sheet (MSDS) shall be ensured.

xiv. “SOP” shall be displayed. Persons handling ethanol shall be trained for handling of ethanol.

xv. Emergency instructions, Hazardous instruction shall be displayed and PPE as per MSDS requirement shall be in place.

4.0 Commissioning / De-commissioning of facilities

Commissioning is the process of assuring that all systems and components of a facility, a process, or a plant are installed, tested, and operated according to the design parameters and operational requirements. De-commissioning is the process of assuring that all systems and components of a facility, a process, or a plant are tested and confirmed that there is no Hazard available / balance, which may cause any potential damage to the personal and also equipment/ facilities installed in the vicinity before shutdown of the facility. The commissioning / de-commissioning process shall include the following aspects:

i. Standard operating procedures for commissioning / decommissioning of the equipment & facility shall be formulated, reviewed and approved by designated personnel.
ii. Only experienced and trained personnel shall be deployed for commissioning / de-commissioning activities.
iii. The de-commissioning/ commissioning of the facility shall be carried out under the close supervision of the experienced and expert supervisors.
iv. The role and responsibilities of each personnel associated with the commissioning / de-commissioning activities shall be clearly defined and approved.
v. The commissioning process comprises the integrated application of a set of engineering techniques and procedures to check, inspect, test, and verify every operational component of the project, from individual functions, such as stand-alone equipment and instrumentation to complex combinations of modules, subsystems and systems.
vi. There shall be an approved commissioning / de-commissioning plan for each facility / process unit of the project.
vii. The procedures shall be developed taking into account the various hazards that are likely to be encountered during the commissioning process and shall also address the prevention / mitigation systems that need to be in place prior to commencing each activity.
viii. This should include any risks to the operators, facility, and environment based on a risk assessment.
ix. Procedures shall ensure that all necessary checks / safeguards are correctly addressed. Procedures shall be supported with proper checklists for verifying compliance.
x. Pre-commissioning activities like vessel entry, work at height, hot work, and all commissioning / de-commissioning activities shall be carried out complying with work permit system.
xi. Compliance to work permit requirements should be monitored via regular safety inspection.
xii. All staff and the associated contractors, vendor representatives at site shall use Personal Protective Equipment (PPE) as prescribed.
xiii. In the event of an emergency occurring in the Project site / area, the emergency response shall be in accordance with the established Emergency Response Procedures.
xiv. Hazardous waste and non-hazardous waste produced in the pre-commissioning / commissioning activity (e.g. flushing lube oil, oil contaminated water or soil) shall be handled in accordance with established environmental procedures of waste management.
xv. A comprehensive testing procedure shall be developed which address the safety of all personnel and include the provision of specific work instructions and related training and induction for all personnel involved in testing operations. The testing must be supervised by trained and experience personnel. Coordination and team work between Construction, QA/QC, Safety, and Contractor is very important.
xvi. Any pressure test activity shall have approved pressure test Certificates of relevant testing equipment / instruments, work permit and job safety analysis.
xvii. The hydrostatic and pneumatic test pressure utilized for testing of systems shall be as indicated in the data sheet. The relevant Codes and Specifications for the system shall be used for determining the hydrostatic or pneumatic test pressures.

xviii. Test facility shall be set up with provision of a relief valve and calibrated pressure gauge (at least two units in the test loop) shall be deployed.

xix. Prior to commencement of any pressure test, the relief valves shall be correctly set and not isolated, and the pressure gauges shall be functional.

xx. Equipment or piping system isolation spades, gaskets, flanges, etc should be checked for correct size, thickness & rating.

xxi. All vents and other connections which can serve as vents shall be open during filling so that all air is vented prior to applying test pressure to the system.

xxii. Temporary spades and blanks installed for testing purposes shall be designed to withstand the test pressure without distortion.

xxiii. Piping shall be tested prior to installation of inline items such as rupture discs, displacement and turbine meters, orifice plates, flow nozzles, level gauges, rotameters, strainers, etc.

xxiv. Many potential hazards can be realized during start-up or shut-down of a plant or a process unit. Specific Emergency procedures should be provided which take into account all possible eventualities.

5.0 Fire Protection and Prevention Facilities

5.1 Fire Protection Philosophy

Fire protection philosophy is based on loss prevention & control. It considers that a depot/terminal carries an inherent potential hazard due to flammable nature of petroleum products stored therein. A fire in one facility can endanger other facility of the depot/terminal, if not controlled / extinguished as quickly as possible to minimize the loss of life & property and prevent further spread of fire.

5.1.1 Fire protection

Depending on the nature of risk, following fire protection facilities shall be provided in the installation.

a. Fire Water System -(storage / pumps / distribution piping network with hydrant / monitors)
b. Fixed Water Spray System
c. Foam System.
d. First Aid Fire Fighting Equipment.
e. Trolley mounted/Mobile Fire Fighting Equipment.
f. Carbon Dioxide System / Clean Agent Fire Fighting System / Dry Chemical Fire Fighting System
g. Dry Chemical Extinguishing System
h. Clean Agent Protection System.
i. Leak detection System and Alarm System
j. Fire Detection and alarm systems
k. Communication System

5.1.2 Design criteria for fire protection system

i. Facilities shall be designed on the basis that city fire water supply is not available close to the installation. The Installation / Depot should have it's own independent Fire Fighting System.
ii. The fire water pumps shall be provided with auto start facility with pressure drop in fire water network.
iii. The water storage capacity shall be based on minimum 4 hours aggregate rated capacity of main pumps.
iv. The fire water system shall be based on single contingency for all locations where total storage capacity in the location is up to 30,000 KL (Including storage of Class C products if stored with Class A and / or Class B). Wherever water replenishment @ 50% or more is available, the storage capacity can be reduced to 3 hours aggregate rated capacity of main pumps.
v. The fire water system shall be provided based on two largest fire contingencies simultaneously for all locations where total storage capacity in the location is above 30,000 KL (Excluding Class-C products stored in a separate dyke conforming to prescribed separation distances).

   Wherever water replenishment @ 50% or more is available, single fire contingency shall be considered for Fire water storage. This clause shall not be applicable for locations exclusively storing class C & / or excluded products.
vi. At locations where cluster of OMCs exist, fire water shall be shared. Water requirement shall be worked out based on fire scenario of single largest tank, CR or FR tank as the case may be. At locations where single OMC exist, it shall have water requirement for 4 hours.
vii. For location/dyke storing exclusively Class C or excluded or combination of Class-C & excluded products the water requirement shall be based on 1 monitor of 144 kl/hr and 4 hose streams of 36 kl/hr i.e. a total of 288 kl per hr for four hrs.

viii. The hazardous areas shall be protected by a well laid combination of hydrants & monitors. The installations having aggregate above ground storage capacity of less than 1000 KL (Class A+B+C) other than AFS are exempted from this provision.

ix. The installations storing Class A petroleum in above ground tanks shall have fixed water spray system. However, installations above 1000 KL storage fulfilling the following both conditions are exempted from the provision of fixed water spray system.
    a. Aggregate above ground storage of Class A & B petroleum up to 5000 KL.
    b. Floating roof tank storing Class A petroleum having diameter up to 9 M.

x. Class 'B' above ground Petroleum storage tanks (fixed roof or floating roof) of diameter larger than 30 m shall be provided with fixed water spray system.

xi. Fixed foam system or Semi-fixed foam system shall be provided on all tanks (floating roof or fixed roof) exceeding 18 m diameter storing Class A or Class B petroleum.

xii. When Class A & B above ground storage tanks are placed in a common dyke, the fixed water spray system shall be provided on all tanks except for small installations as mentioned in (g) above.

xiii. Installations where inter distances between tanks in a dyke and / or within dykes are not conforming to these regulations, the following additional facilities shall be provided to enhance safety.
    a. The fixed water sprays system on all tanks, irrespective of diameter in the installations.
    b. The Fixed or semi fixed foam system on all tanks, irrespective of diameter in the installation.

xiv. Tank Truck (TT) / Tank Wagon (TW) loading/unloading gantries/facilities, Manifold area of product pump house & Exchange pit shall be fully covered with alternate hydrant and water cum foam monitors of approved make having multipurpose combination nozzles for jet, spray & fog arrangement and located at a spacing of 30 M on both sides of gantry ensuring min foam application rate of 6.5 lpm/sq.m (in line with NFPA-11 for spill fire more than 1 inch deep) to the target zone (3 adjacent segments of 15 mtrs each for TW gantry and 08 bays for TT gantry) of the relevant facility.

xv. The hydrants & monitors shall be located at a minimum distance of 15 m from the hazard (e.g TW&TT loading / unloading facilities) to be protected.

xvi. Tank wagon loading gantries shall be provided with manually operated fixed water spray/sprinkler system.

xvii. The gantry shall be divided into suitable number of segments (each segment having min. length of 15 m length & width of 12 m) and three largest segments operating at a time shall be considered as single risk for calculating the water requirement. Accordingly, a provision shall be made to actuate the water spray system from a safe approachable central location i.e. affected zone and adjoining zones.

xviii. Portable monitors/foam hose streams shall be provided for fighting fires in dyke area and spills.

xix. Medium expansion foam generators shall be provided for dyke area to arrest vapour cloud formation from spilled volatile hydrocarbons.

xx. Installation of medium expansion foam generator shall be as per following criteria:
    a. Class A tanks: Two Nos. Fixed type foam generators (minimum) for each tank dyke.
    b. Class B tanks: Two Nos. Portable foam generator (minimum) for each location.

xxi. Remote or manually operated high volume long range water cum foam monitors (capacity 500/750/1000 GPM and above) to fight tank fires shall be provided at petroleum installations. Numbers, Capacity of monitor or foam pourer shall be provided in such a way that the foam delivery rate from the monitors' meets requirement of foam application rate (8.1 LPM/m2) for full surface tank fire.

xxii. The location of HVLRs monitors shall be planned in such a way that the very purpose of these monitors is served and throw of the monitors is safely delivered at the aimed object. These high volume long range monitors shall be located at a distance of 15m to 45 m from the hazardous equipment subject to:

xxiii. Monitors shall be positioned in such a way that throw of monitors are safely directed to the target tank under full surface fire without damaging tank shell, tank pad and other objects.

xxiv. The throw is directed on the inner upper surface of the tank and not in the middle of the tank to prevent splash over.

xxv. Care need to be taken for petroleum installations located in habituated areas or adjoining to other objects such as High tension line etc. There should not be any High tension line passing through the depot / installation.

xxvi. Water cum foam monitors shall be installed in such a way that all the tanks in the installation are within the horizontal range of foam throw.

xxvii. Additional monitors shall be provided in such a way that each tank is in the coverage area of at least two monitors.

xxviii. Provision for connecting / hooking the portable monitor shall be made in the hydrant system around the fixed roof tanks at various strategic points.

xxix. Well laid procedures and plans shall be made and put into use for use of HVLRs to combat emergencies without loss of much time.

xxx. For determining the total foam solution requirement, potential foam loss from wind and other factors shall be considered while designing.

xxxi. Adequate foam drum/tank or reliable replenishment for foam induction system shall be provided.

xxxii. Automatic actuated rim seal fire detection and extinguishing system shall be provided on all existing as well as new external floating roof tanks storing Class A petroleum. The detection and extinguishing system shall have following features:

xxxiii. The system must detect fire in Rim Seal area immediately but not later than 10 seconds and extinguish the fire in its incipient stage i.e within 40 seconds of its indication.

xxxiv. The system must be robust viz., it should not be affected by environmental conditions like low/high ambient temperature, dust, external corrosion, hydrocarbon vapour, rain etc.

xxxv. The extinguishing foam must apply in the seal area @18 LPM per square meter in a uniform manner in maximum of 40 seconds.

xxxvi. The detection and extinguishing system shall be coupled with fire control panel with audio-visual alarm for necessary fire alert.

xxxvii. In addition, the individual components shall have certification from competent authority for suitability for applicable hazardous zone.

xxxviii. Fixed water spray system shall also be provided in lube oil drum areas if located in hazardous area.

xxxix. Clean Agent (Halon substitute) based flooding system should be provided for control rooms, computer rooms/ repeater station and pressurized rooms in major locations having automated pipeline receipt/dispatch and/or TW/TT loading facilities. Selection of clean agent and design of fire protection system for control rooms, computer rooms and pressurized rooms should follow the Standard on “Clean Agent Extinguishing systems NFPA Standard 2001 including its safety guidelines with respect to “Hazards to Personnel”, electrical clearance and environmental factors in line with environmental considerations of Kyoto and Montreal Protocol & MOEF regulations.

5.1.3 In case, combined Petroleum and LPG facilities have been provided in the same premises. The common water storage facility for fire fighting purpose may be shared between Petroleum Installation and LPG Plant under following conditions:

i. If both locations are located within same premise then one largest fire scenario to be considered and water requirement shall be worked out accordingly. In case if the premises are separate, water requirement to be worked out for independent location.

ii. Each Petroleum / LPG facility shall independently meet the design, layout & fire protection system requirements of PNGRB regulations and have common boundary wall and ownership of both the facilities under same company.

iii. The fire water requirement shall be based on two fire contingencies simultaneously in the combined facility and fire water storage capacity shall be fixed accordingly.

iv. The pump house may be common / separate. In case common pump house is provided the control of the pump house shall remain with group whose premises pump house is situated..

5.2 Fire water system design

Fire water system shall be designed for a minimum residual pressure of 7 kg/cm^2 at hydraulically remotest point in the installation considering the design flow rate.

i. A fire water ring main shall be provided all around perimeter of the location facilities with hydrants / monitors spaced at intervals not exceeding 30 M when measured aerially. Fire hydrants and monitors shall not be installed within 15 Meters from the facilities/ equipment to be protected.
ii. The installation shall have facilities for receiving and diverting all the water coming to the installation to fire water storage tanks in case of an emergency.

5.2.1 Fire water design flow rate

i. Fire water flow rate for a tank farm shall be aggregate of the following :-

a. For water flow calculations, all tanks farms having class A or B petroleum storage shall be considered irrespective of diameter of tanks and whether fixed water spray system is provided or not.
b. Water flow calculated for cooling a tank on fire at a rate of 3 lpm / sqm of tank shell area.
c. Water flow calculated for exposure protection for all other tanks falling within a radius of (R +30) m from centre of the tank on fire (R-Radius of tank on fire) and situated in the same dyke at a rate of 3 lpm / sq.m of tank shell area.
d. Water flow calculated for exposure protection for all other tanks falling outside a radius of (R+30) m from centre of the tank on fire and situated in the same dyke at a rate of 1 lpm/m2 of tank shell area.
e. Water flow required for applying foam on a single largest tank by way of fixed foam system, where provided, or by use of water/foam monitors whichever is higher. (Foam solution applicable rate for cone roof tanks shall be taken as 5 lpm/sqm and for floating roof rim seal protection it shall be 12 lpm / sqm).
f. Various combinations shall be considered in the tank farm for arriving at different fire water flow rate and the largest rate to be considered for design.

ii. For location/dyke storing exclusively Class C/excluded products the water requirement shall be based on 1 monitor of 144 kl / hr and 4 hose streams of 36 kl / hr i.e. a total of 288 kl per hr for four hrs.
iii. Fire water flow for product pump house shed for depot / terminal and cross country pipe line installations with / without tankage shall be at a rate of 10.2 lpm / sqm.
iv. Pumps of volatile products located under pipe rack fire water flow rate shall be calculated at a rate of 20.4 lpm / sqm.
v. Fire water flow rate for TT&TW loading Gantry in a depot or terminal shall be calculated at a rate of @ 10.2 lpm / sq.m. The gantry shall be divided into suitable number of segments (each segment having min. length of 15 m length & width of 12 m) and three largest segments operating at a time shall be considered as single risk for calculating the water requirement. Design flow rate shall be largest of 5.2.1.a, 5.2.1.b, 5.2.1.c, 5.2.1.d and 5.2.1.e. Design flow rate for roof sinking case of largest tank shall be calculated. Where ever the design flow rate of roof sinking case is higher than single or two contingencies, as the condition applicable, the same shall be considered for calculating water requirement.
vi. Supplementary water: Fire water flow rate for supplementary streams shall be based on using 4 single hydrant outlets simultaneously. Capacity of each hydrant outlet as 36 kl/hr shall be considered at a pressure of 7 kg/cm2. The supplementary water stream requirement shall be in addition to the design flow rates.

5.2.2 Fire water storage

i. Water for the fire fighting shall be stored in easily accessible surface or underground or above ground tanks of steel, concrete or masonry.

ii. The effective capacity of the reservoir/tank above the level of suction point shall be minimum 4 hours aggregate rated capacity of pumps. This clause shall be read with clause iii & iv of 5.1.2 (design criteria)

iii. Fresh water should be used for fire fighting purposes. In case sea water or treated effluent water is used for fire fighting purposes, the material of the pipe selected shall be suitable for the service.

iv. Storage reservoir (RCC) shall be in two equal interconnected compartments to facilitate cleaning and repairs. In case of steel tanks there shall be minimum two tanks and all the tanks shall be of equal height/depth to prevent any migration/overflow due to difference in height/depth. During maintenance of water tanks, availability of at least 50% of the water capacity shall be ensured.

v. Large natural reservoirs having water capacity exceeding 10 times the aggregate fire water requirement can be left unlined.

5.2.3 Fire water pumps

i. Fire water pumps having flooded suction shall be installed to meet the design fire water flow rate and head. If fire water is stored in underground tanks, an overhead water tank of sufficient capacity shall be provided for flooded suction and accounting for leakages in the network, if any. Pumps shall be provided with suitable sized strainers on suction and NRVs on discharge lines.

ii. The pumps shall be capable of discharging 150% of its rated discharge at a minimum of 65% of the rated head. The Shut-off head shall not exceed 120% of rated head for horizontal centrifugal pumps and 140% for vertical turbine pump.

iii. At least one standby fire water pump shall be provided up to 2 nos. of main pumps. For main pumps 3 nos. and above, minimum 2 nos. standby pumps of the same type, capacity & head as the main pumps shall be provided. Fire water pumps shall be of equal capacity and head.

iv. The fire water pump(s) including the standby pump(s) shall be of diesel engine driven type. Where electric supply is reliable, 50% of the pumps can be electric driven. The diesel engines shall be quick starting type with the help of push buttons located on or near the pumps or located at a remote location. Each engine shall have an independent fuel tank adequately sized for 6 hours continuous running of the pump. Fuel tank should be installed outside of fire pump house and shall have provision for venting. If tanks are located inside the pump house, the vent shall have provision for venting outside the pump house.

v. Fire water pumps & storage shall be located far away from the potential leak sources / tankage are and shall be at least 60 M (minimum) away from equipment or where hydrocarbons are handled or stored.

vi. Fire water pumps shall be exclusively used for fire fighting purpose only.

vii. Suction and discharge valves of fire water pumps shall be kept full open all the times.

viii. Jockey pump shall be provided for keeping the hydrant system /line pressurized at all times. The capacity of the pump shall be sufficient to maintain system pressure in the event of leakages from valves etc. Capacity of the jockey pump shall be 3% minimum and 5 % max of the designed fire water rate. Besides the main jockey pump the stand by pump of same capacity and type shall be provided.

ix. Auto cut-in / cut-off facility should be provided for jockey pumps to maintain the line pressure.

x. The fire water pumps shall be provided with auto start facility which shall function with pressure drop in hydrant line and specified logic even if initial pump does not start or having started, fails to build up the required pressure in the fire water ring main system the next pump shall start and so on.

xi. The fire hydrant system should be able to maintain a pressure of min 7 kg/cm^2 in the line at the farthest end.

5.2.4 Fire hydrant network

i. Looping: The fire water network shall be laid in closed loops as far as possible to ensure multi-directional flow in the system. Isolation valves shall be provided in the network to enable isolation of any section of the network without affecting the flow in the rest. The isolation

valves shall be located normally near the loop junctions. Additional valves shall be provided in the segments where the length of the segment exceeds 300 M.

ii. Fire hydrant ring main shall be laid above ground ensuring that:
   a. Pipe line shall be laid at a height of 300 mm to 400mm above finished ground level.
   b. The pipe support shall have only point contact. The mains shall be supported at regular intervals:
   c. For pipeline size less than 150 mm, support interval shall not exceed 3 mtrs.
   d. Pipe line size 150mm and above not exceeding 6 meters or design approved.
   e. The system for above ground portion shall be analysed for flexibility against thermal expansion and necessary expansion loops where called for shall be provided.

iii. Fire hydrant ring main may be laid underground at the following places:
   a. At road crossings.
   b. Places where above ground piping is likely to cause obstruction to operation and vehicle movement.
   c. Places where above ground piping is likely to get damaged mechanically.
   d. Where Frost conditions warrant and ambient temperature is likely to fall below zero deg. Centigrade underground piping at least 1 meter below the ground level should be provided. Alternatively, in such cases for above ground pipelines, water circulation to be carried out.

iv. Fire water ring main laid underground shall ensure the followings:
   a. Pipes made of composite material shall be laid underground
   b. The Ring main shall have at least one meter earth cushion in open ground, 1.5 m cushion under the road crossings and in case of crane movement area pipeline shall be protected with concrete/steel encasement as per design requirement and in case of rail crossing, provisions stipulated by Indian Railways shall be complied.
   c. The Ring main shall be suitably protected against soil corrosion by suitable coating/wrapping with or without cathodic protection.
   d. In case of poor soil conditions it may be necessary to provide concrete/ masonry supports under the pipe line.

v. Size of hydrant pipeline:
   a. The hydraulic analysis of network shall be done at the design time. Also whenever fire water demand increases due to addition of facilities or extensive extension of network, fresh hydraulic analysis shall be carried out.
   b. The velocity of water shall not exceed 5 meter per second in fire water ring main.
   c. Fire water ring main shall be sized for 120% of the design water flow rate. Design flow rates shall be distributed at nodal points to give the most realistic way of water requirements in an emergency. It may be necessary to assume several combinations of flow requirement for design of network.
   d. The stand post for hydrants and monitors shall be sized to meet the respective design water flow rates.

vi. General :
   a. Fire water mains shall not pass through buildings or dyke areas. In case of underground mains the isolation valves shall be located in RCC/brick masonry chamber of suitable size to facilitate operation during emergency & maintenance.
   b. Associated Sprinkler/foam riser/branch connections meant for storage tanks if applicable shall be taken directly to the outside of tank dyke and shall not pass through fire wall of any adjacent tanks.
   c. The riser connections shall be taken directly from the mains and provided with separate isolation valve outside of dyke. Suitable strainer shall be provided on sprinkler branch connection and shall be located outside of dyke.

5.2.5 Hydrant / monitors

i. Hydrants/ monitors shall be located considering various fire scenario at different sections of the premises to be protected and to give most effective service.

ii. At least one hydrant post shall be provided at every 30 mtrs of external wall measurement or perimeter of battery limit in case of high hazard areas. For non-hazardous area, they shall be

spaced at 45 mtrs. intervals. The horizontal range & coverage of hydrants with hose connections shall not be considered beyond 45 mtrs.

iii. Hydrants shall be located at a minimum distance of 15 mtrs. From the periphery of storage tank or equipment under protection. In case of buildings this distance shall not be less than 2 mtrs. and not more than 15 mtrs. from the face of building.

iv. Provision of hydrants within the building shall be provided in accordance with IS: 3844.

v. Hydrant/Monitors shall be located along road side berms for easy accessibility.

vi. Fixed water/water cum foam monitors on the network shall be provided with independent isolation valves and Double headed hydrants with two separate landing valves. Hydrants/Monitors shall be located with branch connection.

vii. Double headed hydrants and monitors on suitably sized stand post shall be used. All hydrant outlets/monitor isolation valves shall be situated at workable height of 1.2 meter above ground or hydrant/monitor operating platform level.

viii. Monitors shall be located to direct water on the object as well as to provide water shield to firemen approaching a fire. The requirement of monitors shall be established based on hazards involved and layout considerations.

ix. Hydrants and monitors shall not be installed inside the dyked areas. However, as an additional requirement, oscillating monitors shall be provided in inaccessible area within the dyke with isolation valve or ROV outside the tank farm.(In cases inter distances between tanks in a dyke and/or within dykes are not meeting the requirements).

x. TW/TT loading & unloading facilities shall be provided with alternate hydrant / water cum foam monitor of suitable capacity and size to ensure adequate coverage and located at a spacing of 30 M on both sides of the gantry.

xi. The hydrants & monitors shall be located at a minimum distance of 15 M from the hazard (e.g.TW & TT loading/unloading facilities) to be protected.

5.2.6 Material specifications

The materials used in fire water system shall be of approved type as indicated below:-

i. Pipes: Carbon Steel as per IS: 3589/IS: 1239/IS: 1978 or Composite Material or its equivalent for fresh water service. In case saline, brackish or treated effluent water is used, the fire water ring main of steel pipes, internally cement mortar lines or glass reinforced epoxy coated or pipes made of material suitable for the quality of water able to withstand the temperature and pressure shall be used. Alternately, pipes made of composite materials shall be used. The composite material to be used may be as per API 15LR/API 15HR / IS12709. In case composite pipes are used they shall be used underground.

ii. Isolation Valves: Gate valve or quick shut off type isolation valves made of Cast Steel having open/close indication shall be used. Other materials such as cupro-nickel for saline / brackish water can be used. The material of the valve shall be suitable for the service.

iii. Hydrants post:

   a. Stand post - Carbon Steel
   b. Outlet valves – Gunmetal / Aluminium / Stainless / Steel/Al-Zn Alloy

iv. Monitors / High Volume Long Range Water Cum Foam Monitors (HVLR) / Rim seal :

   a. Approved / listed by any of the international certifying agencies like UL, FM, VdS or LPC, BIS etc..
   b. The electrical or hydraulic remote control mechanism shall be in line with Hazardous Area Classification.

v. Fire Hoses:

Reinforced Rubber Lined Hose as per IS 636 (Type A) /Non-percolating Synthetic Hose (Type B) or Equivalent Standard.

vi. Painting:

a. Fire water mains, hydrant & monitor stand posts, risers of water spray system shall be painted with “Fire Red” paint as per of IS: 5.
b. Hose boxes, water monitors and hydrant outlets shall be painted with “Luminous Yellow” paint as per IS: 5.
c. Corrosion resistant paint shall be used in corrosion prone areas.

5.2.7 Fixed water spray system

i. Fixed water spray system is a fixed pipe system connected to a reliable source of water supply and equipped with water spray nozzles for specific water discharge and distribution over the surface of area to be protected. The piping system is connected to the hydrant system water supply through an automatically or manually actuated valve which initiates the flow of water. In case the system is manually actuated, the isolation valve shall be located outside the dyke for ease of access & operation.
ii. Spray nozzles shall be directed radially to the tank at a distance not exceeding 0.6 M from the tank surface.
iii. While calculating the water rates for spray application for cases other than tanks such as pump house and tank wagon gantry the area should be divided into suitable segments so that maximum water requirement can be optimized.
iv. For TW loading gantry, sprinklers shall be provided to ensure full surface coverage. Three largest segments shall be considered for water requirement.
v. For Tank Truck loading gantries specifically for those cases which have obstructions in water throw, sprinklers should be provided.
vi. The flow rate in the sprinkler system shall be either 1 lpm or 3 lpm depending upon whether tank is outside or within a distance of R+30 m from the tank on fire.

5.3 Foam protection system

5.3.1 Storage tank

5.3.1.1 Floating roof tank

For floating roof tank, foam shall be poured at the foam dam to blanket the roof seal. Features of foam system for floating roof tank protection shall be as follows:-

i. System shall be designed to create foam blanket on the burning surface in a reasonably short period.
ii. Foam shall be applied to the burning hazard continuously at a rate high enough to overcome the destructive effects of radiant heat.
iii. Foam makers/foam pourers shall be located not more than 24 M apart on the shell perimeter based on 600 mm foam dam height. The height of foam dam shall be at least 51 mm above the top of metallic secondary seal.

5.3.1.2 Fixed roof tank

Foam conveying system shall have same features as of floating roof tank excepting that a vapour seal chamber is required before the foam discharge outlet. Features of the foam system for fixed roof protection shall be as follows:

i. The vapour seal chamber shall be provided with an effective and durable seal, fragile under low pressure, to prevent entrance of vapour into the foam conveying piping system.
ii. Where two or more pourers are required these shall be equally spaced at the periphery of the tank and each discharge outlet shall be sized to deliver foam at approximately the same rate. Tanks should be provided with foam discharge outlets/pourers as indicated below :-

Tank diameter (In M)	Requirement of Foam Pourer (Min. Nos.) -
Above 18 & up to 20	2

Above 20 & up to 25	3
Above 25 & up to 30	4
Above 30 & up to 35	5
Above 35 & up to 40	6
Above 40 & up to 45	8
Above 45 & up to 50	10

In case foam pourers are provided on tanks having diameter up to 18 m, minimum 2 nos. foam pourers shall be provided.

5.3.1.3. Floating cum fixed roof tank

Protection facilities shall be provided as required for fixed roof tank.

5.3.1.4 Protection for dyke area /spill fire

i. Portable monitors/foam hose streams shall be provided for fighting fires in dyked area and spills.
ii. Additionally, Medium expansion foam generators shall be provided to arrest vapour cloud formation from spilled volatile hydrocarbons. Installation of medium expansion foam generator shall be as per following criteria:
    a. Class A tanks: 2 nos. Fixed type foam generators (minimum) for each tank dyke.
    b. Class B tanks: Two nos. portable foam generators (minimum) for each location.

5.3.2 Foam application

5.3.2.1 Application rate

The minimum delivery rate for primary protection based on the assumption that all the foam reaches the area being protected shall be as indicated below :-

i. For cone roof tanks containing liquid hydrocarbons, the foam solution delivery rate shall be at least 5 lpm/ sqm of liquid surface area of the tank to be protected. For floating roof tanks containing liquid hydrocarbons foam solution delivery rate shall be at least 12 lpm/ sqm of seal area with foam dam height of 600 mm of the tank to be protected.
ii. The height of foam dam shall be at least 51 mm above the top of metallic secondary seal.In the case of Floating roof tank roof sinking, the application rate shall be considered as 8.1 lpm/ sqm. In determining total solution flow requirements, potential foam losses from wind and other factors shall be considered.

5.3.2.2 Duration of foam discharge

The equipment shall be capable of providing primary protection at the specified delivery rates for the following minimum duration.

i. Tanks (fixed roof/floating roof) containing Class 'A' & 'B' -65 minutes.
ii. Where the system's primary purpose is for spill fire protection such as dyked area and non dyked area (TT/TW etc) - 30 minutes.

5.3.2.3 Water for foam making

Water quantity required for making foam solution depends on the percent concentration of foam Compound. Foams in normal use have a 1 to 6% proportioning ratio. However, foam supplier data shall be used for determining water requirement.

5.3.2.4 Foam quantity requirement

The foam quantity requirement shall be based on the following :

i. Foam solution application at the rate of 5 lpm/ sqm. for the liquid surface of the single largest cone roof tank.
ii. Foam solution application rate of 12 lpm/ sqm. of seal area of the single largest floating roof tank.
iii. Floating roof sinking case also shall be considered for foam compound requirement and storage. Application @ 8.1 lpm/sq.m by required Nos. HVLR of installed capacity. Min. aggregate foam storage shall be total of (i +ii) or iii) whichever is higher.
iv. In case of Aviation Fuelling Stations where aggregate product storage capacity is less than 1000 KL, foam quantity for spill fire protection of 30 minutes shall be made.

5.3.2.5 Foam compound storage

i. Foam compound should be stored as explained in IS-4989 or equivalent standard. Type of foam compound to be used can be protein, fluro-protein or AFFF. Alcohol Resistant Foam shall be used for handling methanol/ ethanol or furfural fires. Minimum 1000 litres of Alcohol Resistant Foam compound shall be maintained at the installation to handle methanol/ethanol or furfural fire.
ii. Shelf life of foam compound shall be taken from manufacturer's data. Foam compound shall be tested periodically as per OEM guidelines to ensure its quality and the deteriorated quantity replaced. The deteriorated foam compound can be used for fire training purposes.
iii. Care shall be taken to avoid mixture of two/more different grades / batches of foam in a foam storage tank. In such cases foam shall be tested on yearly basis to check its efficacy and record maintained.
iv. For details of type of tests & their periodicity, refer IS 4989 or equivalent Standard.
v. Quantity of foam compound as calculated in 5.3.4 should be stored in the Installation. At locations where cluster of OMC exists, foam requirement can be uniformly distributed at respective location. The stored quantity shall be made available to needy company in case of any emergency
vi. Foam may be stored either in storage tanks of fixed type or mounted on mobile trolleys.

5.4 Control room and computer room protection

i. Control room and computer room should be protected by Clean Agent Fire Extinguishing System.
ii. In order to minimize the exposure to Clean Agent Fire Extinguishing System, persons should be evacuated from the areas before the system comes into operation.
iii. Clean agent fire extinguishing system as per NFPA-2001 shall be provided for such protection system. Each hazard area to be protected by the protection system shall have an independent system. The time needed to obtain the gas for replacement to restore the systems shall be considered as a governing factor in determining the reserve supply needed. 100% standby containers shall be considered for each protected hazard. Storage containers shall be located as near as possible to hazard area but shall not be exposed to fire. Storage containers shall be carefully located so that they are not subjected to mechanical, chemical or other damage.
iv. All the components of the system shall be capable of withstanding heat of fire and severe weather conditions.

5.5 First aid fire fighting equipment

Portable Fire Extinguishers

i. All fire extinguishers shall conform to respective BIS or equivalent codes, viz. 9 Kg DCP Type (IS: 15683), 4.5/6, 8 Kg CO2 Type (IS: 2878) & 25/50/75 Kg DCP Type (IS: 10658) and bear ISI mark. BIS or Equivalent certificates of all extinguishers shall be maintained at the location.
ii. While selecting the Extinguisher, due consideration should be given to the factors like flow rate, discharge time and throw in line with IS: 2190 or equivalent.
iii. The Dry Chemical Powder used in extinguisher and carbon dioxide gas used as expelling agent shall be as per relevant BIS or Equivalent code.

iv. While selecting the dry chemical powder, due consideration should be given to the typical properties viz. Apparent Density (0.65 +/-0.05), Fire Rating (144B), Thermal Gravimetric Analysis (with decomposition at around 250oC) and foam compatibility.

v. Siliconised Potassium bicarbonate DCP powder (IS 4308:2003) / Mono-ammonium phosphate based DCP powder (IS: 14609) can also be used for recharging DCP fire extinguishers.

vi. Spare CO2 cartridges and DCP refills as required based on their shelf life should be maintained. However, minimum 10% of the total charge in the extinguishers should be maintained at the location.

vii. Portable fire extinguishers shall be located at convenient locations and are readily accessible and clearly visible at all times.

viii. The sand buckets shall have round bottom with bottom handle having 9 litre water capacity conforming to IS: 2546. The sand stored in bucket shall be fine and free from oil, water or rubbish.

ix. Rain protection of suitable design should be provided for all extinguishers & sand buckets.

x. The maximum running distance to locate an extinguisher shall not exceed 15 m.

xi. The extinguisher shall be installed in such a way that its top surface is not more than 1.5m above the floor/ground level.

5.6 Emergency trolley and emergency kit

i. A trolley containing Fire Proximity Suit, B. A. Set, Water Jel Blanket, Resuscitator, First Aid Box, Stretcher with blanket, Spare fire hoses, Special purpose nozzles, Foam branch pipes, Explosive meter, P. A. System shall be readily available at the location and positioned to have easy access to it during emergency situation.

ii. An emergency kit shall be provided consisting of safety items shall be readily available at the terminals. All the items of the kit shall be kept on a trolley specifically designed for the purpose.

5.7 Motorable arrangement for towing / carrying mobile fire fighting equipment such as Foam trolleys, Portable water-cum-foam monitors etc should be made and available on sharable basis.

5.8 Hydrocarbon detection and annunciation, dyke drain valve annunciation system and emergency shutdown logic.

5.8.1 Hydro carbon detection and annunciation system

Hydrocarbon detectors shall be installed near all potential leak source of class-A e.g. tank dykes, tank manifolds, pump house manifold etc. Hydrocarbon detector of proper type shall be selected and also shall be proof tested and shall be maintained in good condition.

i. General
   a. The best method of prevention of explosion is to avoid basic build up of Explosive Vapour concentration immediately on occurrence of leakage. This would require basically a reliable and continuous Hydro Carbon detection system with warning annunciation to alert the operating personnel to take timely corrective action.
   b. The Hydro Carbon Detection System shall provide early warning on build up of Vapour concentration below the LFL limits.

ii. Application
   a. Hydrocarbon (HC) detectors shall be installed near all potential leak sources of Class-A Petroleum products e.g tank dykes, tank manifolds and pump house manifold. These detectors shall be placed in a way that entire possible source of leaks and collection of products is continuously detected and alarm is set at 20% of lower explosive limit of Class-A.
   b. The detection control equipment should be provided in the control room and the field for continuous monitoring even during power failure.

iii. Power Supply:

The supply to the system shall be through a reliable on line uninterrupted power supply. (online UPS)

iv. Architecture Components : The main components shall be:
   a. Hydro Carbon Detectors.
   b. Field Transmission units / Signal scanners.
   c. Control system / PC
   d. Display
   e. Annunciation System etc
   f. Cables, hooters, repeater, Power Supplies etc.
   g. All the components installed in the hazardous area shall confirm to the Hazard Area Classification applicable and shall be certified by PESO / Authorized lab by the country of the origin.

v. Annunciation System
   a. Appropriate annunciation system shall be available to ensure that all the alarms generated, both, audio and visual are reported to the installation personnel at local and remote control panel. The alarms both, audio and visual can be repeated at additional location to ensure corrective action is taken.
   b. Hydro Carbon Detectors:
   c. The detectors shall be able to detect the presence of Hydro Carbon Vapours well below the LEL level.
   d. Any one or more in combination from the following types can be provided.
      i. Catalytic detectors
      ii. Infra-red detectors
      iii. Line / Path detectors.
   e. The system shall be available at all times.
   f. The control equipment should have data logging facilities to provide print outs of the history of the events with date and time of leakages.
   g. The control equipment should be able to generate at least two alarms at different levels of LEL concentration of Hydro Carbons.

vi. Inspection and Testing:
   a. Calibration of the detectors shall be done as per OEM recommendation or once in six month whichever is earlier.
   b. The drift in the sensitivity of the individual detectors shall be recorded in maintenance history log book during calibration and the detectors with abnormal or wide drift in sensitivity shall be rectified / replaced.
   c. Standard calibration kit must be available in the location for periodic performance test of hydrocarbon detectors.

5.8.2 Dyke Drain valve Annunciation system

i. All the dyke valves will be fitted with a proximity switch / sensor for indication of the position of the valve. The valves of the Dyke shall remain in closed position. In case any valve is open then Audio alarm and visual indication shall come at control panel for suitable corrective measures.

ii. In case of automated locations existing PLC can be used. However, where the locations are not automated a standalone system shall be provided.

5.8.2.1 Power Supply

The supply to the system shall be through a reliable on line uninterrupted power supply. (Online UPS)

i. Architecture Components

The main components shall be:

   a. Proximity Switches / Sensors.
   b. Field transmitter unit / Signal Scanners.

c. Control System / PC / TAS
d. Display
e. Annunciation System etc
f. Cables, hooters, Mimic, Power Supplies etc.

5.8.2.2 All the components installed in the hazardous area shall confirm to the Hazard Area Classification applicable and shall be certified by Central Institute of Mining and Fuel Research (CIMFR) /Petroleum and Explosive Safety Organization (PESO) / Authorized lab by the country of the origin.

5.8.2.3 Appropriate annunciation system shall be available to ensure that all the alarms generated, both, audio and visual are reported to the installation personnel at local and remote control panel on real time basis. The alarms both, audio and visual should be repeated at additional location to ensure corrective action is taken.

5.8.2.4 The control system shall be available at all times. The control equipment should have data logging facilities to provide print outs of the history of the events with date and time of open and close position of the valves.

5.8.2.5 Inspection and Testing

i. The system shall be checked by the safety officer on a daily basis.
ii. The system shall be thoroughly inspected every month by opening and closing the valves and verifying that the Audio Video alarms are generated at local and remote panel and records maintained.

5.8.3 Emergency shut Down (ESD) logic for Terminal Automation System (TAS):

The ESD for TAS enabled locations shall be provided in control room as well as at various strategic locations. ESD system shall be only through push buttons with wired connection.

i. Actuation / pressing of any ESD shall initiate following actions:
    a. Process Shutdown
    b. Power Shutdown
    c. Process Shutdown shall include the following:
        i. To stop loading pumps
        ii. Barrier gates to open
        iii. All ROSOVs and MOVs to close.
        iv. Tank lorry filling (TLF) / tank wagon filling (TWF) operations through the batch controllers to stop.
        v. Fire siren to blow.

ii. Power Shutdown shall initiate the following:

    a. Trip all the panels other than Emergency panel. The Emergency panel should host fire siren, bore wells, jockey pumps, critical High Mast tower lights outside the licensed area, security cabin, fire pump house, Critical lights in TLF, Admin block, MCC room and power to the control room/Automation system.
    b. There should be interlock between ESD for Process shut down and ESD for Power shut down so that full power shut down takes after a time lag required for closing the ROSOV / MOVs and full closure of valves shall be ensured. The time lag shall be location specific.
    c. At pipe line locations alarm signal shall be exchanged between the two control rooms so that necessary actions are taken by the operating personnel at both ends.

iii. Inspection and Testing:

The system shall be checked during each fire drill conducted with full system shut down and records shall be maintained.

5.9 Mock drills, Mutual aid

i. Instructions on the action to be taken in the event of fire should be pasted at each siren point and familiarity with these instructions ensured and recorded.
ii. Monthly fire drills considering various scenarios shall be conducted regularly with full involvement of all employees of the installation. The mock drill shall include the full shut down system activation once in six months.
iii. The offsite disaster mock drills shall be conducted periodically as per local statutory requirements.
iv. The company should approach and coordinate with the district authority for conducting “Offsite Mock Drills”.
v. The post drill analysis should be carried out & discussed emphasizing areas of improvements.
vi. The record of such drills should be maintained at the location.
vii. Mock drill scenarios shall include all probable scenarios and the key areas like tank Farm, Rim seal fire, Gantry, Pump House, Tank Wagon gantry etc., shall be covered at least once in six months.
viii. Security staff should be trained as first responders for fire fighting and rescue operation along with plant operating personnel through oil industry approved reputed institute.
ix. Installation shall have a ‘Mutual Aid' arrangement with nearby industries to pool in their resources during emergency.
x. Mutual Aid agreements shall be prepared and signed by all Mutual Aid members. Fresh agreement shall be made on expiry of 2 years or whenever there is change in the signatories to the agreement. Quarterly meeting of Mutual Aid members shall be conducted and the minutes shall be recorded. The minutes shall be reviewed in the subsequent meetings.

5.10 Fire emergency manual

i. A comprehensive ERDMP shall be developed in accordance to the Petroleum and Natural Gas Regulatory Board (Codes of Practices for Emergency Response and Disaster Management Plan (ERDMP)) Regulations, 2010. The copies of the ERDMP shall be available to all personnel in the installation.
ii. The key action points of this manual shall be displayed at strategic locations in the installation for ready reference.

5.11 Fire Protection system : Inspection and Testing

i. The fire protection equipment shall be kept in good working condition all the time.
ii. The fire protection system shall be periodically tested for proper functioning and logged for record and corrective actions.
iii. One officer shall be designated and made responsible for inspection, maintenance & testing of fire protection system.
iv. The responsibilities of each officer shall be clearly defined, explained and communicated to all concerned in writing for role clarity.

5.11.1 Fire water pumps

i. Every pump shall be test run for at least half an hour or as per OEM guidelines, whichever is higher twice a week at the rated head & flow.
ii. Each pump shall be checked, tested and its shut-off pressure observed once in a month.
iii. Each pump shall be checked & tested for its performance once in six months by opening required nos. of hydrants/monitors depending on the capacity of the pump to verify that the discharge pressure, flow & motor load are in conformity with the design parameters.
iv. Each pump shall be test run continuously for 4 hours at its rated head & flow using circulation line of fire water storage tanks and observations logged once a year.
v. The testing of standby jockey pump, if provided shall be checked weekly. Frequent starts & stops of the pump indicate that there are water leaks in the system which should be attended to promptly.

5.11.2 Fire water ring mains

i. The ring main shall be checked for leaks once in a year by operating one or more pumps & keeping the hydrant points closed to get the maximum pressure.
ii. The ring mains, hydrant, monitor & water spray header valves shall be visually inspected for any missing accessories, defects, damage and corrosion every month and records maintained.
iii. All valves on the ring mains, hydrants, monitors & water spray headers shall be checked for leaks, smooth operation and lubricated once in a month.

5.11.3 Fire water spray system

i. Water spray system shall be tested for performance i.e. its effectiveness & coverage once in six months.
ii. Spray nozzles shall be inspected for proper orientation, corrosion and cleaned, if necessary at least once a year.
iii. The strainers provided in the water spray system shall be cleaned once in a quarter and records maintained.

5.11.4 Fixed / semi fixed foam system

Fixed/Semi fixed foam system on storage tanks should be tested once in six months. This shall include the testing of foam maker/chamber. The foam maker/chamber should be designed suitably to facilitate discharge of foam outside the cone roof tank. After testing foam system, piping should be flushed with water.

5.11.5 Clean agent system

Clean agent fire extinguishing system should be checked as under:-

i. Agent quantity and pressure of refillable containers shall be checked once every six month.
ii. The complete system should be inspected for proper operation once every year (Refer latest NFPA 2001 for details of inspection of various systems.

5.11.6 Hoses

Fire hoses shall be hydraulically tested once in six months to a water pressure as specified in relevant IS/UL/equivalent codes.

5.11.7 Communication system

Electric and hand operated fire sirens should be tested for their maximum audible range once a week.

5.11.8 Fire water tank/reservoir

i. Above ground fire water tanks should be inspected externally & internally.
ii. The water reservoir shall be emptied out & cleaned once in 3 years. However, floating leaves, material or algae, if any shall be removed once in 6 months or as & when required.

5.11.9 Fire extinguishers

Inspection, testing frequency and procedure should be in line with design standard.

6.0 MAINTENANCE AND INSPECTION

Each facility shall have a documented operating manual including operations, maintenance, training procedures, purging and record keeping based on experience and conditions under which the Petroleum Installation is operated, and a documented maintenance manual.

Each facility shall have written operating, maintenance, and training procedures based on experience, knowledge of similar facilities, and conditions under which they will be operated.

6.1 Basic Requirements

Each facility shall meet the following requirements:

i. Have written procedures covering operation, maintenance, and training.
ii. Keep up-to-date drawings of plant equipment, showing all revisions made after installation.
iii. Revise the plans and procedures as operating conditions or facility equipment require.
iv. Establish a written emergency plan.
v. Establish liaison with appropriate local authorities such as police, fire department, or hospitals and inform them of the emergency plans and their role in emergency situations.
vi. Analyze and document all safety-related malfunctions and incidents for the purpose of determining their causes and preventing the possibility of recurrence.
vii. As per maintenance philosophy, the activities should be identified that would be contracted to third party contractors for maintenance and support.
viii. The activity supervisors shall be identified according to the level of supervision required.
ix. These supervisors are given safe supervisor training by designated staff and then they are put on the job.
x. The contractors staff shall be engaged in toolbox talk given on relevant topics are held with the Contract holders and owners.
xi. OEM service engineers are involved in critical overhauls for better quality assurance and for first time activities.

6.2 The operating manual for petroleum storage, handling and loading / unloading facilities shall include standard operating procedures shall include procedures for the following:

i. Bulk handling, bottling operations, maintenance, inspection, fire protection facilities
ii. Determining the existence of any abnormal conditions, and the response to these conditions in the plant.
iii. The safe transfer of petroleum including prevention of overfilling of vessels
iv. For the proper startup and shutdown of all components
v. To ensure that each control system is adjusted to operate within its design limits
vi. For monitoring operations.
vii. Emergency preparedness and handling

6.3 The operating procedures manual shall be accessible to all plant personnel and shall be kept readily available in the operating control room. The operating manual shall be updated when there are changes in equipment or procedures. All petroleum plant components shall be operated in accordance with the standard operating procedures as per operating manual.

6.4 The periodic inspections and tests shall be carried out in accordance with generally accepted engineering practice / recommendations of Original Equipment Manufacturer to ensure that each component is in good operating condition.

6.5 Each facility operator shall ensure that when a component is served by a single safety device only and the safety device is taken out of service for maintenance or repair, the component is also taken out of service.

6.6 It shall be ensured that where the operation of a component that is taken out of service could cause a hazardous condition, a tag bearing the words “Do Not Operate,” or the equivalent thereto, is attached to the controls of the component. Wherever possible, the component shall be locked out.

6.7 Stop valves for isolating pressure shall be locked or sealed open. These shall not be operated except by an authorized person.

7.0 Maintenance Manual

7.1 Each facility operator shall prepare a written manual that sets out an inspection and maintenance program for each component that is used in its facility.

7.2 The maintenance manual for facility components shall include the following:

i. The manner of carrying out and the frequency of the inspections and tests as specified.
ii. All procedures to be followed during repairs on a component that is operating while it is being repaired to ensure the safety of persons and property at the facility
iii. Each entity shall conduct its maintenance program in accordance with its written manual for facility components.

In addition, the history card of all critical equipments, instruments and systems shall be maintained.

7.3 Maintenance Workflow

i. The objective of the work flow is to provide an integrated proactive and reactive work plan so that repair work is minimized and reliability and availability are optimized. Maintenance execution begins with the receipt of a work request and concludes with the close out of the work order.
ii. Correct prioritization of work and proactively preparing activities through high quality work preparation, combined with accurate scheduling, will lead to a more stable work environment. This will reduce deferments and breakdowns, improve integrity and safety, and provide additional job satisfaction and ownership to technicians.
iii. The management and control of day-to-day maintenance on all process units and utilities of a site is to provide:

    a) Support for a maintenance strategy based on doing programmed maintenance on time
    b) Safe, healthy and environmentally sound execution of maintenance work,
    c) Availability of equipment
    d) Business efficiency

iv. The designated person for issue of work permit shall verify the execution of preparation activities before issue of the work permit.
v. Maintenance work shall be undertaken in accordance with work permit requirements.
vi. Inspection personnel should be notified on time at which moment witness or hold points set.
vii. A verification of the HSE requirements should be carried as the maintenance execution includes HSE review and a toolbox talk as outlined in the work permit or work pack.
viii. The maintenance supervisor should ensure that a toolbox talk is held before work commences.
ix. Upon completion of the job, the job site should be left safe, clean and tidy. Any excess materials should be returned to the stores and tools should be cleaned and returned to the workshop or put away in the correct storage place.

x. On a daily basis, the progress of work should be reported. If the work is not completed, it should continue the next working day after taking requisite permission and approval from work permit issuing personnel.

xi. The work permit duly signed shall be returned to issuing authority on completion of job, removal of all material from site and handing over of facilities to user etc.

7.4 Maintenance Strategy

i. The facilities should be designed for minimum maintenance intervention.

ii. These maintenance requirements should be clearly defined and further optimized based on maintenance strategy reviews using tools such as reliability centred maintenance, Risk Based Inspection and Risk Assessment Matrix (RAM), after detailed equipment specifications are known.

iii. The criticality of the equipment shall be taken into account during the maintenance strategy selection.

iv. Appropriate diagnostic tools and staff competencies shall be provided to facilitate rapid fault finding and rectification and also to provide opportunistic maintenance during outages.

v. Maintenance strategies shall maximize non-intrusive & on line data acquisition to support planning & analysis.

vi. Special Critical Equipments shall have OEM defined performance standards which shall be periodically tested and verified.

vii. Structural and pipeline survey and painting shall be done on a regular basis.

7.5 The entity shall prepare a written plan for preventive maintenance covering the scope, resources, periodicity etc. The corrective measures should include the preventive maintenance, scheduling, execution and closure.

7.6 Each facility should have well defined system for identification of spare part, rationalization and optimization to minimize any supply chain/logistics constraints & risks.

7.7 Well defined Roles & Responsibilities matrix should be available made for each machine as well as activity to be carried out in the workshop. The procedure for Audits and Review of the workshop shall be documented and adhered to.

8.0 Inspection

i. Each facility shall have written inspection, testing and commissioning program in place. Inspection shall include before commissioning during installation as well as during regular operation of the Petroleum Installation.

ii. All documents related to design, installation procedure of the respective vendors and the manufacturer's instruction for pre-commissioning and commissioning of the equipment, systems, instruments, control systems etc. shall be properly stored and followed.

iii. Inspection shall cover the review of test protocols and acceptance criteria that these are in accordance with the protocols and acceptance criteria specified in line with OEM specific requirements

iv. Inspection shall cover that the equipment is installed in accordance with design, and any deviations documented and approved.

v. All safety systems are installed inspected and tested as per design /OEM requirement.

vi. Inspection shall cover that all safety devices are installed and are in working condition as per the design/ OEM requirements.

vii. Inspection shall cover the verification of various safety interlocks, ESD provided in the design.

viii. Inspection shall cover the adequacy of sealing systems.

ix. Inspection shall cover the electrical systems, check its integrity, earthing resistance, bonding etc.

x. Inspection shall cover the integrity of mechanical and rotating equipment.

xi. The integrity and efficacy of gas detection, fire protection and fighting system, connected equipments shall be covered in the inspection.

xii. Inspection shall cover the efficacy of corrosion system.

xiii. Inspection shall cover and review the mechanical completion records that the PSVs are of the correct type and sizing as per the P&IDs/data sheets.

xiv. Inspection shall cover location of inlet pipe-work to relieving devices in relation to potential restrictions (e.g. above liquid levels, vessel internals, etc.)

xv. Inspection shall cover and review P&IDs to check the position of isolation valves for relieving devices, their capacities. Inspection to confirm by review of all vent locations (atmospheric vent from drums or equipment seals) that they vent to safe location and in the event of liquid carry over will not discharge to areas that may cause a hazard to personnel.

xvi. Inspection shall review the area classification layouts and associated studies to confirm that all possible hazards have been appropriately considered (including possible migration), the hazardous area drawings correctly account for the actual location of the sources of release the hazardous areas have been appropriately defined.

xvii. Inspection shall cover that all ESD devices move to their safe condition on loss of system output, hydraulic power or instrument air. All ESD Valves and actuators shall remain functional following an explosion or under fire conditions for a sufficient time period to perform their intended function.

xviii. The maximum allowable back pressure and minimum design temperature of the relief system shall be checked for suitability for the highest identified flow rate.

xix. Control System shall include all status monitoring and actions to and from the Control Rooms.

xx. Inspection to cover the escape and evacuation passages.

xxi. Inspection shall cover the emergency communication system for its effectiveness during emergency situations.

8.1 INSPECTION OF FLOATING DECK OF INTERNAL FLOATING ROOF TANK

8.1.1 Inspection of Deck without entering the Tank From Top for Mild Steel Deck as well as Aluminium Deck

The Floating Deck inspection of IFR tank should be done through inspection hatches provided on the fixed roof without entering the tank.

i. In Typical Internal Floating Roof tank with MS Roof, following appurtenances are provided to enable inspection of floating deck, without the need of entering on floating deck from Tank top.
   a. Minimum four nos. circulation cum Inspection Hatch
   b. Two Manholes
   c. Entry Hatch Cover

ii. Inspection shall be planned when the product level in tank is near to maximum allowable filling height. Ensure that tank is in DORMANT (No Receipt/ No Dispatch) mode.

iii. Inspection shall be carried out in the presence of supervising officer.

iv. Ensure usage of FLP torch for adequate illumination & safety harness to avoid falling/ tripping.

v. Open all the circulation/ Inspection hatch covers. Decision on opening fixed roof Manhole covers shall be taken on need basis.

vi. Inspection of the Floating deck top surface/ rim seal condition shall be done through open circulation cum inspection Hatches.

vii. Note all the observations by carefully inspecting the floating deck area from each inspection hatch & manhole covers.

viii. Once the Inspection is complete, ensure to close & lock all the inspection hatches as well as the manhole covers.

ix. Specific note regarding closing of all the hatch covers & manholes shall be mentioned in the inspection checklist.

8.1.2 Inspection of Deck by entering on Floating Deck from Tank Top for Mild Steel Deck

If the entry on the floating Deck of IFR is unavoidable, following pre-qualifying conditions & SOP shall be ensured.

i. Pre-Qualifying Conditions

a. No accumulation of Product on the Floating Deck.
b. No visible tilting of the Floating Deck
c. No Damage to the access ladder

ii. Standard Operating Procedures for access to Floating Deck

i. All the permit conditions for confined space entry are complied.
ii. Confined space atmosphere shall be tested using properly calibrated equipment.
   a. Oxygen less than 19.5% can cause asphyxiation.
   b. Use proper ventilation. Ventilate with air flow away from workers to maintain oxygen content between 19.5-23.5%.
   c. Ensure that Hydrocarbon contents are checked using Explosive meter & it should be below the LEL.
   d. Though presence of CO and H_2S is not envisaged, its maximum allowable limit is 35 ppm and 10 ppm respectively.
iii. Plan inspection when the product dip level in tank is near to maximum allowed filling height.
iv. Put the Tank under inspection in DORMANT mode throughout the inspection, till all the inspection personnel are out of the tank & clearance given by supervisor in writing.
v. Inspection shall be carried out in the presence of supervising officer, who will be on the top of the fixed roof. Always inspect the deck with two medically fit personnel.
vi. Open all the Inspection hatch covers including those mounted on the Circulation vents, manhole covers at least two hours before the planned inspection to ensure enough ventilation of fresh air in the tank.
vii. Secure the full body safety harness line of the person entering the Tank from top.
viii. Ensure to wear all the necessary PPEs viz., Full body safety harness with two life lines, safety shoes, safety helmet, SCBA and other as applicable.
ix. Carry Flame-proof torch for proper inspection.
x. Gradually enter the tank using the access ladder.
xi. Inspect the Floating deck areas as per checklist.
xii. Maintain two-way communication through an intrinsically safe VHF set between entrants and supervisor (on Fixed roof Top).
xiii. Supervisor shall monitor the oxygen level inside the confined space for adequacy.
xiv. Complete the planned inspection.
xv. Inspecting Persons shall come out from the access ladder carefully.
xvi. Remove all inspection tools.
xvii. Once the Inspection is complete, ensure to close & lock all the inspection hatches as well as the manhole covers.
xviii. Head count has to be carried out by the site supervisor & recorded.
xix. Specific note regarding closing of all the hatch covers & manholes shall be mentioned in the inspection checklist.

8.1.3 Inspection of Aluminium Floating Deck

i. During In service condition of tank, inspection of aluminium deck by entering on the deck should not carried out.
ii. If any problem is observed on the deck while carrying out inspection from top of Fixed roof, the tank shall be taken out of service for carrying out repairs.

8.1.4 General Precautions

i. Entry into confined space to be avoided during adverse weather conditions like extreme heat conditions, thunderstorms, lightning etc.
ii. Ensure readiness of fire fighting facilities in case of any emergency.
iii. Establish and maintain proper communication system among the members throughout the operation.

9.0 COMPETENCE ASSURANCE AND ASSESSMENT

9.1 Every entity shall develop, implement, and maintain a written training plan to instruct all Petroleum installation personnel with respect to the following:

a. Carrying out the emergency procedures that relate to their duties at the petroleum installation as set out in the procedure manual and providing first aid
b. Permanent maintenance, operating, and supervisory personnel with respect to the following:

   i. The basic operations carried out at the petroleum installation
   ii. The characteristics and potential hazards of petroleum and other hazardous fluids involved in operating and maintaining the petroleum installation.
   iii. The methods of carrying out their duties of maintaining and operating the petroleum installation as set out in the manual of operating, maintenance and transfer procedures
   iv. Fire prevention, including familiarization with the fire control plan, fire fighting, the potential causes of fire, the types, sizes, and likely consequences of a fire at petroleum installation
   v. Recognizing situations when it is necessary for the person to obtain assistance in order to maintain the security of the petroleum installation.

9.2 Each entity shall develop, implement, and maintain a written plan to keep its personnel up-to-date on the function of the systems, fire prevention, and security at the petroleum installation.

9.3 The Refresher programs for training of all personnel shall be conducted an interval not exceeding 2 years to keep personnel updated on the knowledge and skills.

9.4 Every entity shall maintain a record for each employee that sets out the training given to the employee under this section.

9.5 Each entity shall ensure that petroleum installation personnel receive applicable training and have experience related to their assigned duties. Any person who has not completed the training or received experience shall be under the control of trained personnel.

9.6 For the design and fabrication of components, each entity shall use personnel who have demonstrated competence by training or experience in the design of comparable components and for fabrication who have demonstrated competence by training or experience in the fabrication of comparable components.

9.7 Supervisors and other personnel utilized for construction, installation, inspection, or testing must have demonstrated their capability to perform satisfactorily the assigned function by appropriate training in the methods and equipment to be used or related experience and accomplishments. Further their capability shall be assessed periodically.

9.8 Each entity shall utilize for operation or maintenance of components only those personnel who have demonstrated their capability to perform their assigned functions by successful completion of the training as specified an possess experience related to the assigned operation or maintenance function.

9.9 Corrosion control procedures including those for the design, installation, operation, and maintenance of cathodic protection systems, must be carried out by, or under the direction of, a person qualified by experience and training in corrosion control technology.

9.10 Personnel having security duties must be qualified to perform their assigned duties by successful completion of the training as specified.

9.11 Each entity shall follow a written plan to verify that personnel assigned operating, maintenance, security, or fire protection duties at the petroleum installation do not have any physical condition that would impair performance of their assigned duties. The plan must be designed to detect both readily observable disorders, such as physical handicaps or injury, and conditions requiring professional examination for discovery.

9.12 Operations and Maintenance training

Each entity shall provide and implement a written plan of initial training to instruct :

9.12.1 All permanent maintenance, operating, and supervisory personnel :-

i. about the characteristics and hazards flammable fluids used or handled at the facility, including, flammability of mixtures with air, odorless vapour, boil off characteristics, and reaction to water and water spray;
ii. about the potential hazards involved in operating and maintenance activities; and
iii. to carry out aspects of the operating and maintenance procedures that relate to their assigned functions;

9.12.2 All personnel of petroleum installation shall be trained to carry out the emergency procedures that relate to their assigned functions; and to give first-aid;

9.12.3 All operating and appropriate supervisory personnel of petroleum installation shall be trained to understand detailed instructions on the facility operations, including controls, functions, and operating procedure.

9.13 Security Training

Personnel responsible for security at petroleum installation must be trained in accordance with a written plan of initial instruction to:

i. Recognize breaches of security;
ii. Carry out the security procedures that relate to their assigned duties;
iii. Be familiar with basic plant operations and emergency procedures, as necessary to effectively perform their assigned duties; and
iv. Recognize conditions where security assistance is needed.

9.14 Fire Protection and Fighting Training

All personnel including officers, operators, security, T/T drivers & contract workmen, clericals who are likely to be present/working in the petroleum installation shall be trained in accordance with a written plan of initial instruction, including plant fire drills, to:

i. Know and follow the fire prevention procedures as specified
ii. Know the potential causes and areas of fire determined
iii. Know the types, sizes, and predictable consequences of fire determined and
iv. Know and be able to perform their assigned fire control duties according to the procedures and by proper use of equipment provided.
v. Each employee shall undergo a refresher course once in every three years after initial training.
vi. Every employee or authorized person of contractor working in the installation shall be familiarized with fire siren codes and the location of fire siren operating switch nearest to his place of work.

9.15 Training Records

Each entity shall maintain a system of records which —

i. Provide evidence that the training programs required by this subpart have been implemented; and
ii. Provide evidence that personnel have undergone and satisfactorily completed the required training programs.
iii. Records must be maintained for one year after personnel are no longer assigned duties at the petroleum installation.

10.0 Vehicle Management System

The transportation management document shall describe the procedures for effective day-to-day management of Road Transport. These shall include driver selection, recruitment and training, health screening, working hours and other terms and conditions.

10.1 Driver Management

In selection and training of drivers the following should be ensured :-

10.1.1 Qualification of driver

i. The driver shall hold a valid driving license for type of vehicle to be driven and shall be authorized to drive vehicles carrying specific class of product under local Dangerous Goods regulations
ii. Age not less than 25 years with minimum of 3 years' experience of driving vehicles for which he or she is licensed to drive.
iii. Can demonstrate knowledge of local road or highway regulations.
iv. Is able to read and write in local language and comply with local legal regulations in terms of qualifications and requirements.
v. Competence assessment of the driver should be carried out by a company-approved driving examiner with on-road test.

10.1.2 Training and communications

i. Driver must have completed induction training on company rules, emergency response procedures.
ii. Attended defensive driving course within last two years.
iii. Driver has undergone training on first aid procedures.
iv. Completed necessary training as per hazardous good transportation procedures
v. Driver should attend regular tool box meeting , safety meetings.
vi. Driver should attend daily/trip wise counselling on journey management.

10.2 Journey Management

10.2.1 Journey management plans and controls must have following elements:

i. Routes between supply point and major destination shall be drawn up using effective journey management system in order to avoid unsuitable roads and congested areas as far as practicable.
ii. Journey time shall be established for such routes and rest and reporting points designated on the long routes which exceed normal driver shift time.
iii. Resting points where suitable accommodation is available to be designated by management.
iv. Competent person supervise the journey management plan and procedures.
v. System to be in place for deployment of emergency response procedures.
vi. Known en-route hazards , such as steep gradients , narrow bridges , poor road surface to be identified and recorded in the journey management plan.
vii. Route hazards maps to be produced and made available to drivers.
viii. Trip time and other special route hazard information to be given to driver with customer invoice paperwork.

10.2.2 Driving and duty hours

i. Comply to legal requirements if any Irrespective of any limits specified below, the drivers must not drive or be requested to drive when feeling tired and effective fatigue management procedures should be in place

ii. The continuous driving shall not exceed three hours. It should be followed by minimum 15 minutes rest. The rest must be taken on continuous block and either away from vehicle or, if taken in a sleeper cab , while vehicle shall be stationary.
iii. Tachograph or in vehicle monitoring system to be fitted for vehicles

10.3 Vehicle Management

All vehicles shall comply with local legal requirements and respective company standards. These shall be designed and equipped for local environments and intended range of operation.

i. The tank truck shall be visually “well maintained “and capable of meeting basic safety inspection consistent with safe maneuvering at low speeds within confines of loading or delivery location. The inspection includes brake operation and tyre inspection.(tie having a visible tread pattern and no obvious damage)
ii. Three point inertia reel seat belts to be fitted for crew.
iii. The tank truck shall be fitted with an external engine cut-off device.
iv. The tank truck shall be fitted with audible reversing alarm.
v. The tank truck operating in Zone 1 area must have vapor proof electrics, be fitted with master switch external to cab and have Bonding system (compatible with loading rack facilities).
vi. The tank truck should have product tank with an internal valve to prevent product leakage if an external outlet valve is damaged.
vii. The tank truck shall have an exhaust system adequately shielded from direct contact with fuel from overfilled tanks leaks
viii. The tank truck shall have overfill protection system (compatible with loading rack facilities)
ix. The tank trucks shall be loaded and operated within maximum permissible gross weight and in accordance with national regulation and approved limits by RTO for both rigid chasis and trailer body.
x. Trailer tank to be fitted with overturn protection that gives effective protection to man lids in the event of vehicle roll-overs
xi. Tank top safety rail or harness system to prevent driver from falling when/if working on tank top.
xii. In case of bulk fuel tankers, a spill kit capable of dealing with small spills.i.e. <10 liters.
xiii. In case of Dangerous Goods , HGVs to be fitted with at least three number of dry powder fire extinguisher two of which are easily accessible on either side of tank and third in the driver`s cab (size 9kg for external and 2kg for cab extinguisher).Co2 is an acceptable alternative for can extinguisher.

11.0 Safety Management System

11.1 The organization should establish a safety management system which shall be an integral part of the overall management system. Safety Management System (SMS) should be based on PDCA (Plan, Do, Check and Act) cycle which comprises of:

i. Policy setting – includes policy, corporate acceptance of responsibility, objectives, requirements, strategies;
ii. Organization – includes structure, accountability and safety culture, involvement of the workforce, systems for performing risk assessment;
iii. Planning and execution – includes operational standards and procedures for controlling risks, permit to work, competence and training, selection & control over contractors, management of change, planning & control for emergencies and occupational health;
iv. Measuring and evaluating – includes active monitoring, recording and investigation of incidents / accidents, auditing, handling of non-conformities;
v. Continuous improvement – includes review and application of the lessons learnt. Safety management system should not degenerate into a paper exercise only, conducted solely to meet regulatory requirements.

11.2 Elements of Safety Management system

Safety management system should include at least the following basic elements:

i. **Safety Organization**- Leadership and Management Commitment should be clearly visible in the SMS. Management should develop and endorse a written description of the company's safety and environmental policies and organizational structure that define responsibilities, authorities, and lines of communication required to implement the management program. Management should review the safety and environmental management program to determine if it continues to be suitable, adequate and effective at predetermined frequency. The management review should address the possible need for changes to policy, objectives, and other elements of the program in light of program audit results, changing circumstances and the commitment to continual improvement. Observations, conclusions and recommendations of management review should be documented.

ii. **Safety Information**- Comprehensive safety and environmental information for the facility, which include documentation on process, mechanical and facility design, should be developed and maintained throughout the life of the facility.

iii. **Process Hazard Analysis**- The purpose of Process Hazard Analysis (PHA) is to minimise the likelihood of the occurrence and the consequences of a dangerous substance release by identifying, evaluating and controlling the events that could lead to the release. Process hazards analysis should be performed for any facility to identify, evaluate, and reduce the likelihood and/or minimize the consequences of uncontrolled releases and other safety or environmental incidents. Human factors should also be considered in this analysis.

The process hazard analysis should be updated and revalidated by a team, having requisite back ground, at least every 5 years after the completion of initial process hazard analysis. Recommendations resulting from the PHA should be completed before start-up for a new process or facility, or modification in existing facility.

iv. **Operating Procedures**- Written down operating procedures shall be available describing tasks to be performed, data to be recorded, operating conditions to be maintained, samples to

be collected and safety & health precautions to be taken for safe operation. Operating procedures should be based on process safety information so that all known hazards are taken care of. The human factors associated with format, content, and intended use should be considered to minimize the likelihood of procedural error.

v. **Safe Work Practices** - The entity shall maintain procedures that address safe work practices to ensure the safe conduct of operating, maintenance, and emergency response activities and the control of materials that impact safety. These safe work practices may apply to multiple locations and will normally be in written form (safety manual, safety standards, work rules, etc.) but site-specific work practices shall be prepared and followed. In cases where an employee believes that following a procedure will cause an unsafe condition, one shall have authority to stop work and get permission to deviate. Deviations should be documented for future analysis.

vi. **Training-** The training program shall establish and implement programs so that all personnel including contractors are trained to work safely and are aware of environmental considerations, in accordance with their duties and responsibilities. Training shall address the operating procedures, the safe work practices, and the emergency response and control measures. Any change in facilities that requires new or modification of existing operating procedures may require training for the safe implementation of those procedures. Training should be provided by qualified instructors and documented.

vii. **Management of Change (MOC)** -There should be procedures to identify and control hazards associated with change and to maintain the accuracy of safety information. For each MOC, the operator shall identify the potential risks associated with the change and any required approvals prior to the introduction of such changes. The types of changes that a MOC procedure addresses shall include:

a. technical,
b. physical,
c. procedural, and
d. organizational.

This procedure shall consider permanent or temporary changes. The process shall incorporate planning for the effects of the change for each of these situations. These procedures should cover the following:

a. The process and mechanical design basis for the proposed change.
b. An analysis of the safety, health, and environmental considerations involved in the proposed change, including, as appropriate, a hazards analysis.
c. The necessary revisions of the operating procedures, safe work practices, and training program.
d. Communication of the proposed change and the consequences of that change to appropriate personnel. e. The necessary revisions of the safety and environmental information.
e. The duration of the change, if temporary.
f. Required authorizations to effect the change.

viii. **Contractors -**When selecting contractors, operators should obtain and evaluate information regarding a contractor's safety and environmental management policies and practices, and performance there under, and the contractor's procedures for selecting subcontractors. The entity shall communicate their safety and environmental management system expectations to contractors and identify any specific safety or environmental management requirements they have for contractors. Interfacing of SMS of various entities (operator, contractor / service

provider, subcontractor and third-party) should be ensured through a well written bridging document. Entity shall document the clear roles and responsibilities with its contractors.

ix. **Assurance of quality and mechanical integrity of critical equipment**- Procedures should in place and implemented so that critical equipment for any facility is designed, fabricated, installed, tested, inspected, monitored, and maintained in a manner consistent with appropriate service requirements, manufacturer's recommendations, or industry standards. Entity shall maintain inspection and testing procedures for safety-related equipment. Human factors should be considered, particularly regarding equipment accessibility for operation, maintenance and testing.

x. **Pre-startup Safety Review-**Before a new or modified unit is started, a systematic check should be made to ensure that the construction and equipment are in accordance with specifications; operating procedures have been reviewed; hazards analysis recommendations have been considered, addressed and implemented; and personnel have been trained. It should be ensured that programs to address management of change are in place.

xi. **Permit to Work (PTW) System-** PTW system is a formal written system used to control certain types of work which are identified as potentially hazardous. Essential features of permit-to-work systems are:

a. clear identification of who may authorize particular jobs (and any limits to their authority) and who is responsible for specifying the necessary precautions;
b. training and instruction in the issue, use and closure of permits;
c. monitoring and auditing to ensure that the system works as intended;
d. clear identification of the types of work considered hazardous;
e. clear and standardized identification of tasks, risk assessments, permitted task duration and supplemental or simultaneous activity and control measures.

xii. **Emergency Planning and Response-** A comprehensive Emergency Response and Disaster Management Plan (ERDMP) shall be developed in accordance to the Petroleum and Natural Gas Regulatory Board (Codes of Practices for Emergency Response and Disaster Management Plan (ERDMP)) Regulations, 2010. The copies of the ERDMP shall be maintained at each petroleum installation. The emergency response planning shall have clear written procedures for expected actions during anticipated emergencies. Emergency response plan shall include operational and procedural requirements for various emergency scenarios that are relevant for the installation.

a. The emergency procedures shall include, at a minimum, emergencies that are anticipated from an operating malfunction of any component of the petroleum storage, handling and transportation facilities, personnel error, forces of nature, and activities carried on adjacent to the facilities.

b. The emergency procedures shall include but not be limited to procedures for responding to controllable emergencies, including the following:
    i. The notifying of personnel
    ii. The use of equipment that is appropriate for handling of the emergency
    iii. The shutdown or isolation of various portions of the equipment
    iv. Other steps to ensure that the escape of gas or liquid is promptly cut off or reduced as much as possible

c. The emergency procedures shall include procedures for recognizing an uncontrollable emergency and for taking action to achieve the following:

i. Minimize harm to the personnel at the petroleum storage, handling and loading or unloading facilities and to the public
ii. Provide prompt notification of the emergency to the appropriate local officials, including the possible need to evacuate persons from the vicinity of petroleum installation.
iii. The emergency procedures shall include procedures for coordinating with local officials in the preparation of an emergency evacuation plan that sets forth the steps necessary to protect the public in the event of an emergency, including the following:
iv. Quantity and location of fire equipment throughout the petroleum installation.
v. Potential hazards at the petroleum installation.
vi. Communication and emergency-control capabilities at the petroleum installation.

xiii. **Incident Investigation and Analysis**- Procedures for investigation of all incidents as per the Petroleum and Natural Gas Regulatory Board (Codes of Practices for Emergency Response and Disaster Management Plan (ERDMP)) Regulations, 2010 shall be developed. Incident investigations should be initiated as promptly as possible, considering the necessity of securing the incident scene and protecting people and the environment. The intent of the investigation should be to learn from the incident and help prevent similar incidents. A corrective action program should be established based on the findings of the investigation to prevent recurrence.

xiv. **Compliance Audit**- Safety Audits are the periodic examination of the functioning of safety system. It gives an idea about how effectively the safety system is implemented and how they are being accomplished. It is the feed back mechanism that provides management with the status and measurement of effectiveness of the various safety system elements and activities and leads to the appropriate control over these efforts.

a. The audit program and procedures should cover:
   i. The activities and areas to be considered in audits
   ii. The frequency of audits
   iii. The audit team
   iv. How audits will be conducted
   v. Audit Reporting

b. The findings and conclusions of the audit should be provided to the management. Management should establish a system to determine and document the appropriate response to the findings and to assure satisfactory resolution. The audit report should be retained at least until the completion of the next audit.

Annexure 1 – List of Applicable Standards and References

Standard Number	Title of Standard
API STD 650	Welded Tanks for Oil Storage
API STD 620	Design and Construction of Large, Welded, Low-pressure Storage Tanks
API STD 2000	Venting Atmospheric and Low-Pressure Storage Tanks
API 5L	Specification for Line Pipe
API 15LR	Low Pressure Fiberglass Line Pipe
API 15HR	High-pressure Fiberglass Line Pipe
NFPA 2001	Standard on Clean Agent Fire Extinguishing Systems
NFPA 11	Standard for Low-, Medium-, and High-Expansion Foam
ASME B 31.3	Process Piping Guide
ASME B 31.4	Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids
ASME B 16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard
ASME B 16.11	Forged Fittings, Socket – Welding and Threaded
IS 12709	Installation of Glass Fibre Reinforced Plastic (GRP) Piping System Code of Practice
IS 5572	Classification of Hazardous Areas (Other Than Mines) Having Flammable Gases and Vapours for Electrical Installation
IS 11006	Flash Back Arrestor (Flame Arrestor)
IS 5571	Guide for Selection and installation of Electrical Equipment for Hazardous Areas (other than mines)
IS 10810	Methods of Test for Cables
IS 3043	Code of practice for earthing
IS 2309	Code of practice for the protection of buildings and allied structures against lightning
IS 3844	Code of Practice for Installation and Maintenance of Internal Fire Hydrants and Hose Reels on Premises
IS 636	Non-percolating flexible delivery hose for fire fighting
IS 1978	Specification for Line Pipe
IS 15683	Portable Fire Extinguishers-Performance and Construction–Specification
IS 10658	Specification for Higher Capacity Dry Powder Fire Extinguisher