

PETROLEUM AND NATURAL GAS REGULATORY BOARD

NOTIFICATION

New Delhi, the ..., 2022

G.S.R. ___--- In exercise of the powers conferred by Section 61 of the Petroleum and Natural Gas Regulatory Board Act, 2006 (19 of 2006), the Petroleum and Natural Gas Regulatory Board hereby makes the following regulations further to amend the Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Petroleum Installations) Regulations, 2020, 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) Amendment Regulations, 2022.
- (2) They shall come into force on the date of their publication in the official gazette.

2. In the Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Petroleum Installations) Regulations, 2020, -

- (i) in regulation 2, after sub-clause (m), the following shall be inserted: -

“(ma) “Fire station” means building/ housing facilities for parking fire tenders and keeping in readiness other fire-fighting equipment for meeting plant emergencies, fire control room with required communication facilities/mimic panel.

- (ii) in regulation 3, the following shall be substituted, namely: -

“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 will apply to petroleum installations with aggregate above ground storage capacity equal to or more than 1000 KL.”

- (iii) in regulation 4, for sub regulation (2), the following clause shall be substituted: -

“(2) These regulations cover 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 including Aviation Fueling Station (AFS) and Lube manufacturing and filling plants.”

- (iv) The regulation 6 shall be substituted, namely: -

“(1) The technical standards and specifications including safety standards (hereinafter referred to as standards) for Petroleum Installations including Aviation Fueling Station (AFS) or Aviation Service Facilities (ASF) and Lube manufacturing and filling plants are specified in Schedule- I which are as under –

- (a) Part A to Part I which covers layout, design, standard operating procedures, maintenance, inspection, competence assurance, fire protection, safety management plan and vehicle management system.
- (b) Part J for Aviation Fueling Station (AFS) or Aviation Service Facilities (ASF) which covers layout design, design considerations, safe operating practices in storage and handling of bulk aviation fuels, fire protection facilities and vehicle management system.

(c) Part K for Lube manufacturing and filling plants which covers lube plant layout design, design considerations, safe operating/ handling practices in lube plant operations, fire protection facilities, maintenance and inspection of equipment, and vehicle management system.”

(v) in regulation 8, for sub regulation (2), the words “or termination of authorization” shall be deleted.

(vi) in Schedule-1:

(a) in Clause 1.2.1, for sub-clause (3), the following shall be substituted, namely: -

“(3) In case, it is unavoidable to comply with inter distance requirements for control room from Product tanks / Tank Lorry Filling (TLF)/Tank Wagon (TW) gantry/ Unloading area/other hazardous equipment, then, the control room shall be made blast resistant;”

(b) in Clause 1.2.1, for sub-clause (4), the following shall be substituted, namely: -

“(4) 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 or installation is located. Provided this clause is not applicable for existing locations with separate control rooms having facility for real time exchange of signal and data sharing.”

(c) in Clause 1.2.2.1, for sub clause (3) (iv), the following shall be substituted, namely: -

“(iv) Dyke enclosure (entire area of the dyke) shall have impervious layer of suitable material such as EPDM (ethylene propylene di-monomer) liner or polyethylene sheet to prevent the ground water contamination in addition to brick or stone pitching PCC and other similar materials. For existing facilities, imperviousness should be ensured using a suitable technology;”

(d) in Clause 1.2.2.5 –

(ca) for sub clause (3), the following shall be substituted, namely: -

“(3) There shall be a pathway along the inside perimeter of the boundary wall for security patrolling. Security watch tower (if provided) shall have clear access;”

(cb) after sub-clause (7)(iv), the following shall be inserted, namely: -

“(v) For existing locations, wherever the parking area is inadequate due to space constraint, remote parking for empty Tank Trucks (TT) should be provided at designated place. In case remote parking for empty TTs are not feasible due to space constraint, proper monitoring of vehicle parking / movement shall be ensured in liaison with local administration. Such remote parking for empty TTs shall be covered under ERDMP of the installation.”

(e) in Clause 1.2.2.7, for TABLE-1, the following note shall be inserted below the table, namely: -

“Distance of product pump house (loading/unloading) from utilities and electrical sub-station shall be 30mtrs.”

(f) in Clause 2.6, sub-clause (1), after the words “sparkling material) and”, the words “should be” shall be inserted.

(g) in Clause 2.9.2, for sub-clause (2), the following shall be substituted, namely: -

“(2) 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. Further, adequate measures should be taken to avoid accumulation of static charge in case of loading low sulphur or low conductivity petroleum products;”

(h) in Clause 2.9.2, for sub-clause (14), the following shall be substituted, namely: -

“(14) Tank Truck loading gantries shall be provided with safety harness to protect the operating crew against fall from height. Integrity check of anchoring point with gantry should be conducted prior to installation of harness and at periodical intervals.”

(i) in Clause 2.9.2, for sub-clause (15), the following shall be substituted, namely: -

“(15) Loading ladders to have hand railings and shall be light in construction. Neoprene packing shall be provided at the bottom rest to avoid spark generation due to impact;”

(j) in Clause 2.9.2, for sub-clause (26), the following shall be substituted, namely: -

“(26) For placement, brake van or dummy wagons shall be used. Separate segregation gate shall be provided at terminating point and area between boundary wall and segregation gate shall be outside the Hazardous area;”

(k) in Clause 2.13, for the table in sub clause (10), the following table shall be substituted, namely:

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“

Sl. No.	Area	Lux Level
1	Main roads (Gate entry or exit, roads around TT gantry	20
2	Secondary roads (along storage tanks and Periphery and like other places)	10
3	Tank farm area	20
4	Pump or Compressor or Dosing Sheds or Fire Pump House	100
5	Main Operation Platforms and Access Stairs (TT and TW gantry, Tank manifold)	60
6	Ordinary Platforms	20
7	OWS or ETP Area	60
8	Sub Station or PMCC room	150
9	Transformer yard or HT Di pole area	100
10	Battery room, Charger or UPS rooms	100
11	Control Room building or laboratory	150
12	Lube Warehouse	100
13	Admin Building	200
14	Security Cabin or Watch Booth	100
15	Stairs	80
16	Corridors	70
17	Tank truck Parking area	40

”

(l) in Clause 3.1, for sub-clause (7), the following shall be substituted, namely: -

“(7) All operations shall be carried out under supervision of designated personnel. Periodic training and refresher needs should be given to such personnel;”

- (m) in Clause 3.1, sub-clause (9), after the words “or manholes)” and before the words “shall be”, the words “or work at height or any non-routine activity” shall be inserted.
- (n) in Clause 3.2, for sub-clause (36), the word “clear” shall be substituted by the word “clean”.
- (o) in Clause 3.3.2, for sub-clause (7), the word “moment” shall be substituted by the word “movement”.
- (p) for Clause 3.6, in the para heading “Ethanol Handling:”, after the words beginning with “In case ethanol...” and ending with “...Motor Gasoline”, the following shall be inserted, namely: -

“Adequate flame or heat detection mechanism shall be provided for detection of ethanol fires as ethanol burns with a flame which is not clearly visible in bright sun light. Alcohol Resistant foam shall be provided to fight ethanol fires. For fighting other fires including ethanol Blended MS, Aqueous Film Forming Foam (AFFF) can be used.”

- (q) in Clause 3.6.1, after sub-clause (15), the following shall be inserted, namely: -

“(16) Ethanol should be stored either in underground tanks or semi-buried tanks or above ground tanks. Above ground tanks for ethanol storage shall be of Internal Floating Roof Type or Cone Roof type. External Floating Roof tank or Internal Floating Roof tank with window opening on the shell shall not be used for ethanol storage.

(17) The bulk storage tanks for Ethanol service are exposed to severe steel corrosion. Therefore, these steel tanks face internal corrosion due to service medium as well as vapour. Adequate corrosion protection measures should be taken for ethanol service tanks.

(18) Fire fighting on fires related to Ethanol –

- (i) For spill of Ethanol at TLF gantry or during unloading of Ethanol TT alcohol resistant foam cover to be immediately spread over the spilled contents using portable Medium Expansion Foam Generator (MEFG) or appropriate equipment.
- (ii) For leak of Ethanol from gaskets in Pump House or in Tank farm, alcohol resistant foam cover to be immediately spread over the spilled contents using portable MEFG or appropriate equipments.
- (iii) If in Tank Farm, common HVLR is used for tanks storing MS/ Ethanol /Ethanol Blended MS, then, appropriate SOP for use of such HVLR for different fires shall be prepared, displayed and practiced in mock drills.
- (iv) Minimum two MEFG for each tank inside dyke area storing Ethanol / Ethanol Blended MS shall be provided. Separate Alcohol Resistant Foam feeding arrangement shall be made for such MEFGs. Appropriate SOP shall be prepared and displayed near the operating area.
- (v) Hydro Carbon Detection system as applicable for Ethanol shall be provided at all possible places of leak including isolation valve inside dyke and at sump near dyke drain valve.
- (vi) Foam pourer system as provided in Internal Floating Roof Vertical Tank (IFRVT) or in Cone Roof Vertical Tank (CRVT) for Ethanol service shall have dedicated provision for Alcohol Resistant Foam for fire-fighting.

- (vii) Inspection frequency: Internal inspection of ethanol tanks shall be done once in 5 years; External inspection shall be done visually six monthly and Ultrasonic Thickness testing shall be done once in 3 years.”
- (r) in Clause 5.3.2.5, for sub-clause (1), the following shall be substituted, namely: -
- “(1) 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 or ethanol fires. Minimum 1000 litres of Alcohol Resistant Foam compound shall be maintained at the installation to handle methanol or ethanol fire.”
- (s) in Clause 5.8.3, for sub-clause (3), the following shall be substituted, namely: -
- “(3) Inspection and Testing:
- The system shall be checked during mock drill conducted with full system shut down once in six months and records shall be maintained.”
- (t) in regulation 10.1.1, the sub-clause (2) shall be deleted.
- (u) in Clause 10.3, for sub-clause (7), the following shall be substituted, namely: -
- “(7) The tank truck or the loading arm meant for filling the tankers shall have overflow protection system (compatible with loading rack facilities);”
- (v) in Clause 10.3, for sub-clause (12), the following shall be substituted, namely: -
- “(12) In case of Dangerous Goods, Heavy Goods Vehicles (HGV) shall be fitted with at least One number of minimum 9 KG Dry Powder fire extinguisher on side of tank and 1 KG CO₂ Fire extinguisher in Tank Truck cabin.”
- (w) in Clause 11.12, after the words, “written system”, the words “(online or offline)” shall be inserted.
- (vii) in Schedule-1, after Part-I, the following shall be inserted, namely: -

“PART J:

(Aviation Fueling Station (AFS))

[See Regulation 6]

1.0 INTRODUCTION

The Aviation Fuelling Station (AFS) / Aviation Service Facilities (ASF) are generally located at the airports or near to the airport for both defence and civil categories. The purpose of this AFS / ASF is to store Aviation Fuel and carrying out refueling to the aircraft following technical standards and safety regulations. The refueling of aircraft is carried out through Refuelers or through Hydrant Refueling System (HRS) or through the barrels.

HRS includes an underground system of pipes and valves used to transfer aviation fuel directly from Aviation fuel storage facility to one or more designated aircraft parking positions. The system includes pumps, filters. Hydrant pits, Hydrant pit valves. The control of this HRS is located at the AFS.

2.0 APPLICABILITY

For Aviation Fuel Stations across the country falling under the scope of this regulation: Part A, Part B, Part C, Part E and Clause 10.1.1 of Part H (i.e., Qualification of Driver) will be superseded by Part J and remaining parts i.e., Part D, Part F, Part G, Part H, Part I will hold good except Clause 10.1.1 of Part H.

The clauses of this section of regulation are applicable for such Aviation Fuel Station / installation, where aggregate above ground storage capacity is equal to or more than 1000 KL

3.0 SCOPE

This regulation lays down minimum safety requirements in layout, design, fire protection system, hydrant refueling system and supply & handling of aviation product in barrels / packed conditions, keeping in view specific requirements for AFS and availability of a reliable fire fighting support from the airport operator.

4.0 LAYOUT DESIGN

(a) Design philosophy

Following philosophy should be adopted in layout of an Aviation Fuel Station:

- 1) Identify and size the facilities needed for receipt, storage and delivery of Class B (ATF) in bulk, based on the business & process requirements and with a provision for future expansion. Facilities for receipt, storage and dispensing of Class A (Av gas) shall be designed and segregated from ATF.
- 2) Physical segregation/demarcation of hazardous and non-hazardous areas shall be provided. Layout indicating hazardous and non-hazardous area segregation /demarcation shall be available. Hazardous area segregation/demarcation shall be as per latest BIS 5572:2009.
- 3) AFS facilities should be located based on the following:
 - (i) De-licensed area consisting of admin building, security cabin, utilities should be nearer to the entry/ exit gates to minimise movement of personnel in licensed premise.
 - (ii) TT unloading/refuellers loading area and refuellers parking shall be located in such a way that vehicular movement is minimised.
 - (iii) Facilities should be laid such that length of drain leading to OWS is minimal.
- 4) Risk Analysis / Assessment shall be carried out at the layout stage with an objective to arrive at any specific mitigation measures required for the Hazards identified. Risk reduction / mitigation measures shall be given due credit. The outcome of risk assessment shall guide in preparation of onsite & off-site emergency plan. Quantitative Risk Assessment (QRA) shall be done whenever 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.
- 5) Minimum two approaches from the major road should be provided, one for normal movement and another for emergency exit. Both these approaches should be available for receipt of assistance in emergency.
- 6) Roads inside the hazardous area of an AFS shall be restricted to vehicles required for operational, maintenance and safety/security reasons and are to be allowed only with proper safety fittings and authorization from location in-charge/designated safety officer /Shift Incharge.
- 7) 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.
- 8) The access of facility should be available from two approaches.
- 9) Layout should consider the space requirements for:
 - (i) Maintenance and inspection of each equipment / facility.
 - (ii) Dedicated area for construction activities.

- (iii) Future expansion for addition of facilities.
- (iv) Parking of refuellers/hydrant dispensers and other vehicles.
- (v) TT Parking area based on expected fleet size.

- 10) Vehicles with spark ignition engine shall not be allowed inside hazardous area. Vehicles with internal combustion engine (compression ignition) such as refuellers and tank truck required to be permitted for business shall have Petroleum and Explosives Safety Organization (PESO) approved spark arrestor fitted on the vehicle.
- 11) The maximum height of structure at the AFS shall not exceed the maximum permissible height specified by the local airport authority/operator.

(b) Layout of facilities

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

- 1) Storage tanks, utility requirements
- 2) Product receipt / dispatch and mode of transport (by Road & Pipeline)
- 3) Warehouses, DP Shed (for storing Avgas 100LL or Methanol) and other open storage areas like scrap yards
- 4) Chemical storage, hazardous waste storage / disposal facilities etc.
- 5) Service buildings and allied facilities
- 6) Site topography including elevation, slope and drainage
- 7) Seismic data and probability of tsunami in coastal areas
- 8) Highest flood level in the area, water table, natural streams/ canals
- 9) Approach roads for functional areas
- 10) Aviation considerations like height restrictions and distance from flight path
- 11) Environmental considerations
- 12) Statutory requirements, airport operator's requirements, local bye-laws etc.

(c) General consideration for the layout of the facility

While locating the various facilities the following should be considered:

- 1) Tank farm, loading / unloading gantry, utilities, and approach roads should be suitably constructed to prevent flooding.
- 2) Operations Control Room / SCADA/server 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.
- 3) The control room for Pipeline receipt (if applicable) can be co-located with the SCADA/server room for the AFS.
- 4) Utility block(s) shall be located outside the hazardous area.
- 5) Overhead power transmission lines shall not pass over the AFS including the tank truck parking areas. Horizontal clearance shall be in line with the Indian Electricity Rules.
- 6) High Tension (HT) line and HT sub-station(s) shall be terminated /located outside the hazardous area.
- 7) Tank truck/refuellers movement inside the AFS shall be kept to minimum and for this purpose the truck/refuellers 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/refuellers in the gantry shall be in drive out position for easy escape in case of emergency.
- 8) For AFSs with above ground product storage tank having capacity more than 1000 KL, drain shall be provided around the Tank farm, TT/Refuellers loading/unloading area to collect product due to accidental spill over / leakage and shall be routed to OWS/pits. The drains shall always be maintained clean.
- 9) Roads should be provided in a manner to the extent possible to serve all areas requiring

access for the operation, maintenance and firefighting.

- 10) Smoking booths shall not be provided inside an Aviation Fuel Station.
- 11) Firewater storage & firewater pump house, wherever applicable, 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.
- 12) The provision should be made to receive the water from other sources including mutual aid / sharing of water into fire water storage tanks.
- 13) All buildings which are not related to AFS 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 needs to be taken for canteen location where any spark or open flame is likely to exist.
- 14) Congestion inside the hazardous area because of buildings, structures, pipelines, trees etc. should not be allowed. The location of such addition of facilities in existing AFS shall be decided based on Risk Assessment.
- 15) Room for storing hydro carbon samples shall be provided with bottom exhaust for release of flammable vapours. Electrical fittings as well as electrical equipment shall be flame proof. Adequate no of fire extinguishers should be places wherever required.
- 16) Electrical equipment /fittings of type suitable for respective area classification (Zone-0,1,2) to be ensured. Electrical fittings as well as electrical equipment in hazardous areas shall be of approved type.
- 17) The additives shall be stored at the designated / segregated area as per respective Material Safety Data Sheet.
- 18) Unlicensed area shall be suitably demarcated by fencing.

(d) Dyked Enclosures:

- 1) Above ground ATF storage tanks shall be located in dyked enclosures. Facility shall be accessible from atleast two side. Aggregate capacity (combined safe capacity) of tanks located in one dyked enclosure shall not exceed 60,000 KL for a group of fixed roof tanks.
- 2) 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 minimum 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.
- 3) 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/supports/RCC rings as applicable.
 - iii. Volumes of fire break walls.
 - iv. Volume of pipes/supports/steps etc.
- 4) 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.
- 5) The dyke wall made up of earth, concrete or solid masonry shall be designed to withstand the hydrostatic load and shall be impervious.
- 6) Dyke enclosure area (inside area of the dyke) shall be also impervious to prevent the ground water pollution. 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. For existing facilities, imperviousness of dyke enclosure should be ensured using any suitable technology.
- 7) The dyke and the enclosures shall 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.
- 8) Pump stations and piping manifold should be located outside dyke areas.
- 9) Piping through dyke wall, if any, shall be properly sealed to make dyke impervious.
- 10) The dyke area shall have proper slope outward of tank pad towards the inner periphery of the dyke enclosure to prevent reverse flow.

- 11) 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 shall be displayed for reference.
- 12) Horizontal above ground tanks mounted on pedestals shall meet separation distances and shall have dyked enclosure.
- 13) Inter distance between dyke wall and tank shell shall be minimum half the height of the tank.
- 14) Construction of dyke exceeding 2 M may be considered where there is severe constraint on space availability, subject to approval of PESO. In such case, following conditions must be fulfilled:
 - i. Total dyke capacity shall be based on containment of largest tank capacity.
 - ii. Monitors on raised platforms shall be provided so that throw of the monitors are not restricted.
 - iii. All tanks in such a dyke shall be provided with sprinkler system for AFSs storing more than 1000 KL in above ground storage tanks.
 - iv. Suitable railing for fall protection to be provided at cross over in case of dyke height is more than 1.5 mtrs
- 15) In case of buried tanks - Under Ground (UG/buried) & Semi-buried (SB) tanks:
 - i. Semi-buried tanks are treated as underground storage tanks for calculation of inter-distance between the facilities.
 - ii. Kerb wall of minimum 300 mm height should be provided in the UG / SB tank Farm Area to contain accidental overflow.
 - iii. A minimum of 1.5 M clear distance from the tank shell shall be maintained from structures / boundary.
 - iv. Vents shall be located / terminated at a distance of 4 M from hazards and shall be at minimum 4 M height from the ground level.
 - v. The open end of vent pipe shall be covered with non-corrodible metal wire gauge preferably SS having 60 meshes and shall be further protected from rain by hood or by suitably bending it downward.
 - vi. Aviation fuels shall enter a tank through closed piping system/coupled electrically continuous and sound hose.
 - vii. The manholes, dip hatch, floating suction inspection hatch and pipelines should be minimum 300 mm above the grade level of the tank farm.
- 16) Corrosion control measures like wrapping- coating for buried pipelines and tanks, Internal epoxy lining of tanks & hydrant pipelines, provision of Cathodic protection for hydrant pipelines, etc. shall be undertaken.

(e) Grouping of Tanks:

- 1) Tanks shall be arranged in maximum two rows so that each tank is approachable from the road surrounding the enclosure.
- 2) Tanks having 50,000 KL capacity and above shall be laid in single row.

(f) Fire walls inside dyke enclosure for above ground tanks

- 1) In a dyked enclosure where more than one tank is located, firewalls of minimum height 600 mm shall be provided to prevent spills from one tank endangering any other tank in the same enclosure.
- 2) 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.

(g) General

- 1) For aboveground vertical storage tanks, the tank height shall not exceed one and half times the diameter of the tank or maximum 20 m, whichever is less.
- 2) All Piping from / to any tank including connected sprinkler / foam line shall comply with 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) Should not pass-through other tank areas / fire walls.
- 3) Piping design inside tank dyke area should ensure easy accessibility for any operations in the tank farm and wherever necessary well designed cross-overs shall be provided to cross the pipelines running within the dyke area. Elevated catwalks 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.
- 4) No part of the dyked enclosure should be below the level of surrounding ground immediately around the outside of dyke area.
- 5) Minimum distance between a tank shell and the inside toe of the dyke shall not be less than half the height of the tank

(h) Protection of facilities:

- 1) Proper approach towards various facilities should be provided within the AFS for smooth access of fire tenders etc. in case of emergency, for AFSs storing more than 1000 KL in above ground tanks.
- 2) For AFSs located outside airport/defence premises, the boundary wall should 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 3m height with V/Y/X shaped barbed wire fencing on the wall with 600 mm diameter concertina coil on top.
- 3) The emergency gate should be away from the main gate for evacuation of vehicles and personnel in emergency and should always be kept available and free from obstruction.
- 4) CCTV shall be installed in AFSs, other than defence, with aggregate above ground storage tank capacity more than 5,000 KL. The CCTV shall cover entry/exit gate, periphery of installation and all critical operating areas like tank farm, loading/unloading area, etc. which should be monitored continuously. The CCTV monitoring station should be provided in SCADA /SHIFT room, security cabin and Location In-charge room.

(i) Separation distances:

- 1) Minimum separation distances between various facilities described above shall be as per Table-1, 2 & 3. The table shall be read in conjunction with the notes specified with the table.
- 2) The layout shall also take into account findings/recommendations of HAZOP/ Quantitative Risk Assessment study, which shall be carried out at all the stages of facility development process.
- 3) For large AFS, minimum separation distances are specified in Table- 1. The table is applicable where total storage capacity for ATF in above ground tanks is more than 5000 KL.

- 4) For medium sized AFS, minimum separation distances shall be as specified in Table-2. This table is applicable where total above ground storage capacity for ATF is 1000 KL and above but less than or equal to 5000 KL.
- 5) For “other” category AFSs, minimum separation distances shall be as specified in Table-3. This table is applicable where total above ground storage capacity is equal to 1000 KL or where AFSs are having buried /semi-buried tanks irrespective of storage capacity.
- 6) In case of an existing AFS where inter-distance(s) between various facilities are not conforming to the Table 1/ 2/ 3 (as applicable), then QRA / HAZOP study shall be conducted and suggested mitigation measures shall be implemented.

TABLE – 1: SEPARATION DISTANCES BETWEEN FACILITIES FOR LARGE AFSs WITH ABOVE GROUND TANKAGE > 5000 KL

S.No	From / To	1	2	3	4	5	6	7	8	9	10	11
1	Storage Tank- Class B	(D+d)/4 or 10 min	15	30	0.5D or 15 Min	30	30	30	8	30	15	15
2	Tank vehicle loading/unloading for petroleum Class B	15	X	30	20	30	30	30	8	30	15	15
3	Fire water tanks & Pump House	30	30	x	X	12	30	6	30	12	30	X
4	Boundary wall around AFS	0.5 D or 15 min	20	X	x	X	1.5	X	X	X	15	X
5	Service/office buildings/workshop	30	30	12	X	X	30	X	8	X	15	3
6	OWS /pits	30	30	30	1.5	30	X	30	X	30	30	15
7	Electrical Panel Room (PMCC/DG room)/Electrical Sub station	30	30	6	X	X	30	x	8	X	15	X
8	FLP Electric Motors	8	8	30	X	8	X	8	x	8	8	15
9	SCADA/Server Room	30	30	12	X	X	30	X	8	X	30	X
10	DP shed (Class A in packed condition)	15	15	30	15	15	30	15	8	30	X	15
11	Non-FLP Motors	15	15	X	X	3	15	X	15	X	15	X

General Notes to Table-1:

All distances are in meters and the table specified the minimum requirement.

- a) "D" indicates the diameter of the larger tank.
- 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) Safety distances between tanks are not applicable (other than boundary wall) for double walled above ground storage tanks. No dykes are required for such tanks.
- f) Pig launcher/receiver at liquid hydrocarbon handling pipeline installations should be located at least 5 m from boundary.

Specific notes to Table-1:

1. OWS / Pits shall be minimum 1.5 m from boundary wall. However, OWS / Pits in this case shall have permanent covers with venting arrangement located at minimum 4 m from boundary wall and other hazard.
2. Refuellers parking space should be demarcated and a minimum distance of 4m distance to be maintained from the centre line of the nearest refuellers to the boundary wall.
3. Fixed type Proving Measure should be at a minimum distance of 4 m from hazard / source of ignition.

TABLE – 2: Separation distances between tank/ offsite facilities for AFSs with Above Ground Tankage $\geq 1000\text{KL}$ & $\leq 5000\text{KL}$

S.No	From / To	1	2	3	4	5	6	7	8	9	10	11
1	Storage - Class B	0.5D	4.5	D or 4.5 min	D or 4.5 min	4.5	4.5	3	9	30	4.5	D min
2	Tank vehicle decantation / Topping-up	4.5	X	4.5	4.5	4.5	4.5	1.5	9	30	9	9
3	Boundary wall around AFS	D or 4.5 Min	4.5	X	X	X	X	X	9	X	1.5	X
4	Service/office buildings/workshop	D or 4.5 Min	4.5	X	X	X	X	X	9	12	9	x
5	Non-FLP motors	4.5	4.5	X	X	X	X	3	9	x	9	x
6	Electrical Panel Room (PMCC/DG room)/Electrical sub statin	4.5	4.5	X	X	X	X	3	9	X	9	x
7	FLP Electric Motors	3	1.5	X	X	3	3	X	3	30	X	3
8	DP shed (Class A in packed condition)	9	9	9	9	9	9	9	x	30	9	9
9	Fire water tanks & Pump House	30	30	X	12	X	X	30	30	x	30	12
10	OWS / Pits	4.5	9	1.5	9	9	9	X	9	30	x	9
11	SCADA/Server Room	D min	9	X	X	X	x	3	9	12	9	x

Notes:

Safety distances between tanks are not applicable (other than boundary) for double walled above ground storage tanks. No dykes are required for such tanks. Notes given under Table 1 are also applicable for Table 2.

TABLE – 3: Separation Distances between tank for AFS with Above Ground tankage =1000KL or buried/semi-buried tanks irrespective of capacity

S.No	From / To	1	2	3	4	5	6	7	8	9
1	Storage - Class B	0.5D (note b)	4.5	D or 4.5min (note b)	D or 4.5 min	4.5	3	9	4.5	4.5
2	Tank vehicle decantation / Topping-up	4.5	X	4.5	4.5	4.5	1.5	9	4.5	4.5
3	Boundary around AFS	D or 4.5 min	4.5	X	X	X	X	9	X	X
4	Service/office buildings/workshop	D or 4.5 min	4.5	X	X	X	X	9	X	X
5	Electrical Panel Room (PMCC/DG room)	4.5	4.5	X	X	X	3	9	X	X
6	FLP Electric Motors	3	1.5	X	X	3	X	9	X	3
7	DP shed (Class A in packed condition)	9	9	9	9	9	9	X	9	9
8	Non-FLP motors	4.5	4.5	X	X	x	X	9	X	X
9	SCADA/Server Room	4.5	4.5	X	X	X	3	9	X	X

General notes to Table –3:

- a) All distances are in meter and the table specifies the minimum requirement.
- b) Distance norms between buried / semi buried tanks will not be applicable. The distance between buried/semi buried tanks & boundary shall be minimum 1.5 m.
- c) “x” indicates suitable distance as per good engineering practices to meet construction, operational and maintenance requirements
- d) “D” indicates the diameter of the larger tank.
- e) Distances given for the tanks are shell to shell in the same dyke.
- f) Where alternate distances are specified (like 0.5 D / 6.0), the minimum thereof shall be used.
- g) All distances shall be measured between the nearest points on the perimeter of each facility except in case of tank vehicle loading /unloading area where the distance shall be from the centre of each bay.
- h) Pig launcher/receiver should be located at least 5 m from boundary.

- i) Safety distances between tanks & other facilities (other than boundary are not applicable for double walled above ground storage tanks. No dykes are required for such tanks.

For Aviation Fuel Stations:

1. For underground & semi buried tanks the separation distance between Tank Vents and hazard should be minimum 4 m. The vertical separation should be minimum 4 m from the grade level.
2. Separation distance of 1.5 m to be maintained from underground and semi buried tanks to nearby structures and boundary wall. For above ground tanks Table 3 to be followed.
3. Refuellers parking space should be demarcated and a minimum distance of 4m distance to be maintained from the centre line of the nearest refuellers to the boundary wall.
4. Fixed type Proving Measure should be at a minimum distance of 4 m from hazard / source of ignition.

5.0 DESIGN CONSIDERATIONS

A. Tanks

Types of storage tanks

1) Horizontal tanks: Above ground, Underground and semi-buried Tanks

- i. All horizontal tanks –above ground, underground and semi buried, shall be as per IS 10987 or any equivalent industry standard.
- ii. Semi-buried tanks are considered as underground storage tanks for all purposes.

2) Fixed Roof Tank

- i. Fixed roof may be of cone type. For designing atmospheric pressure tanks, API STD 650 or IS 803 or any other equivalent shall be followed.
- ii. Selection of type of tank generally depends on ambient conditions, site requirement and the volume of product to be handled.
- iii. Tank bottoms should be cone down with a continuous slope towards centre sump for vertical tanks as per industry standard and horizontal tank should be installed with a continuous slope of 1:60 minimum.
- iv. Individual above ground vertical and horizontal tanks shall be provided with access to the roof or tank top. A platform with railing should be provided from the top of the stairway to gauge well, vents and floating suction check point.
- v. Stairs should be made of grating. All staircases shall have resting/landing platform for a height not exceeding 5m.
- vi. Minimum two number of roof manholes and 2nos. of shell manholes to be provided in all vertical tanks. For horizontal tanks minimum two numbers of manholes shall be provided.
- vii. Walkway with hand rail on the roof of the tank should be provided to facilitate inspection/checking of vents etc. so that movement of personnel on roof is safer. Anti-slippery path on the roof should be provided for this purpose.
- viii. All ATF tanks shall be provided with floating suction of size depending on the tank capacity and discharge flow rate, with an inspection hatch at the top of the tank.
- ix. Sampling sump to be provided in all types of Aviation tanks.
- x. For vertical tanks minimum one no. sampling draw off line and / or one water draw off line should be provided.
- xi. Flash Back Arrester (Flame arrester) vents where fitted should be as per IS 11006: 2011 or adequately sized free vents should be provided for ATF tanks as API STD 2000 and also considering the following –
 - 1) Maximum and minimum ambient temperatures.
 - 2) Vapour pressure of the product at operating or design temperature;
 - 3) Maximum pumping in and out rates.
- xii. Free Vents shall be provided with Screens made of stainless steel to prevent the ingress of foreign bodies and shall have a coarse mesh with approximately 60 mesh size or finer.

B. Tank farms/manifolds

1) Tank Farm Drains for AFS >1000 KL

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 divert to the OWS / Pits or to main storm water drain.

AFS with total tankage of more than 5000 KL in above ground tanks, the dyke drain valves shall be provided with position indication and alarm system.

2) Tank Manifold

- i. The number of inlet/outlet connections to the tank shell should be kept minimum.
- ii. Tank body valve of above ground tanks shall be manually operated valve and / or motor operated and / or remote operated shut off valve type.
- iii. The second valve on above ground tanks should be motor operated valve (MOV) on inlet and outlet lines for locations having hydrant refuelling system. For other AFSs where HRS system is not installed, in place of MOV, manual operated valve may be provided. This second valve should be located outside the dyke area.
All AFSs with above ground storage capacity more than 5000 KL shall have over-fill protection.
- iv. Hammer blind valves of any type shall not be used in AFSs.
- v. MOV should have open & close remote operation from SCADA / shift room and at field outside of dyke. ROSOV wherever provided shall be fail safe and fire safe (shall close in case of signal failure) and the actuator shall be failsafe. The cables leading to the control room shall be fire resistant. ROSOV shall have only close operation from control room or at a strategic remote location.
- vi. In addition, open, close & stop feature should be available for local operations, close to the valve.
- vii. Tank manifold(s), if provided, should 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 OWS / Pits.
- viii. Thermal safety valve (TSV) / Expansion line should be provided in above ground tanks for blocked portion of pipe line(s) to take care of the thermal expansion of product due to rise of temperature.
- ix. TSV outlet line or expansion line should be connected back to above ground tank / tank inlet/outlet line before manually operated body valve with suitably positioned isolation valve(s). One isolation valve shall be installed close to the tank body/inlet/outlet line to the maximum extent possible.
- x. In case the expansion line is connected at tank top, the line shall be extended inside up to the Tank bottom to avoid free fall through vapour space. However, at existing locations where ever the above provision does not exist in above ground tanks, the same shall be provided on all tanks during scheduled tank maintenance / cleaning.
- xi. 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 MOVs should be above the dyke height.

- 3) **Tank Settlement:** Tank Settlement 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.

4) Drain/sampling point

i. Drain/sampling point in Above Ground tanks

Arrangement should be provided in all above ground tanks for product sampling and water draw off from tanks. Number and details of the drains shall be as per the applicable tank design standard.

Each drain line shall have minimum two isolation valves 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.

ii. Drain/sampling point in Buried / Semi Buried tanks

Arrangement should be provided in all buried and semi buried tanks for product sampling and water from tank sump.

5) Vent

Open Vents: For sizing the vents API STD 2000 is to be referred. However, following are the basic guidelines which should be followed while designing vent:

- i. Maximum and minimum ambient temperatures.
- ii. Vapour pressure of the product at operating/design temperature.
- iii. 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.

6) Dip Hatch/Sampling

- i. Dip hatch or gauge hatch used for gauging the height of the liquid in an above ground tank as well as to take out samples for testing to be provided. In underground and semi buried tanks, separate sampling hatch is provided in addition to dip hatch for gauging purpose.
- ii. Gauge well pipe (with slots) should be provided for all types of tanks.
- iii. The gauge well should 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.

7) Instrumentation

Level controls on Tanks Position of level alarms:

- i. High Level (H): Between normal fill level and safe fill level
- ii. High High Level (HH): At safe fill level
- iii. "H" and "HH" level switches shall have provision of audio & visual alarms on auto-actuation in the control room.
- iv. "HH" level switch shall have audio alarm on auto-actuation in the control room & auto actuation of shut off valve.
- v. "L" alarm may be interfaced with pump for dry run protection.

The above alarms shall be provided as given below:

AFS with total storage equal to 1000 KL above ground.	NIL requirement.
AFS with total storage 5000 KL and more (above ground tanks)	Hi, Hi-Hi alarm and ESD / ESB System
AFSs with above ground storage tank of capacity 1000 KL and above but less than 5000 KL.	Hi level alarm.

The above shall be applicable to all locations.

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 MOV status and to ensure safe shut down of the system in case of any abnormal situation.

Care should be taken for tanks receiving product from 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 should be provided.

8) Piping/valves/flanges

- i. Piping: should 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 AFS) 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 joint 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. The product hydrant pipelines should be provided with low point and high point drains to facilitate emptying /sampling/hydro-testing etc. Ends of each drain point should have provision of blind flange/capping arrangement.
- vi. Buried piping shall be protected against physical damage and corrosion with suitable protective coating.

9) Valves for handling aviation product:

Steel valves for handling aviation products should conform to relevant API or equivalent standards. Cast iron valves shall not be used for handling aviation products.

10) Fittings for handling aviation product:

- i. Steel flanges and flanged fittings shall conform to relevant ASME / ASTM/ANSI or equivalent. Slip on or weld neck flanges should be used. Screwed flanges for sizes 50 mm or smaller may be used.
- ii. Steel unions shall have ground metal to metal seats. Gasket type unions shall not be used. Plugs shall be of steel. Cast iron or brass plugs shall not be used.
- iii. All flanges shall be connected for bonding for electrical continuity.

C. Bulk Loading /unloading operations

1) Loading / unloading Pumps

- i. Pumps conforming to relevant API standards may be used.
- ii. Product pumps may be provided with suitable sized strainers on suction and NRVs on discharge lines. All drain points of strainers shall be provided with isolation valves 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 / Pits for AFSs with above ground storage tank of capacity more than 1000 KL .
- iv. Pump house shall be positioned at an elevated platform and shall be well ventilated on all four sides. In case site condition does not allow for pump house at elevated level, suitable arrangement to be provided to ensure disposal of accumulated product.
- v. Pump-motors are to be provided with suitable IP protection.
- vi. 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.
- vii. Unloading/loading pumps shall also be provided with additional flame proof switch located at the strategic location near the loading-unloading bays to switch off the pump in case of emergency such as over flow, fire or any other abnormal situation.
- viii. Suction and discharge lines at AFSs with above ground tanks 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. When connected to tank, it (TSV) shall be provided with isolation valves, which shall be locked open. One isolation valve shall be installed close to the tank body to the maximum extent possible.
- ix. In addition to above, locations having automation shall be provided ESD (Emergency shutdown) feature through automation system.

2) Tank truck and Refuellers Loading Bays.

- i. Tank Truck and refuellers should be bottom loaded.
- ii. Loading unloading points shall have quick shut-off valves e.g., Cast steel Plug or Ball Valves.
- iii. Automated locations may provide suitable overfill protection system to prevent any overflow and hazards arising out of that.
- iv. Loading hoses for Tank Trucks and refuellers shall be as per relevant API/EI/EN/BIS specifications.
- v. Flameproof lighting or portable flame proof torches shall be provided for night time checking of bottom leaks of trucks and also for proper sealing and inspection wherever loading/unloading during night is required to be done.
- vi. Operating personnel of large size AFSs (storage more than 5000 KL) should be provided with intrinsically safe walkie-talkie sets.
- vii. AFSs with Tank Truck unloading/loading gantries shall be provided with safety harness to protect the operating crew against fall from height.
- viii. Swing type loading ladders with counter weight & hand railing, wherever provided, shall be light in construction. Neoprene packing shall be provided at the bottom rest to avoid spark generation due to impact. Alternatively Swing type hydraulic loading platforms without counter weight can also be provided.
- ix. Proper handrail arrangement should be provided on platforms and stairs for safe movement of personnel.
- x. 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 should be considered as per the site conditions.
- xi. Loading and unloading bay area shall be paved for smooth draining and collection of spillages into drains.
- xii. Open drains shall be covered with gratings so as not to endanger movement of personnel.
- xiii. All tank trucks/refuellers, if not exempted by PESO, entering AFS shall be provided with PESO approved spark/flame arrestor at the exhaust. . Vehicle conforming to BS IV and

- above are exempted for fitment of spark arrestor.
- xiv. Oil and water collected from loading/unloading areas shall be routed to OWS / Pits for AFSs with above ground storage tank of capacity more than 1000 KL . A slop tank should be earmarked for storing separated oil.
 - xv. The loading and unloading bays shall be designed such that movement of vehicle is smooth without criss-crossing.

3) Collection and Drainage for AFSs with above ground storage tank of capacity more than 1000 KL

A network of drainage system shall be provided to collect oil drains from various equipment, loading / unloading areas, pump houses etc. The drainage shall lead to OWS / Pits.

4) OWS / Pits

The receiving sump of the OWS / Pits shall have suitable arrangement for skimming off upper layer of accumulated oil.

D. ELECTRICAL EQUIPMENT

- 1) Electrical equipment including the lighting system shall conform to hazardous area classification. The hazardous area shall be classified as per IS: 5572 and Petroleum Rules, 2002.
- 2) 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.
- 3) 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.
- 4) Protection: The protection 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.

5) Cables

- i. In order to avoid spread of fire due to cables, the outer PVC sheath of all cables including XLPE insulated cables used inside the dyke shall be flame retardant type conforming to category AF as per IS: 10810. The cable shall have a low smoke property.
- ii. All power and control cables in hazardous area shall have extruded inner and outer sheaths. Cables should be Aluminium /Copper Conductor PVC insulated, PVC sheathed, armoured type.
- iii. 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.
- iv. 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.

6) Measurement of earth resistance

The testing of the earth pits shall be done six monthly one in dry and once in wet weather and records maintained. An earth resistance tester to be used for this purpose.

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

7) Allowable earth-Resistance values

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

- i. 4 Ohms for electrical systems and metallic structures
- ii. 7 Ohms for storage tanks
- iii. 1 Ohm for main earth grid, and bonding connections between joints in pipelines and associated facilities.
- iv. 2 Ohms for each electrode to the general mass of the earth.

8) AFS EARTHING

- a. AFS earthing design shall be carried out in accordance with the requirements of Central Electricity Authority (CEA) safety Regulation 2010 and IS 3043 or equivalent system recognized by statutory authorities under the law in force relating petroleum and electricity and all earth connections should be visible for inspection for extent possible.
- b. The earthing system shall have an earthing network with required number of earth electrodes connected to it. Earthing system shall be designed for the following:

- i. System neutral earthing.
- ii. Protective Equipment Earthing for personnel safety.
- iii. Protection against Static discharges.
- iv. Lightning Protection
- v. Earthing for Data Processing system, etc.

c. 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) to be provided for Di Pole/ Four Pole structures and 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 Di Pole/ Four Pole structure shall be earthed with two distinct earth connections. The Gang Operated Switch shall also be earthed.
- iv. Fencing of Di /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 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. Storage Tanks shall have minimum 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. All earth pits shall be located outside dyke area. 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.

9) BONDING:

- i. All flanged connections shall be effectively bonded by strips of suitable material.
- ii. Inside AFS, for the tank truck / Refueler Loading /Unloading bays minimum 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/refuellers under loading or discharging. (For External Bonding of Loading unloading arms/hose with the Tank Truck).
- iii. For sampling devices to be inserted into product tanks, SS chain shall be used.

10) STATIC EARTHING:

- i. Static Earthing shall be provided at Tank Lorry / Refuellers loading/ Decantation Gantries, to prevent building up of Static Charges.
- ii. The Static Earthing shall be segregated from electrical earthing to prevent it from getting energized to the same voltage level as it would exist on electrical fittings in case of fault. This earthing shall be independent of earthing system for automation.

11) 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.

12) EARTHING FOR DATA PROCESSING SYSTEM:

- i. Low noise Earthing are required for critical data processing equipment. These are to be independent of any other Earthing of the Building.
- ii. Wherever 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.

13) 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 LA	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 D G 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 / Eng. Store etc.	2 Nos for each structures
Static Earth for Loading unloading Gantry (Tank Truck)	1 Nos independent for each bay.
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 equipment 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 Clause 4.0 (D) (8) (c) (xi)

14) General

- i. Insulation mats as per IS-15652 standard shall be provided in the Sub Station, control panels etc.
- ii. Relays/Cables shall be tested once in a year and records maintained.
- iii. Transformer oil shall be tested once in a year and records maintained.
- iv. Size of conductor shall be selected based on the fault current that is required to be dissipated during emergency.
- v. Fail safe interlock / changeover switch shall be provided between grid power and the DG power to ensure that equipment gets supply from one source only.

15) Emergency Feeder, for AFSs with more than 1000 KL above ground storage:

Emergency Feeder shall host the following equipment:

Fire water jockey Pump, Critical lighting, Fire Siren, Bore well, Gate Barrier, safety instrumentation and interlocks, CCTV, UPS of automation, supply to essential firefighting equipment.

16) AFS lighting

- i. Sufficient lighting shall be provided so as to enable operators to move safely within the accessible areas of AFS and to perform routine operations. In the event of normal power failure, emergency lighting should be operational in critical areas.
- ii. Normal lighting system shall be on 415V / 240V AC supply, whereas critical

emergency lighting will be DC based in critical areas like Sub-Station, D G Room, SCADA/Shift Room, Security cabin.

- iii. Under normal operation, both emergency and normal lighting shall be fed by normal power source. On failure of normal supply, critical emergency lighting, wherever available may be transferred to emergency source, until the start of D.G. set.
- iv. Critical Emergency lighting (D.C. supply or UPS based) shall be normally kept 'ON'. During power failure, battery bank or UPS shall be used to provide power.
- v. Lighting shall be provided for the various facilities in the AFS. The illumination levels in different areas shall be as per good engineering practice.
- vi. 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.
- vii. Lighting requirements provided during the failure of power supply is intended broadly to,
 - a. Facilitate carrying out of specified operations, for safe shutdown.
 - b. Gain access and permit ready identification of fire-fighting facilities such as fire water pumps, fire alarm stations etc.
 - c. To gain access to escape route for safe evacuation of operating personnel.
- viii. Depending on the nature of job activities carried out, the minimum required illumination levels for various areas shall be ensured for safe movement or operations or emergency handling.
- ix. The lighting fixtures on various circuits shall be suitably designed so that failures of any one circuit do not result in complete darkness.
- x. Switches controlling the lighting fixtures and exhaust fan shall be installed outside the battery room.
- xi. Switches of lighting panels installed in hazardous area, shall have a pole to break the neutral, in addition to the poles for phases.

E. DESIGN OF HYDRANT REFUELLING SYSTEM (HRS):

1) Safety in Design of HRS

- i. No electrical connection between the fuelling vehicle and the hydrant pit to be made. If lanyards are attached to vehicle-mounted reels, the reels should be electrically isolated from the vehicle.
- ii. All new hydrant pit valves shall be as per EI1584 specifications. These shall be compatible with hydrant servicer intake couplings.
- iii. Hydrant lines should preferably be internally epicoated. Before being put into operation, they shall be cleaned by flushing with the product, which the line will eventually carry, until all traces of rust and other impurities completely disappear from samples drawn at delivery points.
- iv. Hydrant pit valves should have isolation valves.
- v. All the hydrant systems shall be provided with equipment that allows the fuel flow to be shut down quickly in an emergency. The preferred hardwired fixed system consists of Emergency Stop Buttons which, when activated, shut down the hydrant pumps (and valves where the pressure head results in continued fuel flow with pump shut down.)
- vi. Emergency Stop Buttons (ESBs)/Emergency Shut Down (ESD) shall be located close (maximum 80 meters) to fueling bays. They shall be clearly identified and easily accessible. High visibility identification signs, emergency instructions should be mentioned such that they remain visible at all times.
- vii. All hydrant pit covers shall be tethered or permanently connected to pits to prevent them from being picked up by jet blast.
- viii. All hydrant low point drains shall be clearly identified.

- ix. All hydrant pits, high and low points and dead end points shall be numbered clearly. These facilities should be located at a minimum distance of 4.5 m from any other hazard.
- x. Larger hydrants should be split into sections, which can be isolated for emergencies and testing and repairs. Isolation should be by Gate Valve or double block and bleed valves (DBBV).
- xi. Color Coding and Identification: All color coding shall be in line with Aviation Quality Control and Assurance Manual. All pipelines leading to or from tanks, fittings such as valves/flanges, filters, strainers, delivery/discharge hoses, etc. shall be properly colour coded to the grade of fuel to which they are dedicated.
- xii. Hydrant pipelines should be sized to handle the fully developed peak design capacity of the system at flow velocities that would not generate unacceptable surge pressures in the event of rapid and simultaneous closure of aircraft tank valves. However, the correct sizing of pipes is but one factor in the design of a safe and efficient hydrant system which must be considered in conjunction with site levels, the product(s) to be handled, the operating temperature range and the design characteristics of all items affecting pressure and flow, including;
 - a. Tanks;
 - b. Pumping sets;
 - c. Automatic control systems;
 - d. Filtration equipment;
 - e. Hydrant pit valves;
 - f. Shock alleviators;
 - g. Hydrant servicers (pipe systems and components), flexible hoses; and
 - h. Aircraft fuel systems (pressure and flow rate limitations).

2) Cathodic protection

Cathodic protection meeting local or national standards should be installed to prevent the corrosion of underground pipeline systems feeding fuel to hydrants.

3) External coating of pipeline

- i. When CS pipes are installed below ground, they should be appropriately protected against corrosion.
- ii. Joints made during installation should be protected by an appropriate wrapping system.
- iii. The integrity of the external coating and wrapping of buried pipes should be verified, and any defects corrected before the trenches are backfilled; great care should be taken to protect the wrapping during back filling.

4) Hydrant Pits:

Hydrant pits are positioned in the areas where aircraft are parked and they should embody the features described as below:

- i. Pits should be capable of accommodating the equipment.
- ii. Pits should be provided with suitable flush fitting covers sealing against rainwater. The design of covers should be such that they can be safely lifted by one person. Materials used for pit covers should not produce sparks when struck. Covers should be hinged or tethered or permanently connected to pits to prevent them being carried away by jet blast or propeller vortex. Pit boxes, where riser pipes enter, should be adequately sealed to prevent water entering from below and to prevent any fuel from seeping into the ground. Where there is more than one system in an airport, covers should be provided with a

suitable plate to identify the name of the owner/operator and the grade of fuel. If the pit box is fitted with a hinged lid, the lid should be so orientated that, when open, it does not cause the lanyard to become snagged.

- iii. High loadings can be imposed on hydrant pit boxes from aircraft wheels, tugs, other service vehicles or from settlement or movement of adjacent aprons. To prevent transmission of these loadings to hydrant risers (to which the hydrant pit valve is fitted, each hydrant pit box should be effectively isolated from its hydrant riser by means of a sealing arrangement that can accommodate both lateral and vertical differential movement.
- iv. Pits should be installed so that they project at least 25 mm (1 inch) above the apron level to prevent the entry of surface water. Concrete surrounds should be ramped up at a gradient between 3° and 5° to the top of pits.
- v. Isolating valve should be installed between the riser flange and the hydrant pit valve.

5) HYDRANT PIT VALVES:

- i. Hydrant pit valves should be of the 'quick release' type designed to close at a controlled rate so that during closure the build-up of shock pressure in the hydrant line is minimized.
- ii. As a minimum, the pilot device controlling the operation of the valve should be fitted with a manual means of opening and closing, the closing action being made possible by pulling on a lanyard. However, an air-operated pilot device to be installed with the pit valves.
- iii. The lanyard should always be of fire-resistant material of adequate strength to enable the valve to be operated remotely should an emergency occur during the fuelling operation and should preferably be red in colour.
- iv. Where a dual closure device is provided, the air-operated pilot device should be fitted with a lanyard. (as per latest API/EI 1584).
- v. A self-sealing male adaptor with tethered / permanently connected dust cap should be incorporated in the hydrant pit valve outlet to which the female coupling of the hydrant inlet hose is attached. It should be so designed that the hydrant hose can be connected or disconnected without spillage of fuel.
- vi. Hydrant pit valves should be fitted API standard hydrant pit outlet adaptors. The hydrant pit assembly arrangement should conform to API/EI 1584.

6) EMERGENCY SHUT DOWN (ESD) CONTROLS FOR HRS System:

Because of the nature of aircraft fuelling operations and the distance between the pumps in the airport fuel depot and the fuelling location, it is essential to have a safe system to shut down the flow of fuel in an emergency. Wired or Wireless system to be installed for shutting down the hydrant refueling system (HRS). Emergency Stop Buttons (ESBs)/Emergency Shut Down (ESD) shall be located close to fueling bays. They shall be clearly identified and easily accessible. High visibility identification signs, emergency instructions should be mentioned such that they remain visible at all times."

6.0 SAFE OPERATING PRACTICES IN STORAGE AND HANDLING OF BULK AVIATION FUELS

A. GENERAL

The section deals with safe operating practices and provisions applying to loading, unloading and storage of Aviation Fuel at AFSs.

B. SAFE OPERATING PRACTICES

- i) AFS SCADA room where ever provided shall be manned on continuous basis during operations and in emergency.
- ii) Site Specific, Standard Operating Procedures (SOPs) shall be developed. Such procedures 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).
- iii) The critical operating steps based on “SOPs” shall be displayed on the board near the location where applicable.
- iv) VHF handsets provided to operating personnel shall be of intrinsically safe type.
- v) All operations shall be carried out under supervision of a responsible operating personnel.
- vi) The pipeline transfer should preferably be commenced during day light. Due to urgency if operation requires to be carried out/extended in night time, the same to be carried out under supervision of trained & experienced staff.
- vii) Manning level in the shift should be adequate to ensure coverage for normal and emergency operations.
- viii) For locations with above ground storage tanks having aggregate capacity more than 5000 KL, the tank farm management system should be integrated with electronic data services repository. Provision of recording of TFMS inventory levels should be made on electronic data services repository.
- ix) For locations with above ground storage tanks having aggregate capacity more than 5000 KL, suitable interlocks shall be provided for tripping / alarm / MOV operation based on the events high level, high high level etc.
- x) 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) for safe disposal.
- xi) Personnel protective equipment such as safety shoe, hand gloves, apron, safety goggles, safety belt, helmet, ear muff, bump caps, self-contained breathing apparatus (SCBA), resuscitator etc. as applicable shall be worn while carrying out operations in normal and emergency situations. Personnel protective equipment (PPE) are equipment designed to offer protection against potential hazards, fire, toxicity, accidental fall etc. during normal and emergency operations.

C. Bulk Handling for movement by Road

For movement of refuellers, sampling/pit cleaning vehicles and hydrant dispensers, inside airport premises, the relevant Motor vehicle Rules, local airport operator’s requirement and Civil Aviation Requirements to be followed.

D. Safety Precautions during TT / Refuelers Loading / Unloading Refuelers in Aviation Fuel Station

Following precaution shall be taken due to associated hazards during transfer of Petroleum products to or from a tank truck.

- i. Open source of ignition shall not be allowed in the area where product transfer operations are carried out.
- ii. Vapour space of not less than 3% in each tank truck and refuellers in respect of Class A&B petroleum products.
- iii. Fire extinguishers shall be placed near the tank trucks during operations in a designated marked place.

- iv. The master switch shall be put off immediately after parking the truck in position. No electrical switch on the vehicle shall be turned "on" or "off" during the transfer operation.
- v. The first operation after positioning the truck/refuellers shall be to provide proper earthing/bonding. Earthing/bonding shall be disconnected just before the release of the truck.
- vi. All Refuelling Hoses shall conform to EI-1529/ISO 1825 or equivalent standard and shall be handled with care and hydrostatically tested once in 6 months.
- vii. No repairs shall be made on the truck/refuellers while it is in the loading/unloading area.
- viii. Personnel shall wear applicable Personal Protective equipment.
- ix. Filling/transfer operations should be suspended immediately in the event of –
 - a) Uncontrolled leakage occurring
 - b) A fire occurring in the vicinity
 - c) Lightning and thunderstorm

E. Procedure for Loading / Topping up operations of Refuelers:

- i. Check for following in a tank truck/Refuellers as per statutory regulations before accepting it for filling: -
 - a) Provision of PV vent, emergency vent valve (for refuellers), master valve, spark arrestor and other safety fittings.
 - b) Fire screen between cabin and tank is provided. For this purpose, cabins with metallic back over without any opening will be considered as fire screen.
 - c) Each tank truck shall be provided with 2 nos. of Fire Extinguishers of ISI mark (1 no.10/9 kg DCP and 1 no. 1 kg CO₂ /equivalent approved fire extinguisher in driver's cabin).
 - d) Each refuellers shall be provided with 3 nos. of Fire Extinguishers of ISI mark (2 no.10/9 kg DCP and 1 no. 1 kg CO₂ /equivalent approved fire extinguisher in driver's cabin).
 - e) Spark arrestors, unless exempted by PESO, shall be welded on the exhaust.
 - f) No leakage in exhaust silencer pipe.
 - g) Valid Explosive License with PESO approved drawing and RTO registration certificate is available.
 - h) Availability of brazed copper strip for earthing / bonding connection.
- ii. Move vehicle to the loading/topping up bay.
- iii. Place the truck/refuellers on loading/topping up bay and place wheel chokes at front and rear wheels. Keep the truck/refuellers in neutral mode with hand brakes "ON".
- iv. Stop the engine and switch off all electrical equipment.
- v. All persons should leave the driver's cabin.
- vi. Provide earthing connections of the vehicle at specified point to the fixed grounding system.
- vii. Ensure tank vent valve is open and fire extinguisher is readily available near loading point
- viii. Start the loading/topping up operations.
- ix. The quantity loaded into the truck/refuellers can be assessed by -Liquid recorded through manual dipping/dial gauge reading.

F. Procedure for Unloading Operations of Refuelers in AFSs

- i. Necessary steps described under clause B should be carried out.
- ii. Test the connections for leaks
- iii. Start the Unloading operations
- iv. Before releasing the trucks, ensure that valves are closed/ends are capped.
- v. An authorized person of the company shall supervise the unloading operation and respond immediately in the event of an emergency.

G. Tank Farm Operations: Safety Precautions in Tank Farm Area in AFS

- i. Whenever operations are not in progress, 100% closure of all the operating valves must be ensured and they shall not be left in partial open condition.
- ii. All electrical fittings shall be maintained to ensure its integrity and type of protection.
- iii. The tank farm must be kept clean and free from vegetation.
- iv. Tanks shall be periodically checked for leakages / sweating and repairs must be immediately carried out whenever scaling / pitting are observed.
- v. Proper earthing and bonding shall be maintained and ensured at all times for the tank body.
- vi. Dyke drain valve shall be in closed condition and shall be operated only under supervision of an authorised person and log book maintained.
- vii. Isolation Valves on expansion line(s)/TSV vent line(s) shall be always kept open except under requirement during location specific operations to take care thermal expansion.
- viii. No gauging or sampling of tanks shall be undertaken during thunder or hail storms.
- ix. Flow velocity at tank inlet shall not exceed 1 m/s until the inlet is completely submerged. For easy reference, permissible flow rate for initial filling are given below: -

Size (in mm) of Inlet pipe	Max. Flow Rate (Kl/Hr)
300	246
250	168
200	109
150	59
100	27
80	25.5

- x. Safety shoes/PPEs shall be worn by the operating staff in the operational area.
- xi. Tank dip pipes shall be extending to tank bottom. If dip pipes are not provided, give a relaxation time of 30 minutes before sampling/gauging.
- xii. Synthetic fibre cord shall not be used for sampling, gauging etc. If the sampling, gauging, etc., equipment is a conductor, the cord must be conductive, e.g., a metal wire/chain. Proper bonding to be provided in this case.
- xiii. While cleaning the tanks, care shall be taken to avoid generation of static electricity.
 - Cleaning of tanks by gas oil spray shall not be permitted.
 - Cleaning of tanks by steaming shall not be permitted for Class A & B products.Earthing and bonding connections shall be ensured during the entire operating process.

H. Pipeline Transfer Operations

Pipeline transfer of ATF is carried out through dedicated pipeline for receipt of ATF at the AFS from refineries / cross country pipeline/ marketing terminal/other AFSs within the same company or between oil companies.

Where ever pipe line transfer is envisaged between various companies, a mass flow meter/flow meter with integrator shall be installed on receipt line. Signal shall be provided in the control

rooms of both dispatching and receiving companies 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. Line up shall be started from the exchange pit end
- 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
- 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 DGCA approved Quality Control Manual.
- xi. Pipe Line transfer (PLT) from a pipeline 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 should 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.

I. Methanol Handling at AFS

- i. For piston engines methanol/water mixtures (MWM) are used and these may have 1% of anti- corrosion oil added.
- ii. The principal grades of Methanol Water Mixtures in use is MWM (45/55/0). In this grade 45 parts of PBM (Power Boost Methanol) is mixed with 55 parts of de-ionized water and there is no corrosion inhibitor which is denoted by '0'. This grade is used in the turbine engines in Aircraft like Avro, Fokker Friendship, etc.
- iii. Containers used for storage of De-ionized Water shall be of high-density polythene (HDPE) or stainless steel and will be flushed clean before use.
- iv. High density Polythene (HDPE) pipes shall be used for transferring De-ionized Water from one container to another.
 - v. The HDPE container shall be handled with care to avoid damage.
 - vi. The container shall always be kept closed and in a clean condition.
- vii. DP Shed of required dimensions duly approved by PESO shall be provided for storage of PBM.
- viii. Blending of Methanol Water Mixture is carried out in a blending unit kept in a ventilated area.
 - ix. De-ionized Water and PBM shall be pumped into the blending unit through a pump in the required proportion. Only polythene pipes and stainless-steel pipes shall be used for suction of PBM and De-ionized Water.
 - x. Both PBM and De-ionized Water are simultaneously allowed to mix in a blender, by adjusting the valves in the blending unit. The Methanol Water Mixture is drawn out of the unit and loaded into the MWM refuelling unit.
 - xi. All sampling procedures and tests shall be carried out as per Quality Control Manual.
- xii. In case where blending units are not available, blending may be carried out in the refueling

unit itself. All precautions taken during normal refueling shall be ensured for MWM refueling also.

J. SAFETY IN BARREL OPERATIONS:

1) Receipt of Aviation Fuel in barrels:

- i. The normal packages used to transport Aviation Fuels are the drums with 200 / 210 litres capacity.
- ii. The loading location must comply with the quality control and safety requirements, while loading and transporting the stocks in drums.
- iii. The stocks in drums are transported in trucks. While unloading the drums, enough care should be exercised, to ensure that the drums are not damaged.
- iv. It is recommended to stack old unserviceable tyres below the drum unloading point. The drums should be unloaded using an unloading ramp.
- v. The drums should be stacked in the place earmarked for this purpose. All drums carrying "DP" products shall be stacked in DP shed.
- vi. It shall be ensured that the license of the DP shed is valid and the storage does not exceed the authorised capacity.

2) Storage:

- i. For each consignment, placard indicating the grade of product, Batch No. and date of Test Report shall be exhibited.
- ii. Each consignment shall be stacked separately to facilitate delivery of stocks on first in first out basis.
- iii. All the barrels when stored shall be kept only in sealed condition.
- iv. The barrels shall be visually inspected at least once in a day for any leaks and the observations recorded in the shift log.
- v. During monsoon, adequate precautions shall be taken to prevent ingress of water into the drums. When drums are stored in the open over dunnage with a tarpaulin cover, the water stagnated over the tarpaulin cover shall be removed on priority.
- vi. Barrels shall be stored in 3 o'clock – 9 o'clock position on a thick wooden plank of minimum thickness 2".

3) Loading of Barrels:

Following procedures shall be followed -

- i. The barrels shall be selected in the following order of priority:
 - a. New Barrels.
 - b. Barrels having stored similar aviation fuel previously Once used
 - c. PBM barrels
- ii. Lube oil/Black oil drums shall not be selected for filling Aviation Turbine fuel. The drum-filling operations shall be taken up only in the licensed area.
- iii. Before flushing, it should be ensured, that each drum is clean and dry.
- iv. Each barrel shall be flushed with a minimum of 5 litres of the grade to be filled or till such time, a clear and bright sample is obtained. The flushed quantities shall be downgraded to a similar non-aviation grade
- v. The electrical bonding connection shall be established between the filling nozzle and the

- barrel. In the case the drums are filled over a wooden platform instead of ground proper bonding connection shall be established between the drum and the filling source.
- vi. While filling, it shall be ensured that adequate space to be left in the barrel depending upon the class of petroleum product. For A class minimum 5% space to be left and for B Class minimum 3% space to be left as vapour space for safety reasons.
 - vii. The barrels shall be sealed tight, using bungs with washers.
 - viii. It shall be ensured that the barrels are stacked in a vertical position in a single tier in the truck properly covered with tarpaulin.
 - ix. Fire extinguishers of adequate capacity shall be carried along with the drums.
 - x. Before filling the containers of the customer, it shall be ensured that the customer furnishes a certificate that the product shall be used for bonafide aviation use.
 - xi. The Explosives License authorising the customer to transport and store the fuel shall also be produced before requesting for fuel.
 - xii. The filling of container shall be taken up only after satisfying conditions mentioned above.
 - xiii. The quantity to be delivered shall not exceed the quantity indicated in the license.
 - xiv. All the precautions and procedures given above shall be adhered to. Containers not fit for Aviation use shall be rejected.
 - xv. The flushed quantities shall be collected in a drum and downgraded to a similar non-aviation grade. However, this downgraded product shall not be handed over to the customer.

7.0 FIRE PROTECTION FACILITIES

Salient features of Fire Protection Facilities for Aviation Fuel Station: -

1) Fire Protection Philosophy

The fire protection philosophy is based on loss prevention & control. It considers that an AFS 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 AFS, if not controlled / extinguished as quickly as possible to minimize the loss of life & property and prevent further spread of fire.

2) Fire Protection

Depending on the nature of risk, following fire protection facilities shall be provided, in AFSs with aggregate above ground storage tank capacity more than 1000 KL .

- i. Fire Water System -(storage / pumps / distribution piping network with hydrant / monitors)
- ii. Fixed Spray System
- iii. Foam System.
- iv. First Aid Fire Fighting Equipment.
- v. Trolley mounted/Mobile Fire Fighting Equipment.
- vi. Carbon Dioxide System.
- vii. Dry Chemical Extinguishing System
- viii. Fire Alarm, Actuation & Communication System.

For AFSs storing 1000 KL aggregate product, the following fire protection facilities shall be provided:

- i. First Aid Fire Fighting Equipment
- ii. CO₂ extinguishers for electrical fire
- iii. Dry Chemical Extinguishers
- iv. Fire Siren

- 3) Design Criteria for Fire Protection System for AFSs With Above Ground Storage Tank Capacity more than 1000 KL**
- i. Facilities shall be designed on the basis that city fire water supply is not available close to the installation.
 - ii. The fire water pumps shall be provided with auto start facility with pressure drop in fire water network.
 - iii. The fire water system shall be based on single contingency for locations where total storage capacity is up to 30,000 KL. Fire water storage shall be sufficient for minimum 4 hours aggregate rated capacity of fire water main pumps. Wherever water replenishment @ 50% or more is available, the storage capacity can be reduced to 3 hours aggregate rated capacity of main pumps.
 - iv. The fire water system shall be provided based on two largest fire contingencies simultaneously for locations where total storage capacity is above 30,000 KL. Wherever water replenishment @ 50% or more is available, single fire contingency shall be considered for Fire water storage.
 - v. The hazardous areas shall be protected by a well laid combination of hydrants & monitors.
 - vi. ATF above ground Petroleum storage tanks (fixed roof) of diameter larger than 30 m shall be provided with fixed water spray system.
 - vii. Fixed foam system or Semi-fixed foam system shall be provided on all tanks (fixed roof) exceeding 18 m diameter storing ATF (Class B).
 - viii. In case of an existing AFS where inter-distance(s) between various facilities are not conforming to the Table 1/2/3 (as applicable), then QRA / HAZOP study shall be conducted and suggested mitigation measures shall be implemented.
 - ix. Tank Truck (TT) / Refuellers/ unloading facilities, Manifold area of product pump house and Exchange pit shall be fully covered with alternate double hydrant and variable flow (pattern) water cum foam monitors having multipurpose combination nozzles for jet, spray & fog arrangement and located at a spacing of 30 M on both sides of facilities 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 of the relevant facility.
 - x. The high-volume long range (HVLR) water cum foam monitors (variable type) shall be provided as under:
 - a. AFSs with above ground storage tank of capacity more than 1000 KL and meeting the safety distance norms as per this standard, minimum one no. trolley mounted mobile type water cum foam HVLR monitor shall be placed for covering the above ground tank farms storing Class B products based on single largest tank diameter to be catered @ 8.1 lpm/m².
 - b. For existing AFSs with above ground storage tank of capacity more than 1000 KL and not meeting the safety distance norms as per this regulation, 2 nos. trolley mounted HVLR monitors shall be provided for tank farms. Requirement of HVLR monitors shall be calculated for full surface fire scenario of the largest tank @ 8.1 lpm/sq m. Refer clause 4(i)(7).
 - c. Provision for connecting / hooking the portable monitor shall be made in the hydrant system around the fixed roof tanks at various strategic points.
 - d. Well laid procedures and plans shall be made and put into use for use of mobile HVLRs to combat emergencies without loss of much time.
 - e. The location of HVLRs to 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 minimum distance of 15m subject to:
 - f. 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.

- g. The throw is directed on the inner upper surface of the tank and not in the middle of the tank to prevent splash over.
- h. For determining the total foam solution requirement, potential foam loss from wind and other factors shall be considered while designing.
- i. Adequate foam drum/tank or reliable replenishment for foam induction system shall be provided near the hook up points of mobile HVLRs with the hydrant system.

4) **Fire Fighting at AFSs:**

General:

- i. Even though all efforts are made to avoid fires from taking place, it is necessary to have firefighting equipment ready for use all times.
- ii. As stated earlier, to produce fire, three elements are necessary, namely, Fuel, Oxygen, and Ignition. Elimination of any one of these three elements can stop a fire. All Firefighting methods are based on this principle.

5) **Fire Drills:**

Location should carry out mock drill for On-site (Level –I or II) and Off site (Level-III) emergency once in three months and twelve months respectively. These Fire Drills should be conducted and recorded as per mock drill reporting format in accordance with ERDMP Regulations 2010 and its latest amendments.

6) **Portable Fire Extinguisher Specification:**

- i. All fire extinguishers shall conform to respective IS/UL or Equivalent codes, viz. 10/9 Kg DCP Type (IS: 15683 /UL 299), 4.5/6, 8 Kg CO₂ Type (IS: 2878/UL 154) & 25/50/75 Kg DCP Type (IS: 10658/UL 299) and bear ISI/UL mark. BIS/UL 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.
- iii. The Dry Chemical Powder used in extinguisher and carbon dioxide gas used as expelling agent shall be as per relevant IS/UL 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 250°C) 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 or buffer stocks of stored pressure vessel type fire extinguishers 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-liter water capacity conforming to IS: 2546 or equivalent specifications. 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.
- xii. The no. of extinguishers at various locations shall be provided as under:

Sl. No.	Type of Area	Scale of Portable Fire Extinguishers
1	Lube Godown	1 no. 9 Kg /10Kg DCP extinguisher for every 200m ² or min. 2nos. in each Godown, whichever is higher.
2	Storage of Class A/B in packed Containers and stored in open/closed area (Example- Downgraded ATF in drums or HSD in drums for own use)	1no.9 Kg / 10Kg DCP extinguisher for every 100m ² or min 2Nos. in each shed, whichever is higher.
3	Pump House (Class A/B) UPTO 50HP Above 50 HP but below 100HP Beyond 100HP	1 No. .9 Kg /10Kg DCP for 2 pumps. 1 No. .9 Kg /10Kg DCP for each pump. 2 nos. of .9 Kg / 10Kg or 1no. 25Kg DCP for each Pump.
4	Tank Truck loading & Unloading Gantry for Class A/B products	1 No. 9 Kg / 10KgDCP extinguisher for each bay plus 1no. 75Kg DCP extinguisher for each Gantry.
5	Aboveground Tank Farm	2nos. .9 Kg /10Kg DCP extinguisher for each tank plus 4nos. 25kg DCP extinguishers for each Tank Farm positioned at four corners. In case of adjoining tank farms, the no. of 25Kg extinguishers may be reduced by 2nos. Per tank farm.
6	U/G & semi-buried Tank Farm	2nos. .9 Kg /10Kg DCP extinguisher for each Tank Farm
7	Other Pump Houses (fire pump house or water pumps)	1no. .9 Kg /10Kg DCP extinguisher for every two pumps or min 2nos. 10Kg DCP extinguisher for each pump House whichever is higher.
8	Admn. Building/ Store House	1no. .9 Kg /10Kg DCP extinguisher for every 200m ² or min. 2nos. .9 Kg / 10Kg DCP extinguishers for each floor of building/store whichever is higher.
9	DG Room	2nos. each .9 Kg /10Kg DCP & 4.5Kg CO ₂ extinguishers for each DG Room.
10	Main Switch Room/PMCC/Sub-station	1no. 4.5Kg CO ₂ extinguisher for every 25m ² plus 1 no. 9 liter sand bucket.
12	SCADA/Server/Computer room/Cabin	2nos. of 2Kg CO ₂ or 2nos. of 2.5 Kg clean agent extinguisher per computer room and 1 No. 2Kg CO ₂ or 1No.1.0 Kg clean agent extinguisher per cabin.
13	Security Cabin	1no. .9 Kg / 10Kg DCP extinguisher per cabin
14	Canteen	1no. .9 Kg /10Kg DCP extinguisher for 100m ²

Sl. No.	Type of Area	Scale of Portable Fire Extinguishers
15	Workshop	1No. .9 Kg /10Kg DCP extinguisher & 1no. 4.5Kg CO ₂ Extinguisher
16	Laboratory	1no. .9 Kg /10Kg DCP extinguisher and 1no.4.5Kg CO ₂ extinguisher.
17	Oil Sample storage Room	1no. .9 Kg /10Kg DCP extinguisher per 100m ² or min.1no. .9 Kg / 10Kg extinguisher per room whichever is higher.
18	Transformer	1no. .9 Kg /10Kg DCP extinguisher per transformer
19	UPS/Charger Room	1no. 2kg CO ₂ extinguisher.

7) Wheeled Fire Fighting Equipment

For AFSs having above ground product storage tanks of diameter larger than 9 m, following firefighting equipment shall be provided: -

Size of AFS (In KL)	Water/Foam Monitor (Nos.)
Having aggregate capacity of 1000 KL	NIL
Having aggregate capacity up to 10,000 KL	Minimum 2 Number of suitable capacity
Having aggregate capacity more than 10,000 KL	More than 2 Numbers of suitable capacity

8) Foam compound trolley 200 / 210 liters shall be provided as under: -

Tank diameter (In m)	Water/Foam Monitor (Nos.)
Up to 24 m	1 no.
24 m - 30 m	2 nos.
Above 30 m	3 nos.

9) Other Safety and PPE Gadgets required for the locations

Minimum fire accessories to be provided in a location without fire hydrant system are as follows:

Sand drum with scoop	: 4 Nos.
Safety helmet	: 1 No. per person.
Stretcher with blanket	: 2 Nos.
First Aid box	: 1 No.
Rubber hand gloves	: 2 Pairs.
Explosimeter	: 1 No.
Fire proximity suit	: 1 Suit.
Resuscitator	: 1 No.
Electrical siren (3Km range)	: 1 No.
Hand operated siren	: 1 No.
Waterjel blanket	: 1 No.
Red & Green flag-fire drill	: 2 Nos. in each colour.
Self-Carrying Breathing Apparatus Set (30minutecapacity):	2 set with spare cylinder.

10) FIRE WATER SYSTEM DESIGN (applicable for AFSs with aggregate above ground storage tank of capacity more than 1000 KL):

- i. Water is used for fire extinguishments, fire control, and exposure protection of equipment, foam application and personnel from heat radiation.
- ii. Fire water system shall be designed for a minimum residual pressure of 7 kg/cm² at hydraulically remotest point in the AFS considering the design flow rate.
- iii. 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.
- iv. The AFS shall have facilities for receiving and diverting all the water coming to the installation to fire water storage tanks in case of an emergency.
- v. For AFSs located in areas where ambient temperature is sub zero during the year, the fire fighting lines should be emptied. Alternatively, a suitably designed mechanism should be provided to prevent freezing of fire water.

11) FIRE WATER DESIGN FLOW RATE

The fire water system shall be provided based on single largest fire contingency for all locations where total tankage in the AFS with total above ground tankage of capacity more than 1000 KL and up to 30,000 KL.

The fire water system shall be provided based on two largest fire contingencies simultaneously for all locations where total tankage in the AFS is more than 30,000 KL.

(A) Fire water flow rate for a tank farm shall be aggregate of the following: -

- i. For water flow calculations, all tanks' farms having class B petroleum storage (above ground) of capacity more than 1000 KL shall be considered irrespective of diameter of tanks and whether fixed water spray system is provided or not.
- ii. Water flow calculated for cooling a tank on fire at a rate of 3 lpm/sqm of tank shell area. For entity installing any tank near the tank on fire which is not maintaining the minimum separation distance prescribed.
- iii. 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/m² of tank shell area.
- iv. 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.
- v. 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.
- vi. Foam solution applicable rate for cone roof tanks shall be taken as 5 lpm/ m².
- vii. 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.
- viii. Design flow rate shall be based on the combination of the above.
- ix. 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
- x. The supplementary water stream requirement shall be in addition to the design flow

rates.

(B) FIRE WATER STORAGE:

- i. Water for the firefighting 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.
- iii. Fresh water should be used for firefighting purposes. In case sea water or treated effluent water is used for firefighting 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.
- vi. In case existing land area is insufficient to have additional water tanks as per requirement, water replenishment rate from the local airport operator/AAI may be added to existing water storage capacity to fulfil the net requirement.

(C) 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 of same capacity 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. 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 30 M (minimum) away from equipment or where hydrocarbons are handled or stored.
- vi. Fire water pumps shall be exclusively used for firefighting 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. 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.

(D) 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 support interval shall not exceed 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.
- d) Suitable strainer shall be provided on sprinkler branch connection and shall be located outside of dyke.

vii. **Hydrant/Monitors:**

- a) Hydrants/ monitors shall be located considering various fire scenario at different sections of the premises to be protected and to give most effective service.
- b) 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.
- c) 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.
- d) Provision of hydrants within the building shall be provided in accordance with IS: 3844.
- e) Hydrant/Monitors shall be located along road side berms for easy accessibility.
- f) 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.
- g) 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.
- h) 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.
- i) Hydrants and monitors shall not be installed inside the dyked areas. However, as an additional requirement, oscillating monitors may be provided in inaccessible area within the dyke with isolation valve outside the tank farm (In cases inter distances between tanks in a dyke and/or within dykes are not meeting the requirements).
- j) TT/Refuellers 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.

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

viii. MATERIAL SPECIFICATIONS

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

- a) **Pipes:** Carbon Steel as per IS: 3589/IS: 1239/IS: 1978 or Composite Material or its equivalent for fresh water service. In case saline, blackish 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.
- b) **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 cupronickel for saline/blackish water can be used. The material of the valve shall be suitable for the service.
- c) **Hydrants post:**
Stand post - Carbon Steel
Outlet valves - Gunmetal/ Aluminum/ Stainless/ Steel/Al-Zn Alloy
- d) **Monitors / High Velocity Long Range Water Cum Foam Monitors (HVLRL):**
Approved / listed by international certifying agencies like UL/FM/ VdS/ LPC or equivalent Indian certifying agencies.
The electrical or hydraulic remote-control mechanism shall be in line with Hazardous Area Classification.
- e) **Fire Hoses:**
Reinforced Rubber Lined Hose as per IS 636 (Type A) /Non-percolating Synthetic Hose (Type B)/UL or Equivalent Standard.
- f) **Painting:**
- i. Fire water mains, hydrant & monitor stand posts, risers of water spray system shall be painted with "Fire Red" paint as per of IS: 5.
 - ii. Hose boxes, water monitors and hydrant outlets shall be painted with "Luminous Yellow" paint as per IS: 5.
 - iii. Corrosion resistant paint shall be used in corrosion prone areas.

ix. FIXED WATER SPRAY SYSTEM

- (a) 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.
- (b) Spray nozzles shall be directed radially to the tank at a distance not exceeding 0.6 M from the tank surface.
- (c) For Tank Truck/refuellers loading gantries specifically for those cases which have obstructions in water throw, sprinklers should be provided.

(E) FOAM SYSTEMS

Fire-fighting foam is a homogeneous mass of tiny air or gas filled bubble of low specific Gravity, which when applied in correct manner and in sufficient quantity, forms a compact fluid and stable blanket which is capable of floating on the surface of flammable liquids and preventing atmospheric air from reaching the liquid.

1) FOAM PROTECTION

i. FIXED ROOF TANK PROTECTION:

Foam conveying system shall have a vapour seal chamber before the foam discharge outlet. Features of the foam system for fixed roof protection shall be as follows:

- a) System shall be designed to create foam blanket on the burning surface in a reasonably short period.
- b) Foam shall be applied to the burning hazard continuously at a rate high enough to overcome the destructive effects of radiant heat.
- c) 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.
- d) 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 Mtrs	Requirement of Foam Pourer (Minimum 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

- e) In case foam pourers are provided on tanks having diameter up to 18 m, minimum 2 nos. foam pourers shall be provided.
- f) The estimation of number of foam discharge outlet is based on pourer capacity of 1000 lpm at a pressure of 7 kg/sq.cm (g) upstream of educator. This can be suitably adjusted for different pourer capacity in accordance with above. Testing of foam pourer system shall be done by reversing the inlet so as to prevent ATF from entering the storage tank.

ii. PROTECTION FOR DYKE AREA / SPILL FIRE

- a. Portable monitors/foam hose streams shall be provided for fighting fires in dyked area and spills.
- b. In addition to above, medium expansion foam generators shall be provided to arrest vapour cloud formation. Two nos. portable foam generator shall be provided for each AFS.

2) FOAM APPLICATION

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: -

- a. 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.
- b. In determining total solution flow requirements, potential foam losses from wind and other factors shall be considered.

3) DURATION OF FOAM DISCHARGE

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

- a. Tanks (fixed roof) containing Class 'B' product: minimum duration will be 65 minutes and
- b. Where the system's primary purpose is for spill fire protection such as dyked area and non dyked area (TT/refuellers etc) : the minimum duration will be 30 minutes.

4) 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) FOAM QUANTITY REQUIREMENT

- i. For locations aggregate capacity upto 30,000 kl (Single contingency):

Foam solution application at the rate of 5 lpm/ sqm for the liquid surface of the single largest cone roof tank.

- ii. For locations aggregate capacity more than 30,000 kl (Double contingency). (Assume, two cone roof tank farm are the two largest simultaneous fire risk in a double contingency Installation for the purpose of foam requirement).

- a. Foam solution application at the rate of 5 lpm/ sqm for the liquid surface of the single largest cone roof tank.

- b. Two hose streams of foam each with a capacity of 1140 lpm of foam solution.

6) FOAM COMPOUND STORAGE

- i. Foam compound should be stored as explained in IS-4989:2006/UL-162. 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 AFSs handling methanol.
- 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: 2006/UL-162 or Equivalent Standard.
- v. Quantity of foam compound equal to 100% of requirement as calculated above should be stored in an AFS.

(F) SCADA/SERVER room protection

- i. SCADA /server room provided for location having pipeline receipt should be protected by Clean Agent Fire Extinguishing System
- ii. Persons should be evacuated from the areas before the clean agent fire extinguishing system comes into operation.
- iii. Each hazard area to be protected by the protection system independently. 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.

(G) FIRST AID FIRE FIGHTING EQUIPMENT

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, Emergency trolley shall be provided at AFSs.
- ii. The above emergency shall be readily available at AFSs at the Aviation Fuel Station. All the items of the kit shall be kept on a trolley specifically designed for the purpose.
- iii. For all other AFSs, Fire Proximity Suit, Water Gel Blanket, Resuscitator, First Aid Box, 2 nos. 10/9 kg DCP fire extinguishers, Safety helmets, Fire buckets, etc shall be placed at an easily accessible location inside the AFS.

(H) Emergency shut Down (ESD)/Emergency Shutdown Button (ESB) system

The ESD/ESB shall be provided in SCADA room as well as at strategic location. ESD / ESB system shall be operated through push buttons or wireless connection. While ESD will actuate overall shutdown for location having Hydrant Refueling system, ESBs shall actuate shutting down of Product pumps, compressors.

(i) Actuation / pressing of any ESD shall initiate following actions:

1. Shutdown of all operations.
2. Power Shutdown
3. Process Shutdown shall include the following:
 - a. To stop all unloading and delivery pumps.
 - b. Barrier gates & access control system to open.
 - c. All MOVs to close.

(ii) Power Shutdown shall initiate the following:

1. Trip all the panels other than Emergency panel. The Emergency panel should host Siren, Bore wells, critical High Mast tower lights outside the licensed area, security

cabin, critical lights in unloading/Refuellers loading area, Admin block, MCC room and power to the control room/Automation system.

2. There should be interlock between ESD for operations shut down and ESD for Power shut down so that full power shut down takes after a time lag required for closing the MOVs and full closure of valves shall be ensured. The time lag shall be location specific.

At pipe line receipt locations alarm signal should 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.

(I) Mock drills and Mutual aid:

- i. Written mutual aid arrangements are shall be worked out by locations to facilitate additional help in the event of Level-II and level-III emergencies by way of rendering manpower, medical aid or fire fighting equipments, etc. as per ERDMP Regulations 2010 and its latest amendments.
- ii. The mutual aid arrangement shall be such that the incident controller of the affected installation shall be supported by neighboring industries on call basis for the support services materials and equipment already agreed. Further, all such services deputed by member industry shall work under the command of the site incident controller of the affected installation.
- iii. Mutual aid associations shall conduct regular meetings, develop written plans and test the effectiveness of their plans by holding drills.
- iv. Fresh agreement shall be made on expiry of 2 years or whenever there is change in the signatories to the agreement.
- v. Quarterly meeting of Mutual Aid members shall be conducted and the minutes shall be recorded and the minutes shall be reviewed in the subsequent meetings.
- vi. Arrangement of mutual aid scheme with the local airport operator/authority and sharing of firefighting with neighboring agencies should be ensured.

(J) ERDMP (Emergency Response and Disaster Management Plan):

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 and the copies of the ERDMP shall be available to all personnel in the installation.

(K) 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.

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 and flow.
- ii. Each pump shall be checked, tested and its shut-off pressure observed once in a month.
- iii. Each pump shall be checked and tested for its performance once in six months by opening required nos. of hydrants or monitors depending on the capacity of the pump to verify that

- the discharge pressure, flow and motor load are in conformity with the design parameters.
- iv. Each pump shall be test run continuously for 4 hours at its rated head and flow using circulation line of fire water storage tanks and observations relating thereto shall be logged once a year.
 - v. The testing of standby jockey pump, if provided shall be checked weekly. Frequent starts and stops of the pump indicate that there are water leaks in the system which should be attended to promptly.

2) Fire water ring mains:

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

3) Fire water spray system:

- i. Water spray system shall be tested for performance that is to say its effectiveness and 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 thereof shall be maintained.

4) Fixed and semi fixed foam system:

- i. Fixed or Semi fixed foam system on storage tanks should be tested once in six months and such testing shall include the testing of foam maker or chamber.
- ii. The foam maker or chamber should be designed suitably to facilitate discharge of foam outside the cone roof tank and after testing foam system, piping should be flushed with water.

5) Clean agent system:

Clean agent fire extinguishing system should be checked as below, namely: -

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

6) Hoses:

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

7) Communication system:

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

8) Fire water tank or reservoir:

- (1) Above ground fire water tanks should be inspected externally and internally.
- (2) The water reservoir shall be emptied out and cleaned once in 3 years, but floating leaves, material or algae, if any, shall be removed once in 6 months or as and when required.

9) Fire extinguishers:

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

8.0 Vehicle Management System:

Qualification of Driver: -

- i. The drivers shall hold a valid driving license for type of vehicle to be driven and shall be authorized to drive vehicle carrying specific class of product under local dangerous goods regulations.
- ii. The regulations of airport with regard to qualification and experience of driver will prevail.

**“PART K:
(Lube manufacturing and filling plants)
[See Regulation 6]**

1.0 INTRODUCTION

Lube manufacturing and filling plants were inherently considered safe and non-hazardous operations. The products handled during the process of manufacturing of lubes fall under the category of excluded petroleum which will not require PESO license for storage, however, small quantities of petroleum Class-B and C in the form of fuels for running utilities and for additives / dyes will require storage license as applicable.

2.0 APPLICABILITY

For Lube manufacturing and filling plants across the country falling under the scope of this regulation: Part A (Design and Layout), Part B (Design Considerations), Part C (Safe Operating Practices), Part E (Fire Protection and Prevention Facilities) and Part F (Maintenance and inspection) shall be superseded by “Part K” and remaining parts i.e., Part D (Commissioning or De-commissioning of facilities), Part G (Competence Assurance and Assessment), Part H (Vehicle Management System) and Part I (Safety Management System) shall hold good.

3.0 SCOPE

The clauses of this part of regulation lays down minimum safety requirements in design, layout, automation, storage, loading / unloading, packaging, inspection and maintenance, fire protection, of lube manufacturing plants including standalone packing and fillings units with / without blending facilities.

4.0 LUBE PLANT LAYOUT DESIGN

LAYOUT PHILOSOPHY

Following philosophy should be adopted in layout of a Lube Plant:

- a) Quantitative Risk Assessment should 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 should be given due credit.
Risk assessment should include societal risk (if any). The outcome should guide in preparation of onsite/off site emergency plan. Further, emergency response disaster management plan (ERDMP) should be made in line with requirement of PNGRB guidelines 2010 and its latest amendments.
Quantitative Risk Assessment (QRA) should be done whenever major addition(s) in facilities (such as addition of major storage facility, new process unit block) or major demographic changes in the surrounding of plant areas takes place.
- b) Two approaches from the highway / major road should be provided, one for normal movement and other for emergency exit. Both these approaches should be available for receipt of assistance in emergency. Minimum road width should be 3.5 M for one-way vehicular movement.
- c) Alternative access should be provided for each block so that it can be approached for firefighting in the event of blockage on one route.
- d) Road widths, gradient and turning radius at road junctions should be designed to facilitate movement of the largest fire-fighting vehicle envisaged in the event of emergency.
- e) Physical segregation should be provided between operating and non-operating area. Segregation should be minimum 1 M height either in the form of chain link fence or brick wall or combination of both. Entry to operating area should be through security access control only, that may be either manual or using technology.
- f) Various additives should be stored within the blocks in separate demarcated area with required fire protection as per MSDS.

4.1 LAYOUT FACILITIES

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

- (i) Storage tanks, utility requirements.
- (ii) Product receipt / dispatch and mode of transport (Rail, Road, Pipeline and Tanker / Barge).
- (iii) Warehouses, storage areas for additives, containers, packaging bitumen / asphalt etc., and other open storage areas like scrap yards and dumping ground.
- (iv) Chemicals / Toxic chemicals storage, Sludge, hazardous waste storage / disposal facilities etc.
- (v) Service buildings, fire station and allied facilities.
- (vi) Site topography including elevation, slop, and drainage.
- (vii) Meteorological data.
- (viii) Bathymetric data (high tide level, surge wave height etc.) for installations in coastal areas.
- (ix) Seismic data and probability of Tsunami in coastal areas.
- (x) Highest flood level in the area, water table, natural streams/ canals.
- (xi) Approach roads for functional areas.
- (xii) Aviation considerations to and from adjacent facilities.
- (xiii) Environmental considerations.
- (xiv) Statutory requirements.

GENERAL CONSIDERATION FOR THE LAYOUT OF BLOCKS / FACILITIES

While locating the various facilities the following should be considered:

- a) Layout of blocks / facilities should be in sequential order of process flow.
- b) The process operations like blending, and packaging operation should be carried out under the common block / shed, Separate block for boiler / heating unit should be provided. Refer table for separation distance between blocks and between units within the block.
- c) Plant elevation should be higher than the outside boundary surroundings and approach roads inside the plant area should be on higher ground to avoid flooding.
- d) Process units, tank farm, bulk loading / unloading gantry/platform, filling, boiler unit/other heating unit, solid storage, additive storages, Effluent Treatment Plant (ETP) / OWS and utilities should be located on high ground to avoid flooding.
- e) Fire control room should be earmarked / located in non-operating area, upwind (Majority of the year) of lube oil storage, handling, blending, filling/storage area and at a distance (refer table) from potential leak sources. It should not be located on a lower level than surrounding plant area and tank farms. Fire control room may be in the security room/administrative building.
- f) Utility facilities should be located in separate blocks. However, air compressor can be installed in the boiler house in same block.
- g) Overhead power transmission lines should not pass over the plant processing and operating areas including the truck parking areas. In case, the power transmission lines are passing through non- operating areas, horizontal / vertical clearance should be in line with the Central Electricity Authority.
- h) High Tension (HT) line and HT sub-station(s) should be terminated / located outside the operating area.
- i) Truck (bulk and packed) movement inside the plant should be kept 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. Positioning of truck at loading unloading facilities inside the plant should be in drive out position for easy escape in case of emergency.
- j) A designated platform should be provided suitably at the main entrance exit gate, inside the location, for the purpose of checking road taker safety fittings / documents to avoid any obstruction for other vehicular movement in normal / emergency situation.
- k) Surface drainage should be provided in the plant and drainage from each operating blocks/facility should be routed to OWS/ETP. The drains should always be maintained operable and clean.
- l) Effluent Treatment Plant should be located at a distance as per table. This should be closer to disposal point (to outside storm drain) by the side of the boundary and at lower grade to facilitate gravity flow of effluent from other operating facilities.
- m) Roads should be provided in a symmetric manner to serve all areas requiring access for the operation, maintenance, and firefighting. At least two approaches should be provided for each operating area.
- n) Smoking booths shall not be allowed inside the plant area.
- o) Firewater storage and firewater pump house should be located upwind of lube/hydrocarbon storage and handling facilities with straight approach from non-operating area to enable easy receipt of mutual aid and make up water assistance/replenishment.
- p) The provision shall be made to receive the water from other sources including mutual aid / sharing of water directly into fire water storage tanks. Provision should also be made to receive water in an underground tank and lifting / diverting to main water storage tanks.
- q) All buildings which are not related to direct plant operation should be located at upwind of lube/ hydrocarbon storage and handling facilities. These should be located outside the operating area. These areas include administrative building, canteen, security / access control gate, emergency control room etc. Location of such facilities shall be based on Risk Assessment.
- r) Congestion inside the plant area because of buildings, structures, pipelines, trees etc. shall not be allowed. Such addition of facilities in existing plant shall be decided based

- on Quantitative Risk Assessment.
- s) While selecting location of laboratory, due consideration shall be given for hazards from main plant/unit facilities assessed through Risk Assessment. Floor should be resistant to fire and chemicals and made anti-skid. There should be no fittings on the floor that would hinder / obstruct free movement. Sinks and drains should be made of chemically resistant material and the drains should be properly trapped and vented. Final discharge to storm water drain shall be thru' neutralization pit.
 - The laboratory shall have segregated storage of materials in various categories like inflammable hydrocarbon samples in -bulk, toxic, reactive such as chemicals and re-agents, retention samples in non-bulk etc. Compressed gas cylinders shall be chained or strapped and placed outside the laboratory in a well-ventilated shed. This area shall be readily approachable for material handling / firefighting.
 - Effective ventilation i.e., forced ventilation / air turbo ventilation, single pass once –through type shall be considered with about 10-12 changes of whole air /per hr. Emergency exits shall be provided at strategic locations. Each laboratory shall have two easily accessible, hindrance free exits. Doors shall open in the direction of the exit.
 - t) Turbo / forced ventilation shall be considered for enclosed /confined process / utility blocks.
 - u) Various additives (non-bulk), within blocks, shall be stored at the demarcated area based on requirement of fire protection system and application as per respective Material Safety Data Sheet. Additives falling under A/ B class shall be stored separately (duly marked) with suitable fire protection.
 - v) Electrical fittings and fixtures for empty package storage area (HDPE/ PE/ PET/ PFTE) containers, cartons, labels etc. should be flame proof type. Laboratory storing inflammable materials shall have designated / demarcated area for storage of hazardous products.
 - w) All electrical cables shall be laid through conduit / cable trench. The designated cable route should be having route markers as per applicable Rules.
 - x) Storage of sludge inside the plant or its disposal strictly should be as per concerned state pollution control board's norms.

4.1.1 LAYOUT OF FACILITIES

DYKE ENCLOSURE

- a) Storage tanks for excluded petroleum product shall be located in dyked enclosures. Each dyke shall have roads all around for access for normal operation and maintenance as well for emergency handling.
- b) For excluded product, 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 shall be 600 mm.
- c) Where Petroleum class-C is stored in separate dyke or along with excluded product, the enclosure capacity shall be constructed for containment of the largest tank content. The height of the enclosure wall shall be not less than one metre.
- d) The dyke wall made up of earth, concrete or solid masonry shall be designed to withstand the hydrostatic load.
- e) The dyke enclosure wall and dyke inside area shall be constructed leak proof / impervious to prevent ground pollution.
- f) Dyke enclosure (entire area of the dyke) should have impervious layer of suitable material such as EPDM (ethylene propylene di-monomer) liner / polyethylene sheet/PCC or RCC to prevent the ground water contamination.
- g) The dyke and the enclosures shall 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. Following should be done –
 - Piping through dyke wall if any shall be properly sealed to make dyke impervious.

- The dyke area shall have proper slope outward of tank pad towards the inner periphery of the dyke enclosure to prevent reverse flow.
- h) 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 should be displayed near the facility for ease of understanding.
- i) Pumps and pipe racks should be located outside dyke areas by the side of roads. The same shall not be applicable for excluded products.
- j) Horizontal above ground tanks are mounted horizontally above ground and are approachable externally. Horizontal above ground tanks, irrespective of product class, mounted on pedestals shall meet followings: -
- Dyked enclosure shall contain the largest tank capacity.
 - Separation distance between adjacent tanks shall be $(D+d)/4$ or minimum 3 m whichever is higher.
 - Separation distance from adjacent facility / boundary shall be minimum 15 m.
 - Minimum two manholes having minimum size of 600 mm.
 - All tanks shall have either individual or common stairs with toe guards and hand railing. Emergency exit / stair should be considered.
 - Drain from dyked enclosure shall be routed to ETP/OWS
 - Vents shall be located / terminated at a minimum height of 4 M from the ground level.
 - 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 liner centimeter and shall be further protected from rain by hood or by suitably bending it downward.
 - The petroleum product shall enter a tank through closed piping system / coupled electrically continuous and sound hose.
- k) Underground tanks are placed in earth, masonry or concrete pit and packed around with sand, earth or clay leaving no air space between the tank and the pit. Under Ground Tanks, irrespective of product class, shall meet followings: -
- Inter tank distance for UG tanks shall be $(D+d)/4$ or minimum 1.5 M whichever is higher.
 - A minimum of 3 M clear distance around the tank shall be maintained (from structures / boundary wall etc.).
 - Minimum burial depth under the earth should be 300 mm and the manholes / gauge pipe should be 300 mm above the ground level.
 - Minimum two manholes having minimum size of 600 mm.
 - Embankment wall of minimum 300 mm height shall be provided in the UG tank farm area to contain accidental overflow/spillage and area shall be paved.
 - Drain from UG tank farm shall be routed to ETP/OWS
 - Vents shall be located / terminated at a minimum height of 4 M from the ground level.
 - 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 liner centimeter and shall be further protected from rain by hood or by suitably bending it downward.
 - The petroleum product shall enter a tank through closed piping system / coupled electrically continuous and sound hose.
- l) Depending upon saline /corrosive nature of water/weather, suitable corrosion protection measures shall be considered for storage tanks, pipelines and other facilities.

4.1.2 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. For example, excluded product and other than excluded products should be stored in separate dyked enclosure.

- b) In case, different class of products are stored in any combination of product classification, the following shall, be applicable:
 - When excluded petroleum is stored with other class of product in same dyke, applicable fire protection shall be considered based on flash point of different class of products and fire protection for lower flash point product shall be applicable for all other tanks in that dyked enclosure.
- c) Tanks should be arranged in maximum two rows so that each tank is approachable from the road around the tank farm enclosure. This stipulation is not applicable for tanks storing excluded products, however, tanks in middle rows not covered by hydrant/monitors from outside of dyke, shall be considered with elevated monitors or oscillating monitors for adequate water coverage.
- d) To meet the objective, the peripheral drain of the plant shall be provided with sluice gates at the exit point where from drain goes outside of boundary. Pipelines if any entering / exiting the plant boundary shall be sealed properly.

4.1.3 FIRE BREAK WALLS INSIDE DYKE ENCLOSURE

- a) In a dyked enclosure where more than one tank is located, fire break walls of minimum height shall be provided to prevent spills from one tank endangering any other tank in the same enclosure as per following: -
 - i. For excluded petroleum product storage, for the provision of firewall, a group of small tanks with aggregate capacity not exceeding 5000 kl shall be treated as one tank for the provision of firewall. The height of fire wall should be minimum 300 mm.
 - ii. For other than excluded product storage, a group of small tanks each not exceeding 9 M diameter and in all not exceeding 5000 kl in capacity shall be treated as one tank for the provision of fire wall. The height of fire wall should be minimum 600 mm.
- b) Drains inside the dyke area, if passes through fire break wall, shall be isolated suitably by providing valve.

4.1.4 LAYOUT OF SUBSTATION

- a) The main substation floor shall be raised above grade level and the space below the sub-station floor (cellar) shall be utilized for installation of cable trays. The bottom of cable trench entering the cable cellar shall be kept minimum 150 mm grade level. In case the cable cellars provided from top, the cable tray entering the substation shall have provision to arrest rainwater from outside.
- b) Every substation shall have a min of two exits. These exits shall be located at opposite ends of the building, to prevent the possibility of operating personnel being trapped in case of fire. The doors should open outward and be equipped with exit signs. For existing plants, all effort shall be made to meet these guidelines.
- c) The roof shall be given adequate water proofing treatment to ensure that rainwater does not seep into the substation.

4.1.5 GENERAL

- 4.1.5.1 The tank height shall not exceed one and half times the diameter of the tank or 20 m whichever is less.
- 4.1.5.2 All Piping from / to any tank shall run directly to outside of dyke to minimize piping within the enclosures.
 - Piping design inside tank dyke area should ensure easy accessibility for any operations in the tank farm. Elevated Catwalks 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.
- 4.1.5.3 No part of the dyked enclosure shall be below the level of surrounding ground

immediately around the outside of dyke area.

4.1.5.4 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.

4.1.5.5 Properly laid out road shall be provided for easy access on all four sides of each dyke for normal and emergency use.

4.1.6 PROTECTION OF FACILITIES:

- a) Properly laid out roads around various facilities shall be provided within the plant 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 3m height with V/U/X shaped barbed wire fencing on top of the wall with 600 mm diameter concertina coil on top (in V/U/X shaped fencing).
- c) 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.
- d) CCTV shall be installed in plant area covering entry/exit gate, periphery of installation and all critical operating areas which should be monitored continuously. CCTV monitoring station shall be provided in control room, Security cabin and in-charge room.
- e) The storage tank bottoms may be protected against soil corrosion by providing suitable cathodic protection system based on requirement and maintained (if provided) in sound working condition.
- f) Truck parking area based on fleet size shall be provided adjacent to the plant gate with following facilities:
 - Segregation of parking area thru' chain link fence/boundary wall.
 - Separate entry and exit gate with security control.
 - Parking lane demarcation or slotting to ensure independent drive out position parking for quick evacuation in the event of emergency.
 - Suitable fire protection facility through hydrant / monitors shall be considered at least from two sides of the parking lot.

4.2 SEPARATION DISTANCES BETWEEN VARIOUS FACILITIES

A. BETWEEN STORAGE TANKS AND OFFSITE FACILITIES

- a) For lube manufacturing plant storing excluded products, minimum separation distances between various facilities shall be as per table-1. The table shall be read in conjunction with the notes specified with the table.
- b) Class-C petroleum, if stored in separate dyke or along with excluded product, in lube plant, the same table-1 shall be applicable for the purpose of separation distances between various facilities.
- c) 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.
- d) For facilities where inter distance is not meeting in existing locations, necessary Quantitative Risk Assessment (QRA) carried out and suggested control / mitigation measures shall be implemented.
- e) The layout shall also take into account findings / recommendations of Risk Analysis / Assessment study, which should be carried out at all the stages of facility development process.

B. FOR SEPARATION DISTANCES BETWEEN OTHER BLOCKS/EQUIPMENT: -

Table -2 shall be followed for inter-distances between various facilities within the

Process Block. The table shall be read in conjunction with the notes specified with the table.

Table-1: Separation distances between various facilities (between storage tanks and offsite facilities): -

#	From / To	1	2	3	4	5	6	7	8	9	10
1	Process Block	30 (Note4)	15	15	30	30	20	30	15	30	15
2	Storage tanks in tank farm area (Excluded/Class C) *	15	x	15	30	15/30	0.5 D min 20	20/30	15	30	15
3	Bulk loading/unloading gantry (excluded/ class C) *	15	15	X	30	15/30	20	20/30	15	30	15
4	Fire Engines/water tanks	30	30	30	X	30	6	6	6	30	X
5	Boiler house	30	15/30	15/30	30	X	15	15	6	30	6
6	Boundary wall	20	0.5 D min 20	20	6	15	X	X	6	15	X
7	Admin Building/ / Fire Control Room/ Canteen	30	20/30	20/30	6	15	X	X	15	15	X
8	Cooling Tower/ DM/ RWTP	15	15	15	6	6	6	15	X	6	6
9	OWS/API separator or Sludge pit	30	30	30	30	30	15	15	6	X	15
10	Electrical sub station	15	15	15	X	6	X	X	6	15	X
11	Warehouse	15	15	15	6	15	X	X	15	15	X
12	Fire Station (Fire tender, Ambulance etc.)	30	30	30	X	30	X	X	6	15	X
13	Thermic Fluid Heater	15/6 (Note-5)	15	15	15	X	15	15	15	15	15

* Indicates separate inter distance for excluded and Class C

Table-2: Inter-distances between various facilities within the Process Block: -

#	From / To	1	2	3	4	5	6	7	8	9
1	Process control room	X	X	6	6	3.5	3.5	6	6	6
2	QC Lab	X	X	6	6	3.5	3.5	6	6	6
3	Blending Kettles	6	6	3 (Note-3)	3.5	3.5	3.5	6	6	6
4	Intermediate/Finished Product storage	6	6	3.5	X	3.5	3.5	6	3.5	6
5	Filling Nozzle	3.5	3.5	3.5	3.5	X	3.5	3.5	3.5	6
6	Drum Empty Unit	3.5	3.5	3.5	3.5	3.5	X	3.5	3.5	3.5
7	Packaging Material	6	6	6	6	3.5	3.5	3.5 (Note-3)	3.5	6

8	Packed Material Storage	6	6	6	3.5	3.5	3.5	3.5	X	6
9	Package Container Loading	6	6	6	6	6	3.5	6	6	X

NOTE:

General Note to table -1 & 2

1. All distances are in meters. "X" indicates any suitable distance for constructional, operational and maintenance requirement as per good engineering practice.
2. 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. (ii) The distances given in case of storage tanks are from the shell of the tank.
3. The distance specified is between two sub-units/ facilities in the same Process Block.
4. Separation distances between two Process Blocks shall not be less than 30 m. In case of space constraints, the distance can be reduced, provided hydrants are placed at a minimum distance of 20m from the respective process Blocks on both sides.
5. Thermic fluid unit within the process block shall have clear distance of 6 m from other facilities in the same process unit. Thermal fluid heater unit and Boiler unit can be in the same block.

Specific note to table- 1& 2:

1. For a process control room attached to single process unit like lube blending unit, the minimum separation distance shall be 6 M from the nearest vessel. Each process control room shall have separate emergency exit.
2. The distance specified in tables above is minimum.
3. Building within the blocks for operational / maintenance requirements shall not be considered as administrative building for the purpose of inter-distances.
4. Mezzanine floor is provided for storage of input packaging material and to feed the same to filling nozzles. The Mezzanine floor, if required can be constructed above the can filling machine / nozzles. In such cases, electrical fittings inside the cellar above the Mezzanine floor should be flame proof type. Necessary fall arresting protection like railings / guards etc., shall be in place to avoid any accidental fall of personnel while working inside the cellar above the Mezzanine floor.

5.0 DESIGN CONSIDERATIONS

CONSTRUCTION OF STORAGE

TANKS

Fixed Roof Tank

Fixed roof may be of cone type or dome shaped. The tank may be pressurized (to a few inches of water) type with fuel gas or inert gas blanketing to prevent oxygen/moisture ingress. For designing atmospheric / low pressure tanks, API STD 650 or API 620 or IS 803 or IS 10987 shall be followed based on the type of the tank.

SELECTION OF TYPE OF STORAGE TANKS

Selection of type of tank generally depends on ambient conditions and the product handled.

SPECIAL CONSIDERATIONS

Tank bottoms should be of cone up or cone down ("Apex down") based on requirement and product handled.

TANK APPURTENANCES

i) **Handrails**

Handrails and toe guards shall be provided around the roof for safe movement of personnel for tank dipping, inspection, maintenance etc.

ii) **Stairs**

Above ground / horizontal tanks shall have access to their roofs by means of a ladder or staircase constructed and attached to the outer tank shell. An alternate, emergency access / escape ladder or staircase may be constructed based on site specific / user requirement.

Stairs should be made of grating. All staircases shall have resting / landing platform for every 5 m height. The landing platform as well as individual stairs / ladders shall be provided with toe guard. The stairs / ladders shall have suitable hand railings on both sides.

iii) **Manholes**

Number of manholes shall depend on diameter of the tank and code followed for construction of tanks. Each manhole shall be of suitable sized and provided with hold down handle for ease of handling for maintenance etc.

iv) Two isolation valves to be installed on each product / water draw off lines.

TANK FARMS / MANIFOLDS

i) Tank Farm Drains

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.

ii) Dyke drain Valves shall be provided with position indicator. Audio alarm and visual indication should be provided in the control room to monitor open / close status of dyke valve.

TANK MANIFOLD

i) The number of inlet / outlet connections to the tank shell should be kept minimum. Each product line nozzle connected to tank shell shall have minimum two valves. 1st tank body valve on inlet / outlet lines should be motor operated valve (MOV) / Pneumatic operated valve (POV) and 2nd valve can be hand operated valve or MOV/POV as decided by the user. This clause is applicable for above ground tanks having capacity above 500 kl (nominal capacity). Water/ product drain lines / recirculation line shall be provided with at least two manual operated isolation valves. The above stipulation is not applicable for utilities / instrumentation lines entering the tanks.

ii) The Close push buttons of MOV/POV shall be provided in field i.e., just outside the dyke. Open feature can be near the valve inside the dyke these push buttons should have distinctive feature so that opening is different than action required for closing (e.g., pull type and push type). Motor operated valve (MOV) / Pneumatic operated valve (POV) should have provision for local manual over-ride.

iii) The push button assembly shall be mounted at a place, easy accessible to the operator and would be visible. MOV should have close remote operation from control room also.

- iv) Tank manifold(s) for excluded products, if provided, may be located inside the dyke. Manifold for class –C if considered shall be provided outside the dyke area. The floor underneath the manifold shall be paved and have embankment wall and connected to oil water drainage system leading to ETP / OWS.
- v) Thermal safety valve (TSV) / Expansion line should be provided for blocked portion of pipe line(s) to take care of the thermal expansion of product due to rise of temperature.
- vi) TSV outlet line or expansion line shall be connected back to tank shell / tank inlet / outlet line suitably. TSV or expansion line shall have provision of NRV before termination to tank shell or inlet / outlet line. Isolation valves shall be installed on both sides of NRV for ease of maintenance / inspection of NRV.

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 rainwater 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.

TANK HEATERS / MIXERS

i) 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.

ii) Design Criteria

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.

iii) Steam Heating (low pressure steam)

Man way heaters consist of a tube bundle, usually of hairpin type, fixed through a manhole of the tank. Man way heater should 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. As far possible, the Inlet and outlet nozzle height of steam coil should be such that the same should always be immersed in the dead level of storage tank during normal operations. Due to operational reason, if product level is brought down below the steam coils, the steam input thru' coils should be avoided / restricted and monitored for maximum temperature limit.

iv) Hot Oil system

In case of fuel oil, LSHS etc. steam leak in the tank could lead to boil over. For this reason, hot oil heating can also be considered for such cases. This would consist of fired heater located in remote area. A pump takes suction from a tank containing heating oil (e.g., dowtherm) and

circulates through heater to the tank. Necessary remote temperature indicators and control valves are required for the system.

Isolation and sampling facilities are to be provided at each tank to check leaks. Heating oil tank level should be monitored with indicators and alarms.

v) **Electric Heating**

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

vi) **Tank mixtures**

Mixing is required to avoid stratification of heavy oil products and also to accommodate downgraded products, seasonal quality changes as well as for pipeline inter phases during pipeline transfer.

vii) **Types of mixers**

- Blending may be carried out by side entry propeller mixers, jet mixers or educator mixers. In general educator mixers should be preferred for blending. The outlet of educator shall be located away from tank shell to avoid direct impingement.
- Jet mixing shall not be considered for high viscous products and products with high water content. Selection of type of mixer should be based on safety of operation. The mixing stream in operation should never break the surface of the liquid.
- The side entry propeller mixers should be of such design as to facilitate add-packing while the tank is in operation.

5.1 DRAINS FROM THE TANKS

i) **Bottom Drains**

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) **Drain line**

Each drain line shall have minimum two isolation valves 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.

5.2 VENTS

Open Vents

Number of vents shall be provided as per applicable standard. For sizing the vents API STD 2000 is to be referred. However, following are the basic guidelines need to be considered.

- Maximum and minimum ambient temperatures.
- Vapour pressure of the product at operating/design temperature.

- 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 procedure. For details refer –MOC chapter.
- Blending components likely to be handled in the tank.

5.3 DIP HATCH / SAMPLING

Dip hatch or gauge hatch is used for gauging the level of the liquid in a tank as well as to take out samples for testing. Gauge hatch cover shall be self-closing type. Suitable barrier shall be provided on roof around half of the neck of gauge hatches at downside to prevent any spread of spill owing to the gauging/sampling.

5.4 INSTRUMENTATION

- i) **Level instrument for storage tanks:** This clause is applicable for above ground tanks having nominal capacity above 500 KL. Level instrument on the tank should be provided as under: Minimum one reliable level instrument shall be provided in each above ground tank.

Level instrument on the tank should be provided as under:

- a) Minimum one reliable level instrument shall be provided in each above ground tank.
- b) High Level (H) alarms: The tank level instrument shall have provision for sending audio visual alarms to the process control room.
- c) Level for “H” alarm shall be decided based on site specific operating parameter i.e diameter of tank, flow rate and operator’s response time for corrective measures to stop product level reaching curb angel. However, this level shall be below the level corresponding to tank safe filling capacity.

- ii) This clause is applicable for above ground tanks having capacity above 500 kl. An independent level switch shall be provided at the “HH” level which in any case shall not be above the level corresponding to safe filling capacity of the tank.

This level switch shall enable initiation of action for closure of the respective tank inlet line MOV /POVs i.e., 1st tank body valve so that the entire receipt operation closes on safe mode and the product does not overflow.

Closure of pump should be based on pressure development philosophy in the outlet line in case of transfer from Refinery.

Care needs to be taken for tanks receiving product from ships at high flow rates for surge pressures due to sudden closures of valves and accordingly wherever required, suitably designed surge relief system to be provided. Timely closure of transfer operations to be ensured through effective communication system.

iii) 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. The location of the temperature indicator shall be 500 mm above the inlet/outlet nozzle so as not to sense the direct heat of the coil.

Insulation shall be provided for heat conservation. The storage tanks /process tanks having higher surface temperature shall have insulation up-to minimum 2 m high for personal

protection. Also, patch insulation should be provided on the shell along with spiral stairway/ladders.

PIPING / VALVES / FLANGES

Piping: should 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. Piggable pipelines shall be as per DIN standard or as per manufacturer’s recommendations so as to meet the operational requirements of pigging operations.

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.

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

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

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

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

The pipelines 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.

5.5 VALVES

Steel valves conforming to relevant API standards shall be used. Cast iron valves shall not be used for class C/ excluded Petroleum products.

5.6 FITTINGS

Steel flanges and flanged fittings shall conform to relevant ASME / ASTM/ANSI or equivalent.

5.7 Slip on or weld neck flanges should be used.

5.8 Screwed flanges for sizes 50 mm or smaller may be used

5.9 Steel flanges should conform to the applicable provisions of ASME B 16.5 or equivalent.

5.10 Steel screwed fittings and couplings shall conform to ASME B 16.11 or equivalent.

5.11 Steel unions shall have ground metal to metal seats. Gasket type unions shall not be used.

5.12 Plugs should be of steel. Cast iron or brass plugs shall not be used.

5.13 All flanges shall be connected for bonding for electrical continuity.

5.14 BULK LOADING / UNLOADING FACILITY

i) Loading / unloading Pumps

- Pumps conforming to relevant API standards or equivalents shall be used.
- 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.
- Pumps shall be installed on paved area above the ground level with drainage facilities routed to OWS / ETP.
- Pump house shall be well ventilated.
- 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.
- Loading pumps should also be provided with additional remote stop switches at the strategic point close to loading area to switch off the pump in case of emergency such as overflow, fire, or any other abnormal situation.
- Automated plants alternately, can install ESD at strategic points for total shutdown.
- Suction and discharge lines should 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, it (TSV) shall be provided with isolation valves. One isolation valve shall be installed close to the tank shell to the maximum extent possible.
- Pump delivery shall have bypass to facilitate loading operations in peak and lean periods.

ii) Tank truck loading Gantry (top or bottom loading)

- Loading points shall have quick shut-off valves such as Cast steel / Ball Valve.
- In case of loading hoses, only neoprene impregnated hoses having electrical continuity between nozzle and flange shall be used.
- Proper lighting shall be provided.
- Loading gantry shall be provided with at least one suitable telephone or walkie talkies for effective communication with pump house in normal and emergency operations.
- Tank truck loading gantry shall be suitable for all weather conditions.
- Tank Truck loading gantry shall be provided with safety harness to protect the operating crew against fall from height.
- Swing type loading platforms with counterweight and hand railing shall be provided and should be light in construction.
- Proper handrail arrangement shall be provided on platforms and stairs for safe movement of personnel. Stairs and platforms shall be constructed of gratings. Minimum width of stair shall be 610 mm.
- At one emergency escape ladder shall be provided at rear middle of 8 bays gantry for emergency use. Minimum width of emergency ladder stairs should be 610 mm. Escape ladders shall be prominently identified from distant view. A safety cage shall be provided around top portion of the escape ladder.
- 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. Isolation valves shall be located at least 15 m away from the gantry and easy accessible location.

- Drain in front and rear side of the loading / unloading gantry shall be provided. Open drains along gantry shall be covered with gratings so as not to endanger movement of personnel.
- Loading gantry area shall be paved for smooth draining. Oil and water collected from loading / unloading areas shall be routed to Oil water separator system / Effluent Treatment Plant or similar facility.
- 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.
- All trucks entering the plant shall have safety fittings as required.

iii) Blending vessel pumps

Installation of pumps should not be directly beneath the blending vessels. Spillage from the process vessels directly on heated / overheated pumps may cause safety / fire hazard.\

iv) Pipeline Pigging system and pigging Manifold

Interconnecting the large number of source tanks with different possible destinations (blending, filling and bulk loading etc., has always been a major challenge of Lube blending plants.

Thus, wherever required, the Pipeline Pigging system can be used where a large variety of products are transferred primarily for optimization of installation cost by reducing the number of lines.

The pigging system/ manifold must be a closed system to ensure safe interconnection without cross-contamination or product loss.

5.15 HANDLING OF SICK / LEAKY TANK TRUCKS/TANK WAGON

Suitable provision shall be made for safe handling of sick / leaky tank trucks/tank wagons. These methods should include:

- Arresting of leaks using suitable method as a first aid measure till the sick / leaky tank truck /tank wagon is unloaded safely at designated place. In no case such tank truck/tank wagon to be used for transportation.
- Either permanent facility or portable pump motor arrangements with suitable fittings to be used for quick disposal. Such products to be handled further as per IQCM (Industry Quality Control Manual)

5.16 HANDLING OF SLOP

Collection and Drainage

A network of drainage system shall be provided to collect Oil drains from various equipment, storage area, filling plant, 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.

5.17 ETP/ 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.

Final effluent discharge should be tested periodically to check the PPM contains in order to meet the prescribed limit by PCB.

5.18 ELECTRICAL EQUIPMENT

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.

Protection: 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 enclosure for electrical equipment/ panels/ JBs/ double entry glands for cable entries in process blocks, finished product and empty storage area should have Ingress Protection (IP 54/ IP 55).

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

a) Variable speed drivers, electrical system

A reduction in electricity consumption will be achieved by installing soft starters and variable speed drivers for agitators at the oil blending unit, pumps and compressors. Thus, should be considered.

b) Cables

In order to avoid spread of fire due to cables, the outer PVC sheath of all cables used inside the plant operating area shall be fire retardant type conforming to category AF as per IS: 10810. The cable shall have a low smoke property. The minimum Oxygen Index should be 29.

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

Instrument 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.

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.

c) Measurement of earth resistance

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. Earth resistance also can be measured through direct earth clamp tester (DECT).

The testing of the Earth Pits shall be done half yearly basis, once in dry and once in wet weather and records maintained.

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

Allowable earth-Resistance Values

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

- 4 ohm for electrical systems and metallic structures
- 7 ohm for storage tanks
- 1 ohm for main earth grid, and bonding connections between joints in pipelines and associated facilities.
- 2 Ohm for each electrode to the general mass of the earth (read in conjunction with note)

Note: In areas with high soil resistivity (e.g., Granite, rocky area etc.,) allowable resistance for individual electrode to the general mass of the earth is acceptable up-to 5 ohm, but grid resistance value shall no way exceed 1 ohm.

5.19 PLANT EARTHING / BONDING

Installation earthing design shall be carried out in accordance with the requirements of Indian Electricity Rules and IS: 3043, OISD RP 149 or equivalent system recognized by statutory authorities under the petroleum Act / electricity Act. All earth connections (termination) should be visible for inspection to the extent possible. Termination joints inside the earth pit shall be at workable depth to facilitate testing etc. Earthing system shall be designed for the following:

- System neutral earthing.
- Protective Equipment Earthing for personnel safety.
- Protection against Static discharges.
- Lightning Protection
- Earthing for Data Processing system

The earthing system shall have an earthing network with required number of earth electrodes connected to it. The following shall be earthed:

- System neutral.
- Current and potential transformer secondary neutral.
- Metallic non-current carrying parts of all electrical apparatus such as transformers, switch gears, motors, lighting/power panels, terminal boxes, control stations, lighting fixtures, receptacles etc.
- Steel structures, loading platform etc.
- Cable trays and racks, lighting mast and poles.
- Storage tanks, vessels, columns and all other process equipment.
- Electrical equipment fencing (e.g., transformer, yard etc.)
- Cable shields and armour.
- Flexible earth provision for truck.
- Pump handling hydrocarbon if its base plate is separate from motor's base plate.

a) Electrically independent earth electrodes

Earth electrodes should 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.

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 shall be connected to each other to form an independent earthing network. This independent earthing network /grid shall be connected with main earthing grid below the ground (at a depth of min. 500 mm), minimum at two points.

The use of rod / pipe / strip electrodes is permissible. Their choice will depend upon site conditions, soil resistivity and economic considerations. The material of earth electrodes shall be galvanized iron.

The whole of lightning protective system including any earth ring shall have a combined resistance to earth not exceeding 10 ohm without taking account of any bonding.

The Two Pole / Four Pole structure shall be earthed with two separate earth connections from grid. The Gang Operated Switch shall also be earthed.

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

The Neutral of the Transformer(s) shall be earthed with two distinct earth pits separately. Connections shall be made to the pit directly and then pits shall be connected to each other to form a grid. This independent earthing network /grid should be connected with main earthing grid below the ground (at a depth of min. 500 mm), minimum at two points.

The Neutral of the Diesel Generator(s) 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 independent earthing network /grid should be connected with main earthing grid below the ground (at a depth of min. 500 mm), minimum at two points.

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

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 in case of faults.

All the electrical equipment operating above 250 volts shall have two separate and distinct connections to the earth grid.

All Steel structures, loading platform / gantry etc., shall be earthed with two separate connections from main earthing grid.

Each Product Storage tank shall have one separate earth connection at every 30 M of the tank perimeter from main earthing grid. However, minimum two connections shall be provided for smaller tanks.

b) Bonding

Flanges: All joints in pipelines, valves, storage tanks and associated facilities and equipment for petroleum shall be made electrically continuous by bonding. The resistance value between each joint shall not exceed 1 ohm.

Tank Truck Loading and Unloading Gantry: For the 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).

c) Static earthing

Static Earthing (earthing for static charge dissipation) shall be provided at Tank Lorry filling / decantation Gantries, to prevent building up of Static Charges.

The earthing for static dissipation, electrical system and automation system shall be separate and can be taken from main grid below the ground.

d) Lightning protective for structure and building

Lightning protection shall be provided for the structures and buildings which are higher than 20 meters or as per the risk index analysis worked out as per IS 2309.

Self-conducting structures having metal thickness of more than 4.8 mm may not require lightning protection with aerial rod and down conductors. They shall, however, be connected to the earthing system, at least, at two points at the base.

Non-conducting chimneys or stacks whose overall width or diameter at top is up-to 1.5 m shall be provided with one aerial rod and down conductor and chimneys with overall width of diameter at top more than 1.5 m shall be provided with 2 Nos. aerial and down conductors.

In case, lightning arrester is provided for any structure or building or stack, an independent earthing network shall be provided for grounding the lightning protection system. This independent earthing network /grid shall be connected with main earthing grid below the ground (at a depth of min. 500 mm), minimum at two points. OISD-GDN-180 may be referred for details on lightning protection.

e) Earthing for data processing system

Low noise Earthing are required for critical data processing equipment. 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.

Wherever 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.

f) Minimum Permissible Sizes of the Earthing Conductors

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

Equipment	Size of the conductor
Main Earthing Grid	50 mm x 6 mm GI strip
Lightening Arrester of the 2/4 Pole Structure	50 mm x 6 mm GI strip
2/4 Pole structure / Sub-Station equipment's / VCB etc.	50 mm x 6 mm GI strip
Fence of the 2/4 pole structure / transformer yard	25 mm x 3 mm GI strip
Power Transformer Neutral	50 mm x 6 mm GI strip
Power Transformer Body	40 mm x 5 mm GI strip
Fire Water Pump House	25 mm x 3 mm GI strip
Building / Structure Columns	50 mm X 6 mm GI Strip
Storage Tanks	50 mm X 6 mm GI Strip
Push Button Stations	No. 8 SWG Solid GI Wire
Street Light Poles	10 mm (3/8") GI Wire Rope
Small Equipment and Instruments	No. 8 SWG Solid GI Wire
Bonding of Pipes	25 mm square copper strip / braided flexible cable.
Motors up to 3.7 Kw	No. 8 SWG Solid GI Wire
Motors above 3.7 Kw up to 30Kw	10 mm (3/8") GI Wire Rope
Static Earth at Tanker / Wagon loading/Unloading gantry	50 mm x 6 mm GI strip.
Flexible cable for Static Earth	10 Sq mm Copper flexible cables with lugs at one end and crocodile clip at other end.

g) Facility / equipment wise recommended minimum Nos. of earth pits / connections which should be bonded in main earthing grid.

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

Facility / Equipment	Nos. of earth pits / connections
For earthing of lighting arrester (LA)	2 Nos.
For Di / Four Pole Structure, GO, Fence	2 Nos.
For Neutral of the transformer(s).	2 Nos.
For Neutral of the DG Set(s)	2 Nos.
For Body and electrical control panel for DG Set(s)	2 Nos.
For main electrical Sub-station	4 Nos.
For Fire Pumps and electrical panels.	2 Nos.
For Air Compressors and electrical panels.	2 Nos.
For each structural shed.	2 Nos.
For Static Earthing of Loading / unloading Operations (Road)	2 Nos.
For electrical product pump motors & JB's in each shed.	2 Nos.
For each High Mast Tower (HMT)	2 Nos.
For each admin block	2 Nos.
Data Processing	2 Nos. independent grid.
Inspection Platform / Watch Tower / Weigh Bridge	Two connections from main earthing grid.

Each tank farm of product storage tanks	4 Nos. for each tank farm.
Each product storage tank	Two connections from main earthing grid (For additional connection refer 4.19 a)
Each fore water storage Tank	Two connections from main earthing grid.
For Laboratory / equipment	2 Nos.
All critical equipment / Electrical motor / JB etc.	Two connections from main earthing grid.
Other equipment such as Cooling Tower, Boiler, Thermic Fluid Heater, Weigh Bridge, filling machine, Blending vessels, Intermittent tanks etc.	Two earthing connections per equipment from earthing network / grid or as recommended by OEM.

h) Electrical safety for laboratories

Hazardous are classification within laboratory building should be carried out in line with OISD STD-113 and IS: 5572. Accordingly, the electrical equipment / fittings should be selected in line with IS:5571.

Following aspects should be considered for electrical equipment /fittings in the laboratory.

- Layout of electrical switch room shall have spacing as per Indian electricity rules.
- Plugs, having multiple outlets, should not be used. Industrial type closed /tight metal clad fittings for plug and socket assembly should be used.
- ELCB/ MCB shall be installed in the main power switchboard.

i) General

- Fail safe Interlock / change over switch shall be provided between the normal supply and the DG power to ensure that the equipment get supply from one source only.
- Insulation mats shall be provided in the Sub Station, control panels etc.
- Relays / Cables insulation shall be tested once in a year and records maintained.
- Transformer oil shall be tested once in a year and record maintained. Transformer Oil filtration should be done based on test results as and when required.
- Variable Frequency Drives (VFDs): In case VFDs are used for motors the motors should be inverter grade or equivalent as VFDs require Insulation class F motor and additional cooling of winding / bearings at lower RPM.

5.20 PLANT LIGHTING

Sufficient lighting shall be provided so as to enable Plant 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.

Normal lighting system shall be on 415/ 240V AC supply, whereas critical emergency lighting will be DC based in critical areas like Sub-Station, D G Room, Control Room, Security cabin(s).

Under normal operation, both emergency and normal lighting should be fed by normal power source. On failure of normal supply, emergency lighting should be transferred to emergency source until the start of D.G. set within 15 seconds.

Critical Emergency lighting (D.C. supply based) shall be normally kept 'ON'. During power failure, battery bank shall be used to provide power.

Lighting shall be provided for the various facilities in the Depot/Terminal. The illumination levels in different areas should be as per good engineering practice.

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.

Lighting requirements provided during the failure of power supply is intended broadly to,

- Facilitate carrying out of specified operations, for safe shutdown of the installation.
- Gain access and permit ready identification of firefighting facilities such as fire water pumps, fire alarm stations etc.
- To gain access to escape route for safe evacuation of operating personnel.

i) Depending on the nature of job activities carried out, the minimum illumination levels for various areas should be as follows:

Area	Lux level
Main roads (Gate entry /exit, roads around loading / unloading (bulk/packed) operating area	20
Secondary roads (along storage tanks and Periphery etc.,)	10
Tank farm area (tank body valve approach and operating area)	20
Pump / Compressor / additive dosing Sheds / Fire Pump House	100-150
Boiler house / thermic fluid unit / Cooling tower unit.	100-150
Main Operation Platforms and Access Stairs (bulk and packed)	60
Ordinary Platforms	20
OWS / ETP Area	60
Sub Station / PMCC room	150
Transformer yard / HT Di pole area	100
Battery room, Charger/UPS rooms	150
Inside Process block /filling units	100 / 150
Process control Room bldg./ laboratory	300
Lube Warehouse	100
Admin Building	300
Security Cabin / Watch Booth	100
Stairs (building)	50

Area	Lux level
Corridors (building)	70
Tank truck Parking area	20

- a) Low pressure sodium vapour lamps shall not be installed in hazardous areas.
- b) The lighting fixtures on various circuits shall be suitably designed so that failures of any one circuit do not result in complete darkness.
- c) Switches controlling the lighting fixtures and exhaust fan shall be installed outside the battery room.
- d) Switches of lighting panels installed in hazardous area, shall have a pole to break the neutral, in addition to the poles for phases.
- e) For details on inspection practices OISD standard 147 to be referred.
- f) Min. One number calibrated lux meter shall be kept in the location.

ii) Emergency lighting panel

Emergency lighting panel shall have provision of power input both from normal supply and DG supply independently with a provision of failsafe interlock. In the event of failure of normal supply or emergency or maintenance, emergency panel shall be receiving alternate supply from DG set. Emergency lighting panel shall host the following equipment:

Jockey Pump, Critical lighting (one or two high mast, minimum lighting for fire pump house, security room, control room, administrative building, operating facilities etc.), Fire Siren, Electrical pumps for fire water replenishment, Gate Barrier, safety instrumentation and interlocks such as CCTV, smoke/heat detectors, Dyke drain valve system, UPS of automation, supply to essential firefighting equipment.

5.21 AIR TURBO VENTILATION SYSTEM IN LUBE PLANTS

The ventilation not only provides pleasant, healthy working atmosphere in workplaces but also maintains hygienic condition. In emergency like fire, it also extracts smokes / fumes which enables easy escape of personnel working there and fire fighters to reach the fire site. Construction material should be weatherproof.

Thus, effective ventilation is desirable for 7 x 24 hrs at lube blending blocks, laboratory, boiler house, workshop and other working places wherever required. Design of ventilation system shall be such that it provides single pass once –through type and considered with about 10-12 changes of whole air /per hr.

Air turbo ventilation system is preferable as this ventilation works on natural wind energy without any electricity or generator. It can be installed on roof /slopes on sheds.

Salient features should be: -

- 7 x 24 hrs. availability.
- Noiseless operation.
- Cost effective.
- Capable of extracting heat, humidity, smoke, fumes and dust etc.
- Maintains hygienic condition.

5.22 FLOORING

- a) Flooring of blocks shall be non-skid type and having proper slope for necessary drainage.
- b) Any level difference on floor in account of operational requirement / equipment layout should be clearly demarcated so as to ensure safe movement of persons.

5.23 STAIRS AND PLATFORMS

- a) All platforms / stairs shall be of non-skid type surface, preferably made of gratings.
- b) Toe guards and suitable railing shall be provided all around the elevated platform.
- c) Alternate access / emergency escape shall be considered for each elevated platform.

5.24 LADDERS

a) General information

Ladder is an appliance or equipment usually consisting of two side rails joined together at regular intervals with cross pieces like steps, rugs or cleats and used in ascending or descending between two points at different levels.

In Oil industry mainly two types of ladders are used; one is built up ladder and another portable ladders of rigid construction. Salient features are given below, for details refer IS 3696.

Built up ladders

These are built on the job to its particular requirements. They are fastened to the structure in a fixed position, securely held in place and not moved about as required.

Portable ladders of rigid construction

These are used as and when required to give access to scaffolds, platforms etc. in a building or other structure or to any required location for repairs or maintenance. They may be of any type viz. stock ladders, extension ladders, sectional ladders, step ladders, trestle ladders, extension trestle ladders etc.

Portable ladders may be categorized of lean to ladders or self-supporting ladders.

Lean to ladder, that is, their upper ends are supported by leaning against a wall or any other rigid support.

Self-supporting ladders hinged near the upper end with a spreader arrangement between two sections. When such a ladder is arranged for use, it is in the form of letter "A". Wide flat steps are secured to the side rails which form one of the slopping sides of "A". The other slopping side acts as a strut to support the ladder.

b) Material construction of ladder

Metal ladder may be either of steel complying with IS 1977 or of Aluminium alloy complying with the suitable grade of IS 617. Wooden ladder or rope ladder should not be used in Petroleum Industry except usages around electrical equipment or circuits of any kind where there is a possibility of coming in contact with the current. Wooden ladders may be either of timber or of bamboo.

c) General requirements

- All ladders shall be constructed to carry their intended loads safely.
- Side rails of metal ladders should be of sufficient cross-section to prevent excessive deflection in use
- Ladders which are to remain as a part of the permanent structure should conform to any local, state or municipal bye laws which may be applicable.
- Top and bottom of each built up ladder should be securely fastened.
- All surfaces of the ladder should be planed, free of splinters and edge of handrails used should be beveled.
- Rung spacing should be uniform and not over 300 mm on centers. Rungs should be recessed at least 12 mm into rails.
- Safety shoes, lashing or other effective means shall be used to avoid danger of slipping

5.25 STACKING OF DRUMS / PACKED PRODUCTS

- i) Stacking of drums or packed lubes should be on racks/pallets/reefers and above the grade levels.
- ii) Stacking should be max in 4 rows, 5 tier height and 25 M length. A minimum access path should be provided which should be min of forklift turning radius plus 0.5 M between two groups of stacks.
- iii) Light fittings on the ceiling should be fixed in between two stack lines. Suitable cage type protection should be provided so as to avoid external damage.
- iv) The drum / packed storage space should be properly marked / painted on the flooring.

5.26 BOILER

The steam boilers intended for use in lube plants shall be governed by the regulation of Indian Boilers Act, 1923 and latest amended Rule thereof applicable in the concerned state.

The design and drawings of the boiler or boiler component, as the case may be, and the materials, mountings and fittings used in the repair of such boiler or boiler component conform to the applicable regulations.

5.27 STEAM TRAP

Suitable type steam trap shall be installed at outlet of steam lines. A steam trap is a device used to discharge condensate and non-condensable gases with a negligible consumption or loss of live steam. Most steam traps are nothing more than automatic valves. They open, close or modulate automatically. Others, like venture traps, are based on turbulent 2-phase flows to obstruct the steam flow.

The three important functions of steam traps are:

- Discharge condensate as soon as it is formed.
- Have negligible steam consumption.
- Have the capability of discharging air and other non-condensable gases.

5.28 THERMAL / STEAM INSULATION

Thermal energy inputs could be reduced through the proper insulation of the blending kettles, steam lines, tanks (deemed fit), equipment etc. to prevent heat losses. Effective insulation protects the personnel from burn injury, thus insulation always to be maintained in healthy condition.

5.29 COMPRESSOR

Compressed air

The quality of instrument air shall conform to the requirements as recommended by the manufacturers of instruments/ equipment:

If one compressor is envisaged to run normally, another standby compressor of 100% capacity shall be provided. When more than one compressor running is envisaged, 50% standby capacity shall be provided.

5.30 SERVICE WATER FOR PLANT OPERATIONS

Service water is required for the plant operations such as, Boiler use, cooling tower, compressor cooling and in hose stations for washing etc. Water may be provided at a pressure of about 3 Kg/sq.cm. g. If one pump is envisaged to run normally, another pump with 100% capacity shall be provided as a standby. Where more than one pump running is envisaged, 50% capacity as standby shall be provided.

Water Quality should be of potable quality conforming to IS: 10500 - Specification for Drinking Water.

5.31 COOLING TOWER

Cooling Tower should be located on the downwind side of the Plant, control room and administrative buildings. Product Pipe rack/ track should be located minimum 6m from cooling tower to avoid corrosion due to drift. Suitable dosing system should be provided for corrosion, scale and micro-biological control.

5.32 INDUCTION SEALING SYSTEM

The container sealing shall have auto cut-off in case of no/slow movement of containers. It shall also enable auto cut-off in case of no containers.

5.33 STORAGE SPACE FOR EMPTY PACKAGES, PACKED ADDITIVES, AND PACKED FINISHED PRODUCT

The storage area should be designed for supporting adequate inventories for peak production capacity to ensure safe storage, handling and smooth operation.

5.34 SRV FOR VESSELS/KETTLES IN CONFIRMITY TO ASME SECTION VIII Div. 1.

Pressure vessels / kettles with internal coils/limpet coils/jackets shall have SRV/s, set at 110% of the maximum operating/ working pressure.

5.35 PRESSURE REGULATION FOR LOW PRESSURE STEAM

Pressure reducing station should be provided, as applicable, for ensuring supply of low pressure (LP) steam.

5.36 TRANSFER / FILLING HOSES

Special type hoses should be used for transfer / filling operations to ensure spill free operations in lube plant. Hoses intended to be used for special products /chemicals / liquids in a lube plant should be selected in conformity to the type / pressure rating required to serve the intended purpose.

5.37 AUTO CUT-OFF FACILITY

Lube filling machines preferably should have automatic features like auto filling, auto cutoff, auto pick up etc.

6.0 SAFE OPERATING/HANDLING PRACTICES IN LUBE PLANT OPERATIONS

GENERAL

This section deals with the safe operating practices and provisions applying to loading, unloading and storage of bulk Petroleum Products at installations. There should be strict compliance w.r.t selection, deployment of proper skilled manpower for effective operation and maintenance.

6.1 SAFE OPERATING PRACTICES

- i) Plant process control room wherever provided shall be manned on continuous basis during operations and in emergency.
- ii) Site Specific, Standard Operating Procedures (SOPs) shall be developed which not only give what the procedures are, but also why they are needed.

These must be made with the involvement of users and approved by the operations and safety team. Such procedures 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).

- iii) The critical operating steps based on “SOPs” shall be displayed on the board near the location where applicable.
- iv) POV shall be in fail safe mode (i.e., with loss of pressure the valve shall shut off). At the day end operations all operating valves must be in closed position.
- v) VHF or UHF handsets of appropriate type shall be provided to all operating personnel working in critical areas.

- vi) Check list for operators for checking safety system and equipment shall be prepared and check records kept in safe custody.
- vii) All operations shall be carried out under supervision of a responsible officer. Only in serious exigencies, permission can be granted by authorized personnel subject to obtaining a reliever forthwith. The person leaving site shall only be allowed on a valid authorization issued by the immediate officer and records maintained.
- viii) The pipeline transfer should preferably be commenced during day light. Due to urgency if operation requires to be carried out/extended in nighttime, the same to be carried out under supervision of adequately trained and experienced staff.
- ix) Manning level in the shift shall be adequate to ensure coverage for normal and emergency operations.
- x) Suitable interlocks shall be provided for tripping / alarm of MOV operation based on the events e.g., low level, high level, high high level, high pressure, low pressure etc.
- xi) 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 (ETP) for safe disposal.
- xii) Personnel protective equipment (PPE):

Equipment designed to offer protection against potential hazards, fire, toxicity, accidental fall etc. during normal and emergency operations.

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

6.2 BULK HANDLING FOR MOVEMENT BY ROAD

- i) Transportation of petroleum products by road is regulated by the Motor Vehicle Act 1988.
- ii) Containers and tank trucks should be fabricated in accordance with OISD-RP-167 POL Tank lorry design and Safety or applicable statutory requirement.
- iii) All TTs to be fitted with antilock braking system (ABS) as per RTO regulations published in 2006.

6.3 SAFETY PRECAUTIONS DURING TANK VEHICLE LOADING / UNLOADING IN BULK

- i) Following precaution shall be taken due to associated hazards during transfer of Petroleum products to or from a tank truck.
- ii) Open source of ignition shall not be allowed in the area where product transfer operations are carried out.
- iii) Similarly, minimum 3% vapour space shall be kept in containers and 2% vapour space in tank trucks in respect of petroleum Class C / excluded product.

- iv) Fire extinguishers shall be placed near the tank trucks during operations in a designated marked place.
- v) The Double pole master switch shall be put off immediately after parking the truck in position. No electrical switch on the truck shall be turned "on" or "off" during the transfer operation.
- vi) The first operation after positioning the truck shall be providing wedge / stopper and earthing. They shall be removed / disconnected just before the release of the truck.
- vii) Hoses shall be handled with care and inspected periodically as per OISD-STD-135.
- viii) No repairs shall be made on the truck while it is in the loading / unloading area.
- ix) Personnel shall wear applicable Personal Protective equipment.
- x) Filling/transfer operations should be suspended immediately in the event of –
 - Uncontrolled leakage occurring.
 - A fire occurring in the vicinity.
 - Lightning and thunder storm.

6.4 SAFE PROCEDURES DURING OPERATION

(A) Loading operations

- i) Check for following in a tank truck as per statutory regulations before accepting it for filling:
 - Provision of PV vent, emergency vent, Master valve and other safety fittings.
 - 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.
 - Provision of 2 nos. of Fire Extinguishers of ISI mark (1 no. X 9 kg DCP and 1 no. 1 kg CO₂ /DCP /equivalent approved fire extinguisher).
 - Spark arrestors should be properly bolted / welded on the exhaust.
 - No leakage in exhaust silencer pipe.
 - Availability of valid RTO certificate.
 - Availability of brazed copper strip for Earthing / bonding connection.
- ii) Drive the truck at stipulated speed to the loading bay.
- iii) Place the truck on loading bay and place wheel wedge /stopper / chokes at front and rear wheels. Keep the truck in neutral mode with hand brakes "ON".
- iv) Stop the engine and switch off all electrical equipment.
- v) All persons should leave the driver's cabin.
- vi) Provide earthing connections of the vehicle at specified point to the fixed grounding system.
- vii) Start the loading operations.
- viii) The quantity loaded into the truck can be assessed by –
 - Liquid level through manual dipping
 - Filling through' Flow meter

(B) Unloading operations

- i) Operations described under clause 5.4(A) should be selectively carried out.

- ii) Test the connections for leaks
- iii) Start the unloading operations
- iv) Before realizing the trucks ensure that valves are closed / ends are capped.

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

Checklist for bulk/packed lube / additive trucks at loading / unloading locations is given at Annexure-1.

6.5 HANDLING OF SICK BULK TRUCK /TANK WAGON

When a truck/wagon is found leaking during / after loading, provision should be kept for unloading the content safely. A drain header should be provided to drain out the content to an underground tank / sump from where it can be pumped out to storage tank or to the loading header. Alternatively, in case, mobile pump is used for unloading sick truck, suitable type electrical motor and power connection should be provided.

6.6 PIPELINE TRANSFER OPERATIONS

Pipeline transfer of product is carried out for receipt / delivery of products to the plant from refinery / jetty pipeline within the same company or between the oil companies.

Wherever pipeline transfer is envisaged between various companies, a mass flow meter with integrator shall be installed on receipt line at both ends i.e., dispatch and receipt ends. Signal should be provided in the control rooms of both dispatching and receiving companies / plants for monitoring delivered quantity.

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) Line up shall be started from the exchange pit end
- 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 should 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
- 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) Pipeline 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 should 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. For flying switch over from one tank to another, a written down procedure to be in place and followed.

6.7 SAFETY PRECAUTIONS IN TANK FARM AREA OPERATIONS

- i) At the end of day operations, 100 % closure of all the operating valves must be ensured and they shall not be left in partial open condition.
- ii) All electrical fittings shall be maintained to ensure its integrity and type of protection.
- iii) The tank farm shall be kept clean and free from vegetation
- iv) Tanks and tank aprons shall be periodically checked for damage, leakages, sweating and repairs inline with requirement of OISD STD 129.
- v) Proper earthing and bonding shall be maintained for storage tanks and across the flange joints
- vi) Dyke drain valve shall be positioned outside of dyke and kept normally in closed condition and shall be operated only under supervision of authorized person and logbook maintained.
- vii) Isolation Valves on expansion line(s) / TSV vent line(s) shall be always kept open except under requirement during location specific operations to take care thermal expansion.
- viii) No gauging or sampling of tanks should be undertaken during thunder or hailstorms.
- ix) Flow velocity at tank inlet should not exceed 1 m/s until the inlet is completely submerged.
- x) Safety shoe (Conductive type) shall be worn while gauging, sampling or taking temperatures.
- xi) Ensure that gauge tapes with earthing provision are used for gauging.
- xii) Tank dip pipes shall be extending to tank bottom. If dip pipes are not provided, give a relaxation time of 30 minutes before sampling/gauging.
- xiii) Synthetic fiber 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 should not be used instead.
- xiv) Natural fibers such as sisal and manila have sufficient conductivity to prevent the operator from becoming charged by handling it, hence can also be used.
- xv) In case of large tank farms effective communication is essential. Apart from VHF, Pagers with loud hooters may be provided on roadside at various locations. This can also be utilized for communication during emergency like fire.
- xvi) While cleaning the tanks, care should be taken to avoid generation of static electricity. Cleaning of tanks by gas oil spray shall not be permitted. Cleaning of tanks by steaming shall be permitted for Class C/excluded products but not permitted for class-B products. Water washing is preferred.
- xvii) If the tank has internal heating coils, steam to the coils should not be charged until the coils are fully submerged and condensate from these coils must be monitored for Oil content.
- xviii) Side entry mixtures should be operated only when liquid level is above the blades.

6.8 SAFETY INSTRUCTION REGARDING USAGE OF PORTABLE LADDERS

- i) Before use, all ladders shall be tested for load test. For load test, a test load of 1.5 times the mass of worker plus the mass of 16 bricks shall be hung from each rung. The rung and ladder should not show any distress or noticeable bending. The lower rungs may be tested by reversing the ladder. Unless otherwise specified, the mass of worker should be taken as 68 kgs. Load testing shall be done when ladders are brought to the construction site and when damage to ladders is anticipated or observed on visual inspection.
- ii) No ladder having a missing or defective rung shall be used. Defective ladders shall be promptly and properly repaired or replaced.
- iii) Ladders leading to landing shall extend at least one meter above the landing and shall be secured at the upper end.
- iv) To prevent slipping, a ladder shall be secured at the bottom end, otherwise, a person shall

- be stationed at the base wherever it is use.
- v) The pitch at which a lean-to ladder is used shall be such that the horizontal distance of its foot from the vertical plane of its top shall be not more than one quarter of its length.
 - vi) If the surface of the floor on which the ladder rests is smooth or sloping, the ladder shall be provided with non-slip bases.
 - vii) If the use of ladder is essential during strong winds, it shall be securely lashed in positions
 - viii) No ladder shall be placed or leant against window panes, sashes or such other unsafe or yielding objects, nor placed in front of doors opening towards it. If set up in driveways, passage ways or public walkways, it shall be protected by suitable barricades.
 - ix) When ascending or descending, the user shall face the ladder, use both his hands and place his feet near the ends of the rungs rather than near middle
 - x) It is dangerous to lean more than 300 mm to side in order to reach a larger area from a single setting of the ladder. Instead, the user should get down and shift the ladder to the required position
 - xi) Metal ladders shall not be used around the electrical equipment or circuits of any kind where there is a possibility of coming in contact with the current. Metal ladders shall be marked with signs reading “CAUTION: DO NOT USE NEAR ELECTRICAL EQUIPMENT”

6.9 PRECAUTIONS FOR BOILER OPERATIONS

These instructions should be frequently and carefully studied, with view to keeping in mind the precautions to be observed and the ordinary procedure to be followed in the Safe working of boilers.

a) Precautions before starting the Fire; Before starting the fires in a boiler, the attendant should:

- See that there is sufficient water in the boiler, and that the gauge cocks are working freely.
- Ease safety valves, or open cock on top of boiler to allow air to escape.
- See that the blow-off cock is fully closed and tight
- See that the safety valves and feed check valve are free and workable.
- See that water is not leaking from any part of the boiler
- Note if the pressure gauge pointer is at zero. See that the feed pump is in working order.

The attendant must not rely on the supposition that the water he has previously put in is still in the boiler, as it may not have run out without his knowledge through a leak or open cock, nor can be sure that the gauge glass shows the true water level until he has tested it. This is done in the following manner, shut off the lower gauge cock and empties the glass by the drain cock; then shut the drain cock and open the gauge cock; if everything is in order, the water will then rise in the glass to the same height as before.

- b) Special attention for gauge glass: A large number of accidents have been due to inoperative water gauges and to negligence of the attendant in not carefully reading the water level. It does not follow that there is plenty of water in the boiler because there is plenty of water in the gauge glass. The passages may be choked, and empty gauge glasses are sometime mistaken for full ones and explosions have resulted the reform. Hence it is important to keep the gauge cocks perfectly tight and clean blowing through the test cocks frequently. Every water gauge glass to be fitted with a guard to prevent injury to the attendants. See that it is always in place, and clean when there is steam in the boiler
- c) Pressure gauge: The pressure or steam gauge should be kept in order and be in such a position as to be easily seen by the boiler attendant. There should be a plain mark on it showing the highest pressure allowed for the boiler, and the dial should be kept clean so that the figures may easily be read.
- d) Safety valve: The safety valves are provided to guard against over pressure. They should be moved by hand every day so as to prevent them from sticking. If moved only occasionally, they are liable to leak. The valve can be tested by slowly raising it a little, and when let down it should close perfectly tight.

It should never be opened by a sudden knock or pull. If it does not close tight, turn it on its seat until it fits or when its construction does not permit this, raise it slowly a few times and let it down again but on no account must the valve be screwed down further or loaded more than what has been allowed by the Inspector.

Safety valves must never be overloaded, and spring valves should have ferrules or other provisions against the valves being screwed down too far.

- e) Steam pressure: Ordinarily the safety valve will prevent steam from raising much above the working pressure, but if the steam gauge shows so rapid an increase of pressure as to indicate danger of exceeding the highest limit, water should be immediately fed into the boiler and the dampers partially closed in order to diminish the effect of the fire. If, however, the water has fallen so low that there is danger of an accident from this cause, the fires should be withdrawn before feeding in water, the safety valves eased and if the engine is at rest, it should be started so as to reduce the pressure.
- f) The Blow-off Cock: The blow-off should be used daily if the water is at all dirty or sedimentary, especially with Locomotive type and Vertical Boilers, as their narrow water spaces are liable to get choked with mud, which soon hardens into a solid mass. The amount of water to be blown out depends on the size of the boiler and can be determined only from experience. When blowing out, the best result is obtained if the water has been at rest for some time (say before the engine is started) thus giving the sediment time to settle. If the feed water is clean merely turn the cock round.
- g) Re-ignition boiler: Before re-ignition of boiler, sufficient degassing should be done as per SOP to ensure nil hydrocarbon vapour presence. SOP to be displayed.

6.10 FORKLIFT OPERATIONS

- Load bearing test for the forklifts shall be done at a frequency in line with requirement of concerned state Gov. Inspector of Factories and record maintained.
- Vision test / eye test for the forklift operators shall be done at a frequency in line with requirement of concerned state Govt. Inspector of Factories and record maintained.
- Neither forklift or it's operator shall be engaged if above statutory requirements are expired.

6.11 WEIGH BRIDGE

- Calibration of Weigh Bridge shall be carried out as per concerned state Govt. Legal Metrology requirement.
- Required quantity of weight should be kept at site as per requirement of Legal Metrology.

7.0 FIRE PROTECTION FACILITIES

GENERAL CONSIDERATIONS

The size of product storage and handling facilities, their location and terrain determine the basic fire protection requirements.

FIRE PROTECTION PHILOSOPHY

The fire protection philosophy is based on loss prevention and control. It considers that a lube plant 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 plant, if not controlled / extinguished as quickly as possible to minimize the loss of life and property and prevent further spread of fire.

FIRE PROTECTION

Depending on the nature of risk, required fire protection facilities should be provided from the following:

Fire Water System - (storage / pumps / distribution piping network with hydrant / monitors/elevated monitors)

- First Aid Fire Fighting Equipment.
- Trolley mounted Fire Fighting Equipment.
- Carbon Dioxide System
- Dry Chemical Extinguishing System
- Clean Agent Protection System.
- Detection and alarm systems
- Communication System.

DESIGN CRITERIA FOR FIRE PROTECTION SYSTEM

- a) Facilities shall be designed on the basis that city fire water supply is not available close to the installation.
- b) The hydrant system shall be kept pressurized @ 7 kg/sq.cm by jockey pumps. The fire water pumps shall be provided with auto start facility with pressure drop in fire water network.
- c) For lube plant storing mainly 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.
- d) If Class –A and or B products are stored in above ground tanks in the lube plants, applicable fire protection system in line with PNGRB T4S Petroleum installation regulation shall be provided. Class –A and or B storage tanks should be in separate dyke. If stored in common dyke with class –C / excluded storage in above ground tanks, the applicable fixed type spray system shall also be provided on all tanks as applicable in PNGRB T4S Petroleum installation regulation. *However, this clause should not be applicable in case the class A and or Class B and or Class C product is stored in UG tanks. In such cases, fire protection facility as per Petroleum Rules shall be applicable.*
- e) The operating / hazardous areas shall be protected by a well laid combination of hydrants and monitors. The following plants are exempted from this provision: -
 - i) The plants having aggregate above ground storage capacity of less than 1500 KL, irrespective of class.
 - ii) Plants storing products in UG tanks, irrespective of class.
- f) Installations where inter distances between tanks (class C and above) in a dyke and / or within dykes are not conforming to the extant provisions of this standard. Additional remedial measures (if any) need to be taken based on QRA report and recommendations.
- g) The empty package storage area within blocks which stores flammable materials such as cans or small containers /cartons/labels/pails or buckets/HDPE barrels etc., shall be covered by manually operated medium velocity fixed type spray system with application @ 10 lpm / sq.m area. Isolation valves on fixed type spray riser lines shall be provided at sufficient distance from the hazard i.e., 15 M(minimum), preferably outside of shed. Alternate isolation valves should be considered from opposite side. However, for existing plants or plants under construction, in case it is not practically feasible to provide the fixed spray system due to space constraints or structural stability of the sheds, the double hydrant points should be provided outside the shed at nearest location of the empty package storage area so that any exigency can

- be mitigated.
- h) The storage area should be divided in zones with max 150 sq.m size. For the purpose of fire water calculation 3 zones shall be considered at a time, affected zone and adjacent two zones. For optimization of water consumption, the area may be divided into suitable sized zones. The total area of 3 zones shall be limited to 450 sq.m. In case area exceeds the above stipulation, the same shall have separation distance of minimum 3 M between two storage areas.
 - i) The smoke/heat detectors shall be installed overhead near carton storage area, process control room, warehouse and laboratory. These smoke/heat detectors, in the event of smoke/heat shall annunciate visual indication and audio alarm in the process control room at field and repeater panel in fire control room for action thereon.
 - j) Lube (bulk/packed) truck loading/unloading gantries/facilities, tank farm area (including product pump station and manifold area) shall be fully covered with alternate hydrant and water cum foam monitors having nozzle with jet, spray and fog arrangement and located at a spacing of 30 M at least at two sides of the facility.
 - k) Hydrant facility should not be laid inside the process blocks viz. blending process blocks. However, hydrant system should be laid all around the process blocks.
 - l) The hydrants and monitors shall be located at a minimum distance of 15 m from the hazard to be protected.
 - m) Portable monitors / foam hose streams shall be provided for fighting fires in dyke area and other plant area.
 - n) At least two Nos. trolley mounted water cum foam monitor of capacity 2400 lpm each shall be provided at lube plant.

7.1 FIRE WATER SYSTEM DESIGN

Water is used for fire extinguishments, fire control, and exposure protection of equipment, foam application and personnel from heat radiation.

Header Pressure: Fire water system shall be designed for a minimum residual pressure of 7 kg/cm² (g) at hydraulically remotest point in the installation considering the design flow rate.

- a) A fire water ring main shall be provided all around perimeter of the plant facilities with hydrants / monitors spaced at intervals not exceeding 30 m when measured aially. Fire hydrants and monitors shall not be installed within 15 Meters from the facilities/ equipment to be protected.
- b) The water replenishment arrangement either from bore well or natural / artificial reservoir should be at least 12.5 % of per hour design flow rate. Availability of fire water from above source should be 7 x 24 Hrs.
- c) The installation shall have facilities for receiving fire water from external source in emergency and diverting them to the fire water storage tanks.

7.2 FIRE WATER DESIGN FLOW RATE

The design flow rate shall be any one of the maximum requirements of the following cases for four (4)hrs.

- a) For lube plant 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.
- b) For Class-A and/or B petroleum, if stored in the same plant, the water requirement should be based on requirement as stipulated in PNGRB T4S Regulation for Petroleum Installation, whether the fixed fire protection facilities are provided or not. Storage of class A/B product in

non-bulk category shall comply Petroleum Rules.

- c) Water requirement corresponding to 2 nos. of 2400 lpm water cum foam monitor.
- d) The water requirement for fixed type water spray system (affected zone and adjacent zones).

Design flow rate shall be the maximum among a, b, c and d above.

7.3 FIRE WATER STORAGE

- a) Water for the firefighting shall be stored in easily accessible surface or underground or above ground tanks of steel, concrete.
- b) The effective capacity of the reservoir/tank above the level of suction point shall be minimum 4 hours aggregate rated capacity of pumps.
- c) Fresh water should be used for firefighting purposes. In case sea water or treated effluent water is used for firefighting purposes, the material of the pipe selected shall be suitable for the service.
- d) Storage 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.
- e) Large natural reservoirs having water capacity exceeding 10 times the aggregate fire water requirement can be left unlined.

7.4 FIRE WATER PUMPS

- a) 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. Isolation valve one each shall be installed on upstream of suction strainer and downstream of NRV on discharge line respectively.
- b) 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.
- c) 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 and head as the main pumps shall be provided. Fire water pumps shall be of equal capacity and head.
- d) 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 installed inside the pump house, a safe distance from engine (3 m) to be maintained and the vent shall have provision for venting outside the pump house. Installation of fuel tank shall be such that tank bottom is at least 200 mm above the suction valve of the fuel injection pump / as specified by OEM.
- e) Fire water pumps and storage shall be located away from the potential hazards and shall be at least 30 m (minimum) from periphery of hazards, equipment or where hydrocarbons are handled or stored.
- f) Fire water pumps shall be exclusively used for firefighting purpose only.
- g) Suction and discharge valves of fire water pumps shall be kept full open all the times.
- h) 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.
- i) Auto cut-in / cut-off facility should be provided for jockey pumps to maintain the line pressure.

- j) 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. The detail operation of fire water pumps shall be as follows:
- The main fire pump(s) shall start automatically in set sequence in response to a low-pressure condition in the hydrant system.
 - Stand by fire water pump(s) shall start automatically if the main pumps do not start or fail to buildup the required pressure within 20 seconds.
 - Provision shall be made for manual starting of each pump at the pump house and from controlroom also. However, manual stop of each pump unit shall be only at pump house.

7.5 FIRE HYDRANT NETWORK

- a) 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.
- b) Fire hydrant ring main shall be laid above ground ensuring that:
- i) Pipeline shall be laid at a height of 300 mm to 400mm above finished ground level.
 - ii) The pipe support shall have only point contact. The mains shall be supported at regular intervals:
 - For pipeline size less than 150 mm, support interval should not exceed 3 m.
 - For pipeline size 150mm and above, support interval should not exceed 6 m or design approved.
 - The system for above ground portion shall be analyzed for flexibility against thermal expansion and necessary expansion loops where called for shall be provided.
- c) Fire hydrant ring main may be laid underground at the following places:
- i) At road crossings.
 - ii) Places where above ground piping is likely to cause obstruction to operation and vehicle movement.
 - iii) Places where above ground piping is likely to get damaged mechanically.
 - iv) Where frost conditions warrant, and ambient temperature is likely to fall below zero deg. Centigrade, underground piping should be provided at least 1 meter below the ground level. Alternatively, in such cases water circulation to be carried out for above ground pipelines.
- d) Fire water ring main laid underground shall ensure the following:
- i) Pipes made of composite material shall be laid underground
 - ii) 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.
 - iii) The Ring main shall be suitably protected against soil corrosion by suitable coating / wrapping with or without cathodic protection.
 - iv) In case of poor soil conditions, it may be necessary to provide concrete / masonry supports under the pipeline.
- e) Size of hydrant pipeline:

- i) 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.
 - ii) The velocity of water shall not exceed 5 meter per second in fire water ring main.
 - iii) 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.
 - iv) The stand post for hydrants and monitors shall be sized to meet the respective design water flow rates.
- f) General
- i) 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 and maintenance.
 - ii) Associated fixed spray /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.
 - iii) The riser connections shall be taken directly from the mains and provided with separate isolation valve outside of dyke. Suitable strainer should be provided on fixed spray riser connection and shall be located outside of dyke.

7.6 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 m 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 m intervals. The horizontal range and coverage of hydrants with hose connections shall not be considered beyond 45 m.
- iii) Hydrants shall be located at a minimum distance of 15 m from the periphery of storage tank or equipment under protection. In case of buildings this distance shall not be less than 2 m and not more than 15 m 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 roadside berms for easy accessibility.
- vi) Fixed water/water cum foam monitors (if applicable) 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) Bulk and packed truck loading and unloading facilities shall be provided with alternate hydrant / water monitors to ensure adequate coverage and located at a spacing of 30 m at least at two sides of the facility.

The hydrants and monitors shall be located at a minimum distance of 15 m from the hazard to be protected.

7.7 MATERIAL SPECIFICATIONS

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

- i) Pipes: Carbon Steel as per IS: 3589/IS: 1239/IS: 1978 or Composite Material or its equivalent for freshwater 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 should 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:
 - Stand post - Carbon Steel
 - Outlet valves – Gunmetal/ Aluminium/ Stainless/ Steel/Al-Zn Alloy
- iv) Monitors / Water cum foam monitors.
 - Approved / listed by any of the international certifying agencies like UL, FM, VdS or LPC.
 - 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)/UL or Equivalent Standard.
- vi) Painting:
 - Fire water mains, hydrant and monitor stand posts, risers of water spray system shall be painted with “Fire Red” paint as per of IS: 5.
 - Hose boxes, water monitors and hydrant outlets shall be painted with “Luminous Yellow” paint as per IS: 5.
 - Corrosion resistant paint shall be used in corrosion prone areas.

7.8 PROCESS CONTROL ROOM (HAVING CONSOLE/MONITOR, RACK, UPS, BATTERY AND COMPUTERS) PROTECTION

- Smoke /heat detectors shall be installed in the process control room with alarm facility in control room and repeater panel in fire control room.

- Control room should be protected by portable type Clean Agent Fire Extinguishers in addition to portable CO2 fire extinguishers.
- Clean agent shall conform to the NFPA-2001 (Latest edition).

7.9 FIRST AID FIREFIGHTING EQUIPMENT

Portable Fire Extinguishers

- All fire extinguishers shall conform to respective IS/UL or Equivalent codes, viz. 1, 2, 3, 4, 6 and 9 Kg DCP portable type (IS: 15683 /UL 299) and 2, 3, 4.5 and 6 Kg CO2 portable type (IS: 15683/UL 154) and 25/50/75 Kg DCP trolley mounted type (IS: 10658/UL 299) and bear ISI/UL mark. BIS/UL or Equivalent certificates of all extinguishers shall be maintained at the location.
- While selecting the Extinguisher, due consideration should be given to the factors like flow rate, discharge time and throw in line with IS: 2190 / UL 711.
- The Dry Chemical Powder used in extinguisher and carbon dioxide gas used as expelling agent shall be as per relevant IS/UL or Equivalent code.
- 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.
- 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.
- 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.
- Portable fire extinguishers shall be located at convenient locations and are readily accessible and clearly visible at all times. The no. of extinguishers at various locations should be provided as per following table.
- The sand buckets shall have round bottom with bottom handle having 9-liter water capacity conforming to IS: 2546. The sand stored in bucket shall be fine and free from oil, water or rubbish.
- Suitable weather protection shall be provided wherever the fire extinguishers or sand buckets are positioned outdoor.
- The maximum running distance to locate an extinguisher shall not exceed 15 m.
- The extinguisher shall be installed in such a way that its top surface is not more than 1.5m above the floor/ground level.

7.10 Wheeled / trolley mounted firefighting equipment

Wheeled / trolley mounted firefighting equipment includes foam trolleys, water cum foam monitor, 75/25 kgs DCP fire extinguisher etc. Minimum deployment of portable firefighting equipment at Lube manufacturing plants.

S. No.	Type of Area	Scale of Portable Fire Extinguishers
i)	A/G Tank Farm	2 Nos. 09 Kg DCP extinguishers for each tank plus 4 Nos. 25 Kg DCP extinguishers for each Tank Farm positioned at four corners. In case of adjoining tank farms, the no. of 25 Kg extinguishers can be reduced by 2 nos. per tank farm.
ii)	U/G Tank Farm	2 Nos. 09 Kg DCP extinguisher for each Tank Farm
iii)	Bulk loading / unloading gantry	1 x 10 kgs DCP for every two bays plus 1 x 75 kgs For the gantry.
iv)	Pump House (Class C and excluded) Up to 50 HP Above 50 HP	1 no. 09 Kg DCP for every 4 pumps up to 50 HP. 2 nos. 09 Kg DCP or 1x25 kg DCP for 4 pumps.
v)	Other Pump Houses	1 No.09 Kg DCP extinguisher for every two pumps or min 2 Nos.09 Kg DCP extinguisher for each Pump House whichever is higher.
vi)	Lube Go-down	1 No. 09 Kg DCP extinguisher for every 200 m ² or min. 2 Nos. in each Go-down whichever is higher. In addition, minimum 1 no. 75 kg wheeled type DCP extinguishers should be provided.
vii)	Lube blending / cooking unit	1 No. 09 Kg DCP extinguisher for 100 m ² or min. 2 Nos. in each unit whichever is higher plus 1 x 75 kgs DCP.
viii)	Lube Filling unit	1 No. 09 Kg DCP extinguisher for 100 m ² or min. 2 Nos. in each Shed whichever is higher plus 1 x 75 kgs DCP.
ix)	Administrative Building and Store House	1 No.09 Kg DCP extinguisher for every 200 m ² or min. 2 Nos. 09 Kg DCP extinguishers for each floor of Building/Store whichever is higher.
x)	DG Room	2 Nos. each 09 Kg DCP and 4.5 Kg CO ₂ extinguishers for each DG room.
xi)	Main switch Room/Sub- Station	1 No. 4.5 Kg CO ₂ extinguisher for every 25 m ² plus 1 No. 9 Liter sand bucket.
xii)	Computer Room/ Cabin	2 Nos. of 2 Kg CO ₂ or 2 Nos. of 2.5 Kg Clean Agent extinguisher per Computer Room and 1 No. 2 Kg CO ₂ or 1 No. 1.0 Kg Clean Agent extinguisher per cabin.
xiii)	Security Cabin	1 No. 09 Kg DCP extinguisher per cabin.
xiv)	Canteen	1 No. 09 Kg DCP extinguisher for 100 m ² .
xv)	Workshop	1 No. 09 Kg DCP extinguisher and 1 No. 2 Kg CO ₂ extinguisher.
xvi)	Laboratory	1 No. 09 Kg DCP extinguisher and 1 No. 4.5 Kg CO ₂ extinguisher.

S. No.	Type of Area	Scale of Portable Fire Extinguishers
xvii)	Oil Sample Storage Room	1 No. 09 Kg DCP extinguisher per 100 m ² or min. 1 no. 10 Kg extinguisher per room whichever is higher.
xviii)	Effluent Treatment Plant	1 No. 75 Kg. and 2 nos. 09 Kg. DCP Extinguisher
xix)	Transformer	1 No. 09 Kg. DCP extinguisher per transformer.
xx)	UPS / Charger Room	1 No. 2 Kg. CO2 extinguisher.

Note: - All fire extinguishers shall bear ISI or equivalent mark.

Wheeled Fire Fighting Equipment inclusive of quantity specified elsewhere in the standard.

S. No	Type of equipment	Minimum Quantity
1	2400 lpm water cum foam monitor	Two
2	250 lits foam compound trolley	Two
3	75 kgs DCP	Three
4	25 Kgs DCP	As per requirement of this STD.

7.11 HOSES, NOZZLES and ACCESSORIES

7.11.1 Hoses

7.11.1.1 Reinforced rubber lined canvas or non-percolating synthetic fire hoses conforming to IS-636/ UL 19 (Type A or B) should be provided.

7.11.1.2 The length and diameter of the hoses should be 15 m and 63 mm respectively fitted with instantaneous type male and female couplings of material as specified in IS 636/UL 19. All fire hoses shall be tested @ 10 kgs/sq.cm once in every six months and record maintained.

7.11.1.3 The number of hoses (in addition to hose box hose) stored in a lube plant shall be 30% of the number of hydrant outlets. The minimum No. of hoses stored, however, shall not be less than 10 numbers.

7.11.1.4 The hoses shall be stored at convenient and easily accessible location in the lube plant.

7.11.2 Nozzles

7.11.2.1 In addition to one jet nozzle provided in each hose box, there shall be at least two nozzles in each category as per relevant IS/UL Codes and maintained in the plant as per following table.

S. No.	Item Description	Minimum Requirement
1	Jet Nozzle	2 Nos.
2	Fog Nozzle	2 Nos.
3	Universal branch pipe with nozzle	2 Nos.
4	Foam branch Pipe 1140 lpm	2 Nos.
5	Water curtain	2 Nos.

7.11.3 Accessories:

7.11.3.1 The following minimum no. of Personal Protective Equipment, First Aid Equipment and Safety Instrument shall be provided as indicated against each item.

S. No	Item Description	Minimum requirement
1	Sand drum with scoop	4 Nos.
2	Electrical Siren (3 km range)	1 No.
3	Hand operated siren or MCP one each at strategic operating unit.	No. at each operating area
4	Multi gas detector with provision of measuring % of Oxygen and HC detectors.	1 No.
5	Red and Green flag for fire drill	2 Nos. in each color.
6	PA system	1 No.
7	Wind socks	1 No.

7.11.4 Hose box and accessories:

7.11.4.1 One hose box to be provided between two hydrant points. Each hose box shall contain 2 numbers of fire hoses and one no jet nozzle.

7.11.5 Personnel protective equipment

S.No.	Item description	Minimum requirement
1	Safety helmet	1 No. per person
2	Safety shoe meant for use in plant and handling black oil / bitumen.	As per plant requirement
3	Plash goggles	As per plant requirement
4	Rubber hand glove	2 Pairs
5	Fire proximity suit	1 Suit
6	SCBA Set (45-minute capacity) with spare cylinder	1 set
7	Ear muff	As per plant requirement
8	Suitable electrical hand gloves	As per plant requirement
9	Resuscitator	1 No.
10	Safety shower and eye wash facility	1 set each
11	Water jell blanket	1 No.
12	Stretcher with blanket	2 Nos.
13	Multipurpose detector (HC and Oxygen)	1 No.
14	Boiler suit	As per plant requirement
15	Apron at lab	As per lab requirement.
16	First Aid box	1 No.

Note: -

- The above guidelines are minimum requirement of each item and can be increased depending on the scale of operations/size of plant or as per requirement of statutory authorities.
- A fire trolley containing Fire Proximity Suit, B. A. Set, and Stretcher with water Jel Blanket, Resuscitator, First Aid Box, Spare fire hoses, Special purpose nozzles, Foam branch pipes, foam etc., should be kept in a speculated place easily accesses-able on demand.
- Explosive meter, P. A. System shall be readily available at the plant and positioned to have easy access to it during emergency situation.

d) In addition, an emergency kit shall be provided consisting of safety items as per the item list given below and shall be readily available at the terminals.

7.11.6 Emergency kit items

7.11.6.1 Emergency Kit consists of listed emergency equipment required for rescue and control / arresting leakage in case of emergency in lube plant. The equipment should be mounted on a compact light weight trolley. Emergency Kit should be consisting of the following emergency equipment:

S. No	Item	Quantity	Remarks
1	Fire proximity suit	1 set	
2	Breathing apparatus set (45-minute duration)	2 sets	
3	Flame proof search light	2 nos.	Rechargeable type suitable for Explosive Environment.
4	Hand siren with stand	1 no	Approx. range of 1.6 KMS
5	Fireman axe	1no	
6	First aid box	1 no.	
7	Manual resuscitator	1 no	Manually operated for artificial respirators consisting of adult size nose, mouth, face plate, air bulb with oxygen inlet connection, non-return, non-breathing human valves and first aid charge packed in a plastic bag
8	Folding stretcher	1 no	Size 6 feet X 3 feet with tying belts and blanket.
9	Mechanical tool kit	1 set	
10	Cold / low temperature hand gloves	2 Pairs	
11	Electrical rubber hand gloves	2 pair	Suitable for Electrical jobs up-to 33000 Volts
12	Electrical tester	1 no	
13	Chemical / oil splash proof goggles	2 nos.	ANSI/CE marked

7.11.6.2 All the items of the kit shall be kept on a trolley specifically designed for the purpose. List of PPE's as mentioned in other clauses should be merged with this list. Any item featuring more than in one list should be considered for one time only.

7.12 USE OF FOAM AND STORAGE

Foam shall be used AR-AFFF or AFFF or equivalent and minimum quantity shall be stored for application of 2 x 2400 lpm capacity water cum foam monitors for 30 minutes or actual requirement for class-B tank (if applicable) whichever is higher. Potential foam loss to be considered due to wind / wastage. At coastal plants potential foam loss should be considered minimum 25 % and that of for noncoastal plants should be 15% of design requirement.

7.13 SMOKE/HEAT DETECTION AND ANNUNCIATION, DYKE DRAIN VALVE ANNUNCIATION SYSTEM AND EMERGENCY SHUT DOWN LOGIC.

i) **Smoke / heat detection and annunciation system:**

Combined or separate (anyone) smoke and or heat detection system should be installed near carton storage area, process control room, warehouse and laboratory. Smoke / heat detectors of proper type should be selected and maintained in sound working condition.

a) General

Smoke / heat detectors are recognized as the most common method of fire detection for life safety throughout the world. The best method to prevent spread of fire is to detect the smoke at initial stage itself. This would require basically a reliable and continuous smoke detection system with alarm annunciation to alert the operating personnel to take timely corrective action.

b) Application

- Smoke / heat detectors should be installed near carton storage area, process control room, warehouse and laboratory. These detectors should be placed in such a way that smokes are detected at the incipient stage of incident.
- The control panel with audio alarm and visual indication should be provided in the process control room and repeater panel at the fire control room.

c) Power Supply

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

d) Architecture Components

The main components shall be:

- Smoke / heat detectors
- Field Transmission units / Signal scanners.
- Control system / PC
- Display
- Annunciation System, etc.
- Cables, hooters, repeater, Power Supplies etc.

e) Annunciation System

Appropriate annunciation system shall be available to ensure that all the alarms generated, both, audio and visual are reported to the plant 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.

f) Smoke/heat Detectors

The detectors shall be able to detect the presence of smoke /heat well below the limit.

g) Inspection and Testing

- The system shall be checked by the safety officer on a daily basis.

- The system shall be thoroughly tested every month by suitable method to ensure that the Audio Video alarms are generated at local and remote panel and records maintained.

ii) Dyke Drain valve Annunciation system

All the tank dyke drain exit valves shall be fitted with a limit 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 Visual alarms shall come at local and remote-control panel for suitable corrective measures.

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

a) Power Supply

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

b) Architecture Components

The main components shall be:

- Proximity Switches / Sensors.
- Field transmitter unit / Signal Scanners.
- Control System / PC / TAS
- Display
- Annunciation System etc.
- Cables, hooters, Mimic, Power Supplies etc.

All the components installed in the hazardous area shall conform 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.

c) Annunciation System

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.

d) Control system:

The 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.

e) Inspection and Testing:

- The system shall be checked by the safety officer on a daily basis.
- 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.

iii) Emergency shut Down (ESD) and Manual Call Point (MCP) logic for plant shutdown.

The ESD at automated plants and MCP at non-automated plants shall be provided in process control room, fire control room as well as at various strategic locations. ESD / MCP system shall be only through push buttons with wired connection.

a) Annunciation of ESD / MCP shall initiate following actions

Process Shutdown

- To stop loading pumps
- Barrier gates to open
- Tank lorry filling (TLF) operations through the batch controllers to stop.
- All MOVs/POVs to close.

Power Shutdown

- Trip all the panels other than Emergency panel. The Emergency panel should host fire siren, bore wells, jockey pumps, critical High Mast tower lights, security cabin, fire control room and fire pump house, Critical lights in TLF, Admin block, MCC room and power to the control room / Automation system.
- 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 MOVs/POVs and full closure of valves shall be ensured. The time lag shall be plant specific.

Alarm signal shall be exchanged between all control rooms so that necessary actions are taken by the operating personnel.

b) Inspection and Testing:

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

7.14 FIRE ALARM /COMMUNICATION SYSTEM

- Hand operated sirens: alternately fire call points shall be provided at strategic locations and clearlymarked in the plant. Fire call points shall have combination of audio / visual alarm.
- Main fire siren (3 km Range) switch shall be provided in fire control room / security room.
- Electrical fire siren shall have alternate supply source both from normal panel/supply and thruemergency panel/supply.
- The tone of fire siren shall be different from shift siren
- The following fire siren codes shall be followed for different situations:
 - Fire: For fire situation, the siren shall be wailing sound for two (2) minutes.

- Disaster: For disaster situation, the siren shall be wailing sound for two (2) minutes, repeated thrice with a gap of 60 seconds.
- All Clear: To indicate all clear signal, the siren shall be straight run sound for two (2) minutes.
- Test siren: To indicate testing, the siren shall be straight run sound for two (2) minutes.

7.15 FIRE SAFETY ORGANISATION/ TRAINING

i) Organization

A well-defined comprehensive Onsite Emergency Plan as per PNRGNB ERDMP regulations shall be drawn.

ii) Training

- a. Training on safety, firefighting and rescue operation shall be compulsory for all officers, operators, security, T/T drivers and contract workmen, clericals who are likely to be present/working in the plant and record maintained. The above training shall be imparted before induction.
- b. Each employee shall undergo a refresher course once in every three years after initial training.
- c. The training shall be conducted through an expert agency such as Fire Brigade/recognized training institute/Oil industry approved reputed agency. The training also includes usage of personnel protective equipment.
- d. All operating personnel shall be given training on Live Fire training at any of the reputed institutes having facilities for simulations representing fire scenarios likely to occur at plant. Security as first respondent may also be considered for above live fire training.
- e. 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.
- f. 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.
- g. Monthly fire drills considering various scenarios shall be conducted regularly with full involvement of all employees of the installation. The mock drill should include the full shut down system activation once in six months.
- h. The offsite disaster mock drills shall be conducted periodically as per local statutory requirements. The company should approach and coordinate with the district authority for conducting "Offsite Mock Drills".
- i. The post drill analysis should be carried out and discussed emphasizing areas of improvements.
- j. The record of such drills should be maintained at the location.
- k. Mock drill scenarios shall include all probable scenarios and the key areas like tank Farm, Rimseal fire, Gantry, Pump House, Tank Wagon gantry etc., shall be covered at least once in six months.
- l. Security staff should be trained as first responders for firefighting and rescue operation along with plant operating personnel through oil industry approved reputed institute.

iii) Mutual aid

Installation shall have a 'Mutual Aid' arrangement with nearby industries to pool in their resources during emergency.

Mutual Aid agreements (valid for a maximum period of 2 years) 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.

7.16 FIRE EMERGENCY MANUAL

- i) Each installation should prepare a Comprehensive fire emergency manual covering all emergency scenarios outlining the actions to be taken by each personnel in the event of fire emergency for effective handling and the same 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.

7.17 FIRE PROTECTION SYSTEM, INSPECTION AND TESTING

a) 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 and 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.
- v) In addition to the following routine checks/maintenance, the requirements of OISD-STD-142 in respect of periodic inspection, maintenance and testing of fire-fighting equipment shall be complied with.

b) 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 and flow.
- ii) Each pump shall be checked, tested and its shut-off pressure observed once in a month.
- iii) Each pump shall be checked and 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 and motor load are in conformity with the design parameters.
- iv) Each pump shall be test run continuously for 4 hours at its rated head and 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 and stops of the pump indicate that there are water leaks in the system which should be attended to promptly.

c) Fire water ring mains

- i) The ring main shall be checked for leaks once in a year by operating one or more pumps and keeping the hydrant points closed to get the maximum pressure.

- ii) The ring mains, hydrant, monitor and water spray header valves should 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 and water spray headers should be checked for leaks, smooth operation and lubricated once in a month.

d) Fire water spray system (if applicable)

- i) Water spray system shall be tested for performance i.e., its effectiveness and 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.

e) 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.

f) 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 months.
- ii) The complete system should be inspected for proper operation once every year (Refer latest NFPA 2001(latest edition) for details of inspection of various systems.

g) Hoses

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

h) Communication system

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

i) Fire water tank/reservoir

- i) Above ground fire water tanks should be inspected externally and internally as per OISD-STD- 129.
- ii) The water reservoir shall be emptied out and cleaned once in 3 years. However, floating leaves, material or algae, if any shall be removed once in 6 months or as and when required.
- iii) Fire extinguishers Inspection, testing frequency and procedure should be in line with OISD-STD- 142 and in this Std.

8.0 MAINTENANCE AND INSPECTION OF EQUIPMENT

GENERAL

This section covers the maintenance and inspection practices to be followed to ensure safe and trouble-free operation of various equipment.

8.1 MAINTENANCE SCHEDULES

To facilitate the maintenance service to be rendered in a planned manner, a preventive maintenance schedule covering the necessary work to be done, mentioning the periodicity i.e., daily, weekly, monthly, half yearly and yearly schedules, must be worked out. Basic recommendations given by the manufacturers should be considered and modified bearing in mind the local conditions.

8.2 PERSONAL PROTECTIVE EQUIPMENT

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 etc. as applicable shall be worn while carrying out maintenance. Such equipment shall be checked periodically and maintained for ready use in normal and emergency situations.

For details refer OISD STD-155.

8.3 WORK PERMIT SYSTEM

Any maintenance, inspection, disassembly or removal of fittings shall not be carried out without a proper work permit and approved procedure.

- i) All Maintenance/ Inspection jobs shall be carried out in line with OISD Standard; OISD-STD-105 on "Work Permit System".
- ii) Working at heights shall be as per provisions of OISD-GDN-192.

APPLICABLE STANDARDS

- Electrical maintenance / inspection, provisions of OISD-STD-137 shall be adhered to.
- OISD-STD -130 on Inspection of pipes, valves and fittings shall be followed.
- OISD Standard No. OISD-120 on Selection, Operation and Maintenance of Compressors.
- OISD Standard No. OISD-119 on Selection, Operation and Maintenance of Pumps.
- OISD Standard No. OISD-123 on "Inspection and Maintenance of Rotating Equipment components.

8.4 INSPECTION and MAINTENANCE OF VARIOUS FACILITIES IN INSTALLATIONS

(1) STORAGE TANKS

OISD Standard OISD-STD-129 on "Inspection of storage tanks shall be followed for details. Salient inspection and maintenance requirements are given below: -

Types of inspection

The post-commissioning inspections of a storage tank shall be as under;

- (i) Routine In-Service Inspections
- (ii) External Inspection
- (iii) Internal

Inspection Intervals:

Routine In-Service Inspection:

The interval of such inspection shall be consistent with conditions at a particular site but shall not exceed one month. Operations personnel, who have knowledge of the storage tank operations, shall carry out this inspection.

External Inspection:

All storage tanks shall be given a Visual External Inspection at least once in a year by a qualified and experienced authorized person.

The Detailed External Inspection along with ultrasonic thickness survey of tanks shall be conducted as under:

S.N.	Fluid Stored	External Inspection Interval(Years)	
		With Corrosion Rate Based Assessment	Without Corrosion Rate Based Assessment
1	Class-B, LDO, Lube Oils	5	3
2	Furnace Oil, LSHS and slops	3	3

Internal inspection:

All storage tanks shall be subjected to a detailed internal inspection after an interval as detailed below. Where the inspection intervals are prescribed in the Quality Control Manual, the same shall override the table below:

S.N.	Fluid Stored	External Inspection Interval (Years)	
		With Corrosion Rate Based Assessment	Without Corrosion Rate Based Assessment
1	Class-B, LDO, Lube Oils, Furnace Oil	Years determined by Corrosion Rate and Integrity Assessment or 15 years, whichever is lower	10
2	Slops	-do-	8

8.4.1 INSPECTION OF UNDERGROUND STORAGE TANK

Prior to entering an underground tank, it shall be cleaned internally of its product and adequate air circulation provided. The man entry should be preceded by ensuring that the tank is Hydrocarbon and gas free. The tank shall be visually inspected for general corrosion/ pitting/ deterioration on internal surfaces.

Ultrasonic thickness measurements shall be carried out on shell plates, end plates and nozzles from inside the tank once in ten-year period or to meet industry's quality control requirements whichever is less. The external inspection of the underground tank shall be performed once in twenty-year period or to meet industry's quality control requirements whichever is less.

After the repairs, the tank shall be hydrostatically tested of at test pressure of 0.75-kg/sq.cm. g- or as specified in the design code and checked for leaks.

Timely inspection and preventive maintenance of these storage tanks assume high importance. Accordingly, the inspection schedules of storage tanks are to be prepared and implemented.

This standard covers the minimum inspection requirements for atmospheric and low-pressure storage tanks constructed as per standards IS-803, API-STD-620, API-STD- 650, IS 10987 or equivalent. The various types of storage tank inspections along with types of repairs and areas of inspections have been covered in this standard.

8.4.2 PIPES, VALVES AND FITTINGS

OISD Standard OISD-Std-130 on "INSPECTION OF PIPING SYSTEMS" should be followed for details. Salient inspection and maintenance requirements are given below: -

Safety in petroleum installations comes through continuous efforts at all stages and as such it can be ensured by observing that plant and equipment are designed, constructed, tested and maintained as per Engineering Standards and subsequent modifications and repairs are conforming to the same standard.

This standard covers minimum inspection requirements for plant piping as per Standard ANSI B-31.3 or equivalent. Areas to be inspected, facilities needed for inspection, frequency of inspection, likely causes of deterioration of pipelines in service and inspection of pipe fittings and repairs have been specified. Also included briefly are the inspection and testing requirements for the pipelines post commissioning.

It is necessary to draw up and adhere to an inspection programme to avoid failures and inconveniences in operation. The authorized person(s) should carry out the On Stream and Comprehensive Inspections. The experience and qualification of the authorized person(s) shall be in line with the applicable inspection standards and procedures.

Type of Inspection: The post-commissioning inspections of pipelines shall be as under –

- (i) External inspection
- (ii) Comprehensive inspection

Inspection intervals: Pipelines in plant mainly comes under class-III category (OISD Std 130) and inspection interval are as under

Class	Service	Maximum Inspection Interval in Years	
		External on stream	Comprehensive
Class-III	Class –B, Lubes, Furnace, asphalt etc.	4	10
Class-III	Air process, cooling water and fire water etc.	4	10

Note:

- i) Any other service which is not covered in the above tables shall be included under appropriate class as the case may be.
- ii) In case, high corrosion rates are observed and half the remaining life is less than the above-mentioned scheduled intervals, then the comprehensive inspection interval shall be suitably reduced to ensure that maximum inspection interval shall not be more than half the remaining life

8.4.3 **BOILER**

Inspection, testing and maintenance shall be as per manufacturer's guidelines and requirement in line with IBR norms. All applicable statutory norms as per requirement of inspector of boiler shall be followed.

8.4.4 **PRESSURE VESSELS**

Inspection, testing and maintenance shall be carried out as per statutory requirement.

8.4.5 **WEIGH BRIDGE**

Inspection and maintenance shall be as per manufacturer's guidelines. All statutory norms as per requirement of Inspector of legal metrology shall be followed.

8.4.6 **HOIST, EOT AND JOIST**

Inspection and maintenance shall be as per manufacturer's guidelines. All statutory norms as per requirement of Inspector of Factory shall be followed.

8.4.7 **FORK LIFT**

Inspection and maintenance shall be as per manufacturer's guidelines. All statutory norms as per requirement of Inspector of Factory shall be followed.

Periodical eye testing shall be carried out in line with requirement of Inspector of Factories and record maintained.

Inspection, testing and maintenance of thermic fluid heater, cooling tower etc. shall be done as per manufacturers guidelines and record maintained.

8.4.8 **LADDER SAFETY (PORTABLE OR FIXED)**

8.4.9 **STRAINERS AND FILTERS**

Strainers and filters shall be inspected and cleaned as per following frequency, unless sluggish operation warrants earlier inspection:

- Frequency of inspection and cleaning. Upstream of Pump Suction: Quarterly Upstream of PD meter quarterly.
- Water spray strainer quarterly.

8.4.10 SAFETY RELIEF VALVES

Safety Relief valves shall be tested once in a year. Further, an on-stream visual inspection should be carried out at least once in every 6 months to check the following:

- Blinds do not exist.
- Upstream and downstream isolation valves, if any, are opened and sealed.
- Seals protecting the spring setting have not been broken.
- Relief device is not leaking. This should be checked visually or by thermography or contact thermometers or by hand touch at outlet nozzle wherever practicable.
- The continuous operation of heat tracing provision, if any, provided for low temperature application on valve and discharge piping.
- Condition of insulation and cladding on the heat traced piping and valves.
- Provisions of OISD-STD-132 on "Inspection of Pressure Relieving Devices" shall be followed.

8.4.11 Rotary equipment:

Compressors: Periodic maintenance checks, as detailed in Annexure-2 to be followed.

Pumps: Periodic checks as detailed in Annexure-2 to be followed.

Diesel Engines: For maintenance of Diesel Engines Original Equipment manufacturer guidelines and OISD-STD-127 shall be followed.

Pressure gauges: Pressure gauges shall be checked daily for its proper functioning and shall be calibrated once in 6 months.

Flow measuring devices: All flow measuring devices shall be checked daily for proper functioning. Calibration of the flow measuring devices shall be carried out in line with requirement of Department of Legal Metrology of concern state.

8.5 FIREFIGHTING EQUIPMENT (PORTABLE AND TROLLEY MOUNTED)

Portable fire extinguishers are not expected to deal with large fires. Nevertheless, these are very valuable in the early stages of fire. The most important features of these extinguishers are their immediate availability and can be used by one / two person(s). A fully charged fire extinguisher should not be more than 17 kgs. The extinguishing medium is discharged and directed into fire by storage pressure or release of pressurized charged stored in a cartridge.

Extinguishers shall be classified by the types of extinguishing medium which they contain. At present, the main types of extinguishers are a) water and or foam-based b) powder c) carbon dioxide and d) clean agents.

Relevant IS code for fire extinguishers and schedule for hydraulic pressure testing of fire extinguishers.

#	Type of extinguisher	IS Code	Test interval (Year)	Test pressure (kg/sq.cm)	Duration (minutes)
1	Mechanical foam type (gas cartridge)	15683/13386/14951	3	35	2.5

#	Type of extinguisher	IS Code	Test interval (Year)	Test pressure (kg/sq.cm)	Duration (minutes)
2	Mechanical foam type (stored pressure)	15683	3	35	2.5
3	Dry powder (stored pressure)	15683	3	35	2.5
4	Dry powder (gas cartridge)	15683/10658/11833	3	35	2.5
5	Carbon dioxide	15683	5	250	2.5
6	Clean agent	15683	3	35	2.5

Note: Extinguisher's should be hydraulically tested with cap.

Each extinguishing media should comply respective IS code (given in following matrix):

S. No	Extinguishing media	Respective IS code
1	Foam concentrate	IS 4989 or ISO 7203
2	Powders (Class –BC)	IS 4308
3	Powders (Class –ABC)	IS 14609
4	Carbon dioxide	IS 15222
5	Clean agents	IS 15493/NFPA 2001 latest edition.

Propellants: The propellants for stored pressure and cartridge operated extinguishers shall be air, carbon dioxide, nitrogen or mixtures of these gases having a max dew point of (-) 55 deg centigrade.

Life of fire extinguishers: (IS 2190:2010)

S. No	Type of extinguisher	Lifetime (year)
1	Foam type	10
2	Powder type	10
3	Carbon dioxide	15
4	Clean agent	10

Note:

Life of extinguishers shall be considered from date of manufacture of extinguishers. In case failure in hydraulic pressure testing, extinguisher should be rejected immediately before the lifetime given above.

Carrying handle: An extinguisher having a total mass of 1.5 kg or more and having a cylinder diameter of 75 mm or more shall have a carrying handle.

Mounting: Each extinguisher intended for wall mounting should be provided with a means of mounting. Further for detail guidelines for inspection, testing etc., OISD-STD-142 shall be referred.

8.6 ELECTRICAL EQUIPMENT

Proper functioning of electrical equipment can only be ensured by means of periodic preventive and predictive maintenance of the equipment. This enhances equipment life and also ensures safety of the equipment, installation and operating personnel.

Maintenance shall be daily, weekly, quarterly or annual depending upon the type of equipment. Adequate logs shall be maintained to ensure that maintenance is carried out as per approved

checklists. Preventive maintenance shall be carried out as per schedules laid down in OISD-STD-137.

Special emphasis shall be laid on the maintenance of equipment installed in hazardous areas.

All electric apparatus and wiring in a hazardous area shall at all times be so maintained as to retain the characteristic on which their approval has been granted.

Precautions to be taken for repairs and testing of flameproof equipment shall be as below:

- i. No Flame proof or intrinsically safe apparatus shall be opened and no work likely to impair the safety characteristics of such apparatus or electric wiring connected thereto shall be carried out until all voltage has been cut off from said apparatus or wiring. The voltage shall not be restored thereto until the work has been completed and the safety characteristics provided in connection with the apparatus and wiring has been fully restored.
- ii. Use of soldering apparatus or other means involving flame, fire or heat or use of industrial type of apparatus in a zone "1" area shall be permitted for the purposes of effecting repairs and testing and alterations, provided that the area in which such apparatus or wiring has been installed, has first been made safe and certified by a competent person after testing with an approved gas – testing apparatus to be safe and free from inflammable vapours, gases or liquids and is maintained in such conditions, so long as the work is in progress.
- iii. No alteration that might invalidate the certificate or other document relating to the safety of the apparatus shall be made to any apparatus.
- iv. Replacement fasteners, nuts, studs and bolts shall be of the type specified by the manufacturer for the particular apparatus. No attempt shall be made to replace or repair a glass in a flameproof enclosure e.g., in a luminaire or other enclosures, except by replacement with the complete assembly or part obtainable from the manufacturer, complying with the approval certificate.
- v. If replacement components such as cable glands, conduit or conduit accessories, are available only with thread forms which differ from those provided on the apparatus, suitable adaptors having necessary certification and approval shall be employed.
- vi. Equipment enclosures and fittings shall be examined to see that all stopping plugs and bolts are in position and properly tightened. Locking and sealing devices shall be checked to ensure that they are secured in prescribed manner.
- vii. If at any time, there is a change in the area classification or in the characteristics of the flammable material handled in the area or if the equipment is relocated in the area, the area classification drawing should be correspondingly revised, and a check shall be made to ensure that the equipment selection corresponds to the revised area classification.
- viii. A system shall be established to record the results of all inspections and the action taken to correct defects.

8.7 LADDERS

Inspection and testing

Wooden ladders shall be inspected at least once in a week for damage and deterioration. Metal ladders shall be inspected at least once in three months and all parts checked for wear, corrosion and structural failure.

Storage and maintenance

- 8.7.1 Ladders shall be stored in dry location and protected from weather. Ladders shall be supported during storage so as to avoid sagging and permanent set.
- 8.7.2 Wooden ladders shall be periodically treated with a clear preservative such as varnish, shellac or linseed oil. Painting shall not be adopted as defects and cracks are likely to be covered up by the coating.
- 8.7.3 Metal rungs shall be cleaned to prevent accumulation of materials which may destroy non-slipping properties.

ANNEXURE: 1

CHECKLIST FOR BULK /PACKED LUBE TRUCKS AT LOADING / UNLOADING POINTS

#	Item	Remarks
Daily Checks		
1	Whether driver is having requisite / mandatory documents required for vehicle and driver?	
2	Whether the vehicle has at least one driver and one helper as its crew member?	
3	Whether the vehicle has two fire extinguishers?	
4	Whether vehicle's cabin is checked for presence of any flammable/explosive substance being carried by the crew?	
5	Whether there are any sources of ignition like matches etc. in the vehicle?	
6	Whether the engine exhaust is wholly in front of bulk truck and has ample clearance from fuel oil system and combustible material.	
7	Whether approved quality flame arrester provided on the engine exhaust and muffler/silencer is properly bolted and without any sign of leaks?	
8	Whether each compartment of tank is fitted with independent vacuum and pre-operated vents (PV Valve)?	
Additional Checks:		
9	Whether the vehicle has a cutoff switch for electrical system?	
10	Whether all electric wiring is properly insulated, and all junction boxes are sealed properly?	
11	Whether there is a quick shut off facility for the drain valves in case of emergency?	
12	Whether the vehicle has First Aid Box, Toolbox and Emergency search light?	
13	Whether the driver has a copy of standing instructions and TERM card?	
14	Whether electrical equipment like generator switches, fuses and circuit breakers are located inside the cabin or engine compartment?	
15	Whether battery is in easily accessible position with a heavy duty switch close by, to cut off the battery in emergency?	
16	Whether battery terminals have protective rubber covers?	

ANNEXURE: 2

MAINTENANCE SCHEDULE OF CRITICAL EQUIPMENTS: - COMPRESSOR

#	Equipment Parameters to check	Periodicity			
		Daily	Weekly	Monthly	Quarterly
1.	Check Lube Oil Level of plunger pump unit and top up if necessary.				
2.	Check the oil level in the crank case and top up if necessary.				
3.	Before start check flow of cylinder jacket cooling water.				
4.	Check oil flow from plunger pump to gland packing assembly and compressor cylinder.				
5.	Check for flow rate from plunger pump				
6.	Drain water from receiver/ liquid trap				
7.	Check belt tension and adjust, if necessary.				
8.	Ensure tightness of foundation bolts.				
9.	Flush out lube oil system: a) Crank case, b) Pump chamber and fill fresh oil.				
10	Flush jacket water cooling system.				
11	Check alignment of compressor and motor pullies.				
12	Change lube oil filter and clean Suction filter.				
13	Clean oil strainer				
14	Clean Breather				
15	Open and inspect suction and discharge valves.				
16	Check instrumentation calibrate if necessary				
17	Check safety release valve.				
18	Suction and discharge valves of compressor cylinder				
19	Interlock with High level alarm				
20	All Trips				
21	Pressure and Temperature Gauges				
22	Control Panel				
23	Complete over-haul.				

**MAINTENANCE SCHEDULE
CENTRIFUGAL PUMP**

#	Equipment Parameters to check	Periodicity			
		Daily	Weekly	Monthly	Quarterly
1.	Check lube oil and top up level if necessary. Check cooling water flow (where provided).				
2.	Check mechanical seal/ gland leakage.				
3.	Check the "AMPS" are within limits				
4.	Change lubes oil every 800 running hours.				
5.	Check coupling and coupling bolts and replace worn out parts.				
6.	Check tightness of foundation bolts.				
7.	Clean suction strainer of: a) Product pumps b) Other pumps				
8.	Check alignment of pump and motor.				
9.	Overhauling				
10	Greasing of Bearings.				
11	High Level Alarm				
12	Relief Valve				

DIESEL ENGINES: - MAINTENANCE STEPS

- (1) Keep the dirt out of the engine.
- (2) Maintain a lubricating film on all bearing surfaces.
- (3) Regulate the engine's fuel.
- (4) Control operating temperatures.
- (5) Guard against corrosion.
- (6) Let the engine breathe.
- (7) Prevent over speeding.
- (8) Know your engine's condition.
- (9) Correct troubles while they are simple.
- (10) Schedule and control your maintenance.

Diesel Engines: "A" Daily Checklist

#	Maintenance Steps	Remarks
1	Check previous day's engine log book.	Correct as required
2	Drain water and sediment from fuel tank and fuel filter through drain cock.	Before starting engine.
3	Check engine oil level and top up if necessary	Must be slightly less than or equal to "h" mark on dip stick when engine is stopped and has stood for 20 minutes or more (must be measured after all oil is drained back into oil pan).
4	Check for Fuel, oil, water	Correct if leaking.
5	Fill radiator/ surge tank with treated water (Chromate concentration 3500 ppm).	Radiator cap must be firmly tightened back into the radiator/surge tank neck engine must not be operated without the radiator cap since this will cause aeration and overheating of the coolant.
6	Check air cleaner oil level and change oil, if required (if oil bath type) clean dust pan and pre-cleaner of day type air cleaner.	Use clean engine oil
7	Check air line connections for leaks	Correct as required
8	Remove and clean air compressor breather, if equipped.	Fill with clean oil, up-to mark.
9	Drain air receiver tank at the beginning of each shift and then close the drain cock.	
10	Clean crankcase breather	Discard paper type element, if clogged.
11	Check oil level in hydraulic governor, if provided.	Check for leaks, use specified engine oil for topping up.

#	Maintenance Steps	Remarks
12	Start the engine and note the oil pressure both at idling and maximum speed	If there is a change in oil pressure from that recorded in the log book on earlier occasion then stop engine and check through trouble shooting technique the cause for oil pressure changes and correct if necessary (for Assistance in diagnosing the change in oil pressure call your service representative if necessary).
13	Record oil pressure	Refer OEM Manual for Lube. Oil pressure limits.
14	Fill fuel tank at the end of the shift.	Use clean fuel and a strainer. Also clean the cap and surrounding area before opening the filler cap.

Note: In addition, Diesel Engine “B”, “C”, “D” and “E” checks shall be carried out as per manufacturers guide lines.

VANDANA SHARMA, Secy.
[ADVT.-...]

Footnote: The Principal regulations were notified in the official gazette vide F. No. PNGRB/Tech/7-T4SPI (1)/2020, dated 11th November, 2020.