

PETROLEUM AND NATURAL GAS REGULATORY BOARD

NOTIFICATION

New Delhi, the 12th February 2016

G.S.R. Infra/ T4S/ P&PPPL/01 /2014 - In exercise of the powers conferred by section 61 of the Petroleum and Natural Gas Regulatory Act, 2006 (19 of 2006), the Petroleum and Natural Gas Regulatory Board hereby makes the following regulations, namely:-

1. Short title and commencement.

- (1) These regulations may be called the Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Petroleum and Petroleum Products Pipelines) Regulations, 2016.
- (2) They shall come into force on the date of their publication in the Official Gazette.

2. Definitions.

- (1) In these regulations, unless the context otherwise requires,-
 - (a) “Act” means the Petroleum and Natural Gas Regulatory Board Act, 2006;
 - (b) “ASME B 31.4” means standard covering Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids referred to in Annexure IV;
 - (c) “Board” means the Petroleum and Natural Gas Regulatory Board established under sub-section (1) of section 3 of the Act;
 - (d) “pumping station” means an installation on the pipeline having pumping units to boost petroleum and petroleum products pressure;
 - (e) “intermediate pigging station” means an installation having facility for receiving and launching of pigs for pigging operations;
 - (f) “onshore” means areas other than offshore which shall form the scope of these regulations. Feeder lines from / to jetty or other storage points shall also form a part of the onshore pipelines;
 - (g) “operating company or operator” means an entity engaged in the operation of petroleum and petroleum products pipeline network;
 - (h) "petroleum" means any liquid hydrocarbon or mixture of hydrocarbons, and any inflammable mixture (liquid, viscous or solid) containing any liquid hydrocarbon, including crude oil and liquefied petroleum gas, and the expression 'petroleum product' shall mean any product manufactured from petroleum;
 - (i) “petroleum and petroleum products pipeline” means any pipeline including branch or spur lines for transport of petroleum and petroleum products and

includes all connected infrastructure such as pumps, metering units, storage facilities at originating, delivery, tap off points or terminal stations including line balancing tanks and tankage required for unabsorbed interface essential for operating a pipeline system;

(j) “right of use or right of way” means the area or portion of land within which the pipeline operator or entity has acquired the right through the Petroleum and Minerals Pipelines (Acquisition of Right of User in land) Act, 1962 or in accordance with the agreement with the land owner or agency having jurisdiction over the land to lay, operate and maintain the petroleum and petroleum products pipelines.

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

3. Application.

(1) These regulations shall apply to all the entities authorized by the Board to lay, build, operate or expand petroleum and petroleum products pipelines under the Petroleum and Natural Gas Regulatory Board (Authorizing Entities to Lay, Build, Operate or Expand Petroleum and Petroleum Products Pipelines) Regulations, 2010 and any other petroleum and petroleum products pipelines including dedicated pipelines.

(2) Definitions of design, material and equipment, piping system components and fabrication, installation and testing, commissioning, corrosion control, operation and maintenance and safety of petroleum and petroleum products pipelines network shall be in accordance with the requirements of ASME B31.4 except in so far as such requirements are specifically cancelled, replaced or modified by the requirements specified in these regulations.

4. Scope.

(1) Requirements of these regulations shall apply to all existing and new petroleum and petroleum products pipelines.

(2) These regulations shall cover pipeline design, materials and equipment, piping system components and fabrication, installation, testing, corrosion control, operation and maintenance and safety of petroleum and petroleum products pipelines. The pipelines include dedicated pipelines for specific consumers but excludes offshore crude pipelines, onshore well flow, feeder and collector pipelines.

5. Objective.

These standards are intended to ensure uniform application of design principles and to guide in selection and application of materials and components, equipment and systems and uniform operation and maintenance of the petroleum and petroleum products pipelines system and shall primarily focus on safety aspects of the

employees, public and facilities associated with petroleum and petroleum products pipelines.

6. The standard.

Technical Standards and Specifications including Safety Standards (hereinafter referred to as Standard) for petroleum and petroleum products pipelines are at Schedule I which cover Design (Schedule 1A), Material and Equipment (Schedule 1B), Piping System Components and Fabrication Details (Schedule 1C), Installation and Testing (Schedule 1D), Corrosion Control (Schedule 1E), Operation and Maintenance (Schedule 1F), Safety (Schedule 1G), Miscellaneous (Schedule 1H) as read with Annexure I to Annexure IV.

7. Compliance to these regulations.

- (1) The Board shall monitor the compliance to these regulations either directly or through an accredited third party as per separate regulations on third party conformity assessment.
- (2) If an entity has laid, built, constructed or expanded the petroleum and petroleum products pipelines network based on some other standard or is not meeting the requirements specified in these regulations, the entity shall carry out a detailed Quantitative Risk Analysis (QRA) of its infrastructure. The entity shall thereafter take approval from its Board or highest decision making body for non-conformities and mitigation measures. Approval of the Board or highest decision making body of entity along with the compliance report, mitigation measures and implementation schedule shall be submitted to the Board within six months from the date of notification of these regulations.
- (3) The continuation of operation of existing petroleum and petroleum products pipelines network shall be allowed only if it meets the following requirements, namely:-
 - (i) The petroleum and petroleum products pipelines system shall have been tested initially at the time of commissioning in accordance with ASME B 31.4. The entity shall have proper records of the same. Such test record shall have been valid for the current operation. Alternatively, if such a record is not available, the entity shall produce in service test record of the petroleum and petroleum products pipelines network having been tested as per ASME B 31.4 or carry out intelligent pigging survey alongwith fitness for purpose report:

Provided that-

- (a) the entity shall submit self-certification in support of meeting the above requirements within a month but not later than three months of notification of these regulations;
- (b) certifications referred to in para (a) shall be done for petroleum and petroleum products pipelines in construction and commissioning, operation and maintenance. The self certification shall be submitted to the

Board with mitigation plan and implementation schedule;

- (c) the critical components of the system as identified by the Board for such existing networks shall be complied with these regulations within a period specified at Appendix from the date of coming into force of these regulations and the authorized entity shall maintain the integrity of the existing petroleum and petroleum products pipelines system at all times in accordance with separate regulations on Integrity Management System; and
- (d) provisions of these regulations related to operation and maintenance procedures shall also be applicable to all such existing installations.

8. Default and consequences.

¹[(1) There shall be an established comprehensive system to ensure compliance with the provisions of these regulations, encompassing the conduct of technical and safety audits throughout the stages of design, pre-construction, construction, commissioning, and operation, and also on an ongoing basis, as periodically specified. Details of any planned project along with Detailed Feasibility Report (DFR), layout, PESO approval and Environmental Clearance etc. as may be applicable, shall be submitted to Board at least one month prior to commencing the construction.

(2) The Board shall monitor the compliance with Technical Standards and Specifications, including Safety Standards, either directly or through an accredited third party via separate regulations on third-party conformity assessment.

(3) In the event of any default or deviation or shortfall under these Regulations, the authorized entity shall qualify as defaulting entity under the regulation 16 of Petroleum and Natural Gas Regulatory Board (Authorizing Entities to Lay, Build, Operate or Expand Petroleum and Petroleum Products Pipelines), Regulations, 2010.

(4) For the purpose of these Regulations, until authorization is granted by the Board or for dedicated pipeline, in event of any default or deviation or shortfall, the entity shall be liable to face the imposition of civil penalty as per Section 28 of the PNGRB Act, 2006 and/or suspension/termination of operation, as per following procedure:

(a) The Board shall issue a notice to the entity, allowing it a reasonable time period to fulfil its obligations under the regulations;

(b) No punitive action shall be taken in case remedial action is taken by the entity, to the satisfaction of the Board, within the time period specified by the Board;

(c) In case the entity fails to undertake remedial action within such time period, the Board may, after giving such entity an opportunity of being heard, by order in writing, direct that, without prejudice to any other penalty which the entity may be liable for, such entity shall pay, by way of civil penalty, an amount which shall not exceed one

¹ Subs By CI(a), Reg 2, the Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Petroleum and Petroleum Products Pipelines) Amendment Regulations, 2025. (w.e.f. 23.07.2025)

crore rupees for each contravention, and in case of a continuing failure, additional penalty which may extend to ten lakh rupees for every day. In addition, the Board, if it deems appropriate, may direct for suspension or termination of operations of the said entity.

(d) If the entity fails to comply with the directions passed by the Board, as provided in clause (c), the Board may take appropriate action as prescribed for offences and punishment under Chapter IX of the Act.

(5) Notwithstanding the procedure contained in sub-regulation (3) or sub-regulation (4), in cases:

(i) where the violation on the part of the entity poses an imminent danger to public safety or

(ii) where the Board determines, in public interest or in the interest of State security, that it is so required,

the Board may, apart from requiring the entity to take immediate remedial action, also direct for immediate suspension of operations of the said entity and in such cases, an opportunity of being heard may be deferred and afforded subsequently to the entity by the Board.

Note 1: Planned projects shall include all greenfield projects and, in the case of brownfield projects, shall encompass any addition to storage, handling, or processing capacity, increase in manpower, or increase in risk level of any installation/facility.]

9. Requirements under other statutes.

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

10. Miscellaneous.

(1) If any question arises as to the interpretation of these regulations, the same shall be decided by the Board.

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

APPENDIX

List of Critical Activities

In Petroleum and Petroleum Products Pipelines

Sr. No.	Critical Infrastructure or Activity or Processes	Time period for Implementation and Compliance	Implementation plan
1	Test record for radiography, ultrasonic test or other applicable NDT methods (as carried out before commissioning)	6 months	to be complied within 6 months
2	Hydro-test (as carried out before commissioning) Report as per Regulation 7(3)	6 months	to be complied within 6 months
3	Pipeline cathodic protection record	6 months	to be complied within 6 months
4	Pipeline As-built records	6 months	to be complied within 6 months
5	Intelligent pigging shall be carried out to detect metal loss for the pipelines of size 6 inch (168.3 mm) and above and length of 10 Km and above.	2 years	If the pigging has not been done for more than 5 years for sour liquid petroleum and petroleum products pipelines and 10 years for other liquid petroleum and petroleum products pipelines, then, the intelligent pigging shall be carried out within two years, otherwise relevant records shall be submitted.
6	HSE Management System (including fire protection system)	6 months to 12 months	To be implemented
7	Environmental friendly fire extinguishing system for closed space.	1 year	For control room, switch gear and battery room, etc. (CO ₂ is acceptable only for unmanned station)
8	HAZOP shall be done for all the pipeline facilities		HAZOP to be carried out and mitigation plan to be implemented

Note: For Sr. No. 1, 2 and 4, if documents are not available or maintained certification by the Pipeline Head to be submitted

Schedule 1

Technical Standards and Specifications including Safety Standards for Petroleum and Petroleum Products Pipelines

Schedule-1A	DESIGN
Schedule-1B	MATERIAL AND EQUIPMENT
Schedule-1C	PIPING SYSTEM COMPONENTS AND FABRICATION DETAILS
Schedule-1D	INSTALLATION AND TESTING
Schedule-1E	CORROSION CONTROL
Schedule-1F	OPERATION AND MAINTENANCE
Schedule-1G	SAFETY AND FIRE PROTECTION
Schedule-1H	MISCELLANEOUS

Schedule 1A

DESIGN

1.1 General Provisions

1.1.1 The pipelines shall be designed in a manner that ensures adequate public safety under all conditions likely to be encountered during installation, testing, commissioning and operating conditions. All materials and equipments shall be selected to ensure safety and suitability for the condition of use.

1.1.2 The selection of design for liquid hydrocarbon pipelines shall be based on the fluid properties, service, required throughput, operating and environmental conditions.

1.1.3 All components of the pipeline system shall be designed to be suitable and fit for the purpose throughout the design life.

1.1.4 Cross country pipeline of size less than NPS 4 inch shall not be used.

1.2 Other Design Requirements

All necessary calculations shall be carried out to verify structural integrity and stability of the pipeline for the combined effect of pressure, temperature, bending, soil or pipe interaction, external loads and other environmental parameters as applicable, during all phases of work from installation to operation. Such calculations shall include but not limited to the following:

- i. Buoyancy control and stability analysis for pipeline section to be installed in areas subjected to flooding or submergence.
- ii. Crossing analysis of rivers by trenchless techniques, wherever sub-strata is favorable for such methods of construction.
- iii. Evaluation of potential for earthquake occurrence along pipeline route and carrying out requisite seismic analysis to ensure safety and integrity of the pipeline system.

1.3 Design Temperature

1.3.1 Appropriate temperature range for design of pipeline or piping system shall be determined based on temperature of liquid hydrocarbon proposed to be transported through the pipeline, ambient or sub-soil temperature.

1.3.2 Maximum temperature for design of above ground section of pipeline or piping shall be the maximum expected liquid temperature during operation or maximum ambient temperature whichever is higher. In no case maximum temperature for carbon steel pipelines shall be more than (+) 120 Deg C.

1.3.3 Maximum temperature for design of buried section of pipeline or piping shall be maximum expected liquid hydrocarbon temperature during operation or maximum sub-soil temperature whichever is higher.

1.3.4 Minimum temperature for design shall be minimum expected liquid hydrocarbon temperature during operation or minimum ambient or sub-soil temperature whichever is lower. In no case minimum temperature for carbon steel pipelines shall be less than (-) 29 Deg C.

1.3.5 When maximum liquid hydrocarbon temperature during operation is below 65 Deg C, thermal expansion and stresses in the above ground section of pipeline or piping shall be evaluated considering pipe skin temperature of 65 Deg C.

1.4 Steel Pipe

1.4.1 Straight Pipe Wall Thickness

The minimum nominal wall thickness for steel pipe shall be as per ASME B31.4.

Wall thickness ‘t’ for straight steel pipe under internal pressure shall be calculated by the following equation:

$$T = \frac{P_i \times D}{2 \times S}$$

Where,

D= outside diameter of pipe

P_i= Internal Pressure

S= F x E x Specified minimum yield strength of pipe.

Where,

F = Design factor

E=1 for Seamless, Electric Welded (HFW) and Submerged Arc Welded (SAW) pipe

1.4.2 Additional Requirement for Nominal Wall Thickness

Consideration shall also be given to any additional loading while selecting Nominal Wall Thickness as per ASME B 31.4.

1.4.3 Design Factors (F)

Design factors to be used in design formula shall be as per Table 1 given below.

Table 1: Design Factor (F) for Steel Pipe

Facility	Design Factor (F)
A. Pipelines, mains, and service lines	0.72
B. Crossings of roads, railroads without casing:	
a) Private Roads, Unimproved Public Roads	0.72
b) Roads, highways, public streets, with hard surface	0.72 (Note -1)
c) Railroads	0.60
C. Crossings of roads, railroads with casing	0.72

D. Parallel Encroachment of Pipeline on Roads and Railways:	
a) Private roads, Unimproved Public Roads	0.72
b) Roads, highways, public streets, with hard surface	0.72 (Note -1)
c) Railroads	0.60
E. Pipelines on bridges	0.50
F. River Crossings	0.72 (Note -1)
G. Dispatch terminal, intermediate pumping and pigging station, receipt or terminal piping and other stations piping	0.72

Notes:

- 1) Higher thickness may be used if required to reduce stresses or for providing stability during installation and/or service.

1.4.3.1 The selected wall thickness shall also be checked to ensure that the diameter to thickness (D/t) ratio does not exceed 100 in order to avoid damage to pipe during handling and transportation.

1.4.3.2 Other loadings shall be considered and provided for in accordance with sound engineering practices, such as:

- i. Loadings caused by scour, erosion, soil movement and landslides, installation forces, wind loading, earthquake loading etc.
- ii. Weight of water during hydrostatic testing and weight of product during operation shall also be considered.
- iii. Consideration shall be given to the use of lower allowable design stress if there is likelihood of repeated stress changes giving rise to fatigue conditions.

1.4.4 Pre-operational Stresses

Consideration shall be given to but not restricted to the effect of the following pre-operational loads:

- i. Transportation and stockpiling of the pipe
- ii. Stringing, coating and wrapping and laying
- iii. Backfilling
- iv. Loads imparted by construction traffic
- v. Field bending
- vi. Pulling load during horizontal direction drilling
- vii. Frictional load during jacking and boring
- viii. Hydrostatic test pressure loads (particularly when the pipeline is constructed as an above ground installation or is buried in unstable soils)

1.4.5 Surge Analysis

1.4.5.1 A detailed surge analysis shall be carried out during design stage considering the following condition:

- i. Closure of sectionalizing motor operated valve (MOV) or ROV or Actuator valves on the mainline
- ii. Closure of inlet MOV or ROV or Actuator valves of the storage tanks during receipt
- iii. Closure of any MOV or ROV or Actuator valves in the delivery pipeline
- iv. Stoppage of pump(s) at originating or intermediate pump station
- v. Closure of valves during emergency shut down
- vi. Combination of the above
- vii. Any other condition which can generate surge pressure

1.4.5.2 In order to protect the pipeline against surge pressure, surge relief valve or equivalent measures such as suitable interlocks to trip the mainline pump through SCADA or station control system shall be provided. The required capacity needed to be relieved through surge relief valve shall be determined by carrying out the surge analysis for above different scenarios under which a surge may occur in the pipeline. The set pressure of surge relief valve shall be such that in any case the overpressure in the pipeline or connected piping system does not exceed the internal design pressure by more than 10%.

1.4.6 Anti-buoyancy Measure

Pipeline crossing water bodies, marshy areas, swamps and areas with high water table, etc. shall be checked for buoyancy and if required suitable anti-buoyancy measures such as continuous concrete weight coating or concrete block, gravel filled geotextile bags, anchors, increased pipeline cover, select backfill, etc. shall be provided. The specific gravity of the same under empty or installation conditions shall be minimum 1.1.

1.4.7 Corrosion

All underground pipes and its components shall be protected against corrosion using suitable external anti-corrosion coating or painting and cathodic protection system. All above ground piping and its components shall be protected against corrosion by providing suitable anti-corrosion painting or coating.

1.5 Location And Layout of Pipeline Installations

1.5.1 Location

1.5.1.1 Originating, intermediate and terminal facilities of cross country pipeline such as Originating Pump Station or Originating Station, Intermediate pump or pigging Station, Tap-off Station and Sectionalizing Valve Stations etc. shall be located considering following aspects:

- i. Functional and pipeline hydraulic requirements.
- ii. Environmental consideration based on Environmental Impact Assessment (EIA) and Risk Analysis (RA) study for the pipeline and stations.
- iii. The Hazard and Operability (HAZOP) study and Hazard Analysis (HAZAN).
- iv. The availability of space for future augmentation of facilities.
- v. Approachability, water table and flood level and natural drainage.
- vi. Availability of electric power and water.
- vii. Habitation.

1.5.1.2 In addition to above, pipeline installations should be located so as to minimize the hazard of communication of fire to the pump station from structures on adjacent property.

1.5.2 Layout

1.5.2.1 The following aspects shall be considered while establishing station layout

- i. Station equipments and their specifications including sump tanks(s), surge tanks etc.
- ii. P&I diagram for the station.
- iii. Utility requirement including other storage tanks like High Speed Diesel (HSD) for power generation etc.
- iv. Storm water drainage system.
- v. Operation & maintenance philosophy of station equipments.
- vi. Fire station and allied facility wherever required.
- vii. Proximity to over head power lines. Overhead power lines should not be allowed directly above station equipment or buildings.
- viii. High Tension (HT) Pole structure, Transformers, Breaker and Master Control Centre (MCC) room etc. to be located maintaining minimum inter distance requirement as per Annexure I.
- ix. Requirement of space and access around the pump (including engine or motor) house or shed or building and other equipments to permit the free movement of firefighting equipment, emergency evacuation.
- x. Blow down facilities or buried drum should be located at one corner of the plant farthest from any fired Equipment and on the downward side of the station.
- xi. For LPG pipeline facilities, Pipeline installation shall be located upwind of LPG bulk storage facilities.

1.5.2.2 Minimum Inter-distances between various station facilities and utilities shall be as per Annexure I.

1.5.3 Piping Layout

1.5.3.1 Station piping may be installed above ground or buried. Buried piping inside the terminal area shall have a minimum cover of 1 m from top of pipe to finished ground or grade level.

1.5.3.2 At internal storm water drains underground piping shall be provided with a minimum cover of 300 mm with additional concrete slab extending at least 500 mm on either side of the edge of the drain and pipe.

1.5.3.3 Where buried pipes come above ground, the anti-corrosion coating on the buried pipe will continue for a length of at least 300 mm above ground.

1.5.3.4 Minimum head room should be kept as 2.2 m.

1.5.3.5 Piping Layout should be designed for reducing the piping loads on the nozzles of critical equipments.

1.5.3.6 Platforms and crossovers with appropriate handrails shall be provided for accessibility, ease of operation and maintenance of above ground piping and equipment where required.

1.5.3.7 All the above ground piping should be properly supported to withstand operational safety requirements.

1.6 Protection of Facilities

1.6.1 Properly laid out roads around various facilities shall be provided within the installation area for smooth access of fire tenders etc in case of emergency.

1.6.2 “Proper industry type boundary masonry wall at least three (3) meters high with an additional 0.6 meters barbed wire or concertina coil on the top shall be provided all around the installation i.e. pump station, booster station, Delivery, Dispatch and Receiving Terminals with petroleum storage and other installations identified as vital under Category-A based on the Risk Assessment carried out from time to time in line with Ministry of Home Affairs (MHA) guidelines and recommendations.

1.6.3 For other installations like Intermediate Pigging (IP) stations, Sectionalizing Valve (SV) stations etc. identified as vital under Category B and C, either proper industry type boundary masonry wall or chain link fencing at least three (3) meters high including 0.6 meters barbed wire or concertina coil on top may be provided. However, Category B and C installations having chain Link Fencing shall be required to carry out Risk Assessment at least once every year for review of categorization of installation in line with MHA guidelines or recommendations. The fencing shall be suitably earthed distinctly at minimum two places and locked or attended for the protection of the property and the public.

1.6.4 Emergency exit (to a safe place) with proper gate(s) shall be provided at all installations such as pump station, intermediate pump stations, pump stations with tank farm, delivery or terminal stations. Emergency exit gate shall be away from main gate and always be available for use of personnel evacuation during emergency.

1.6.5 At critical locations like tank farm area, pump house, manifold or metering area, intermediate pigging station etc., Close Circuit Television (CCTV) camera and/ or intrusion alarm system having SCADA facility may be provided. Cross country pipeline system shall be equipped with following:

- i. Supervisory Control and Data Acquisition (SCADA) System for pipeline length of 50 km and above or line fill of 5000 kl and above except jetty pipelines.
- ii. Leak detection system with provision for identification or location of leak and isolation of affected section from remote operation for pipeline length of 50 km and above or line fill of 5000 kl and above.
- iii. Communication facilities.
- iv. Emergency Response and Disaster Management Plans (ERDMP).

1.7 SCADA Requirements

1.7.1 Pipeline system shall be monitored and controlled using Supervisory control and Data Acquisition (SCADA) or equivalent monitoring and control system to ensure effective and reliable control, management and supervision of the pipeline.

1.7.2 Originating Pump Stations, Intermediate Pump Station, Intermediate Pigging Stations, Intermediate Delivery Station and Receiving or terminal Stations, Sectionalizing Valve stations with remote operation capabilities as well as Telecom Repeater Stations including voice

communication facilities or Cathodic Protection Stations (in case located independent of other facilities) should have suitable field signals' connectivity with the control system.

1.7.3 Application software modules or functions shall be based on the requirement of pipeline operating company to enable as a minimum to detect the leak in the pipeline and also enhance safety of the pipeline and personnel.

1.7.4 It is also recommended that in the Application Software (APPS) modules or functions, the following may be provided:

- i. Leak Detection and leak location
- ii. Inventory Analysis.
- iii. Batch Tracking
- iv. Survival Time Analysis.
- v. Pipeline transportation efficiency and scrapper tracking module.
- vi. Contingency Analysis.
- vii. Planning Module.
- viii. Predictive Module.
- ix. Pump driver power Optimization.
- x. On line network simulation.
- xi. Flow management system.

1.7.5 The SCADA system should be adequate (without adding any hardware to the system at Master Station and remote workstations) to accommodate future expansion (w.r.t. additional Programmable Logic Controllers (PLCs) and consequent pipeline length and facilities, communication channels, additional remote workstations or stations etc.) without any limitations and without affecting the various system performance parameters.

1.7.6 The Communication protocol with Remote Terminal Units (RTU) should conform to IEC 870 –5-101 or DNP3 or MODBUS or TCP or IP or any other available protocol.

1.7.7 Master Station (MS) should have the complete SCADA database and integrated alarm and event summary for overall operations management and control of the entire pipeline network.

1.7.8 Control Station (CS) or RCP (Repeater cum Cathodic Protection) location should not be located in low lying areas prone to flooding. It should be preferably located in higher elevations.

1.8 Pipeline System and Component

1.8.1 Process Piping

All process piping at station shall comply with the requirement of ASME B 31.4.

1.8.2 Valves

Valves shall be provided for isolating sections of station piping in order to:

- a) Limit the hazard and damage from accidental discharge from piping.
- b) Facilitate repair and maintenance of piping facilities and critical equipments.

For LPG Pipeline facilities, API SPEC 6D valves suitable for LPG services shall be provided. All valves shall be fire safe conforming to API 607/6FA.

1.8.2.1 Station Block Valves

Block valves with remote shut off provision from the control room shall be provided at the inlet (downstream of Tee) and outlet (up stream of Tee) of the pump or intermediate pigging or terminal or delivery station piping to isolate the pipeline from station facilities in case of emergency at station.

In addition, Block valves shall be considered as under:

- a) At entry and exit of pipeline stations boundary
- b) On each lateral takeoff from a trunk line

1.8.2.2 Station By-pass

Station by-pass system shall be provided to facilitate flow of liquid hydrocarbon in the pipeline bypassing the pumping facilities inside the station premises.

1.8.2.3 Check Valves

Check Valves shall be installed to provide automatic blockage of reverse flow in the piping system, within the station, wherever required. Check valves, when provided to minimize pipeline backflow at locations appropriate for the terrain features (e.g hills, steep slopes, etc.), shall be suitable for passage of all types of pigs including instrumented pigs.

1.8.2.4 Flow or Pressure Control Valve

Design of control valves in stations shall meet the requirement of part I of API 550 or API-RP-553, ISA (Instrument Society of America) S- 75.01 -75.03, IEC -60079 and IEC-60529.

1.8.2.5 Thermal Safety Valve for LPG Installations

Piping that can be isolated and need thermal safety valves shall have minimum design pressure of 24 kg/cm² or maximum pressure which could be developed by transfer equipment or any other source etc. whichever is higher and conform to the provision of ASME B 31.4 or equivalent.

1.8.2.6 Mainline or Sectionalizing Valves

(i) Sectionalizing valves shall be installed where required for operation and maintenance and control of emergencies. Factors such as topography of the location, ease of operation and maintenance including requirements for section line fill shall be taken into consideration in deciding the location of the valves. However, in any case the distance between two consecutive sectionalizing valves shall not be more than 50 km.

(ii) For LPG pipeline facilities, mainline sectionalizing or block valves shall be installed at maximum spacing of 12 km in industrial, commercial and residential areas.

(iii) For LPG installations, Remotely Operated Sectionalizing or Mainline block valve(s) shall be provided with blow down connection to isolate and evacuate the pipeline section in case of emergency and repair. All blow down piping shall have double valve segregation.

(iv) Mainline block valves shall be installed on both sides of the major river crossings and public water supply reservoirs. The valves shall be as close as possible near the upstream and downstream bank of the river and public water supply reservoirs for isolation of these portions of the pipeline and these valves must be remote operated.

(v) The valve stations shall be located at a readily accessible location such as near roads and shall be provided with an access road from the nearest all weather metalled road. Overhead power lines shall not cross directly over the process area of the valve station facilities.

(vi) The provisions of remote operated feature should be as per the operation and control philosophy to be adopted for the pipeline by the entity or operating company. For LPG installations, Sectionalizing or Block valves with remote shut off provision from the control room shall be provided at the boundary of station pipeline inlet and outlet locations to isolate the station facility. At locations where valve stations are combined with pump or repeater stations, the requirements of safe distance and statutory clearance, as applicable, shall be followed.

(vii) Valve shall be installed buried and provided with suitable stem extension for ease of operation. Sectionalizing valve on the piggable section of pipeline shall be full bore type to allow safe passage of pigs. The valve shall meet as minimum requirements of API SPEC 6D or ISO-14313 – “Specification for pipeline valves”. Isolation of earthing of actuator to be done to avoid interference in C.P.

(viii) Actuator for the actuated valve may be selected based on type of valve, availability of power and project philosophy. Pipeline sectionalizing valve may be electrically or pneumatically or hydraulically operated. Valves used in mainline shall be with butt weld ends. Valves used in buried portion shall be with butt weld joints only, except at the locations where hot tapping operation is to be carried out for which, buried flanged end valve may be provided.

(ix) Valve surface shall be applied with suitable corrosion protection coating.

(x) All joints between the mainline pipe and the first valve on the branch, including the inlet to first valve, should be welded in order to restrict possible leakage which cannot be isolated by the closure of the valve.

1.8.3 Pigging Facilities

1.8.3.1 All cross country pipelines and feeder lines, spur lines and branch lines of 4” and above size and length 10 km and above shall be provided with pigging facilities. However, pigging facilities for pipeline from or to jetty or type of petroleum and petroleum products handled may be provided on need basis.

1.8.3.2 Spacing between consecutive pigging stations shall be determined based on the diameter of pipeline, nature of pigging operation and capability of the pigs.

1.8.3.3 Pigging stations shall be provided with access road from the nearest all weather road.

1.8.3.4 Pigging facilities should be designed to be suitable for:

- i. access to the pig traps;
- ii. handling of pigs ;
- iii. isolation requirements necessary for pig launching and receiving;
- iv. draining of carried over muck or condensate during pigging operation;
- v. direction of pigging including bi-directional pigging;
- vi. minimum permissible bend radius and the distances between bends or fittings;
- vii. variation in pipe diameter and wall thickness;
- viii. internal coatings; and
- ix. Pig signalers.

1.8.3.5 The safety of access routes and adjacent facilities shall be considered when determining the orientation of pig traps.

1.8.3.6 Quick Opening End Closure system shall be used for Trap in order to provide repeated access to the interior of pigging system.

1.8.4 Bends

The minimum radius of Cold Field Bend shall be as per Table 2.

Table 2: Minimum Bend Radius

Nominal Pipe Size (inch)	Minimum bend Radius
12 and below	18 D
14	21 D
16	24 D
18	27 D
20 and above	30 D

Where 'D' is the outside diameter of the steel pipe

1.8.4.1 Use of Miter bend shall not be permitted.

1.8.4.2 The minimum bend radius for hot bends shall be 3D.

1.8.5 Insulating Joints

1.8.5.1 Insulating joints shall be provided to electrically isolate the buried pipeline from the above ground pipeline, station piping and shall allow smooth passage of pigs.

1.8.5.2 Each insulating joint shall be provided with surge diverters and shall have provision for checking integrity of the insulating joint.

1.8.6 Branch Connection

1.8.6.1 Branch connections of size below Nominal Pipe Size (NPS) 2 inch are not recommended in buried pipeline section.

1.8.6.2 All branch connections from mainline shall be provided with an isolation valve located at a minimum possible distance from the main pipeline.

1.8.6.3 Where welded or forged branch connections are installed in the pipelines designed for pigging, special branch connection should be used to ensure that the pig is not damaged while passing the connection.

1.8.6.4 All branch connections or side tap on the piggable section of the pipeline having diameter equal to or exceeding 40 percent of the main pipe diameter, shall be made using flow tees or bar tees in order to enable smooth passage of all types of pigs.

1.8.7 Supports for Above Ground Station Piping

1.8.7.1 If the liquid hydrocarbon piping is required to operate below 20% of SMYS, supports or anchors shall be directly welded to the pipe.

1.8.7.2 If a pipeline is designed to operate at stress level of more than 20% of the specified minimum yield strength of the pipe, all connections welded to the pipe shall be made to a separate cylindrical member which completely encircles the pipe, and this encircling member shall be welded to the pipe by continuous circumferential welds at both ends.

1.8.8 Flanged or Threaded Joints, Bolts, Nuts, Gasket and Other Fittings

1.8.8.1 Threaded joints shall not be used in the underground section of cross country pipelines, spur lines and branch lines. Threaded joints may be permitted in the above ground stations or above ground section of SV stations only if a welded isolation valve is provided before it. The number of threaded joints for station piping shall be to the extent minimum. The threaded joints, after tightening, may be seal welded.

1.8.8.2 The flange joint shall be provided with either spiral wound metallic gaskets or metallic ring type gaskets. Plain asbestos sheet or reinforced gaskets or Compressed Asbestos Fiber (CAF) gaskets shall not be used. The number of flanged joints for station piping for LPG shall be to the extent minimum.

1.8.8.3 For LPG installation, flange connection ratings shall match with the design pressure of the pipeline (on high pressure side) and in no case shall be less than 300 series rating (low pressure side) conforming to ANSI 16.5 or equivalent. All tapping or opening shall be minimum 20 mm dia. The materials used shall conform to ASME B 31.4 or equivalent.

1.8.9 Metering Facilities

Appropriate type of meters or other equivalent measuring device with the desired accuracy shall be installed at all pumping or terminal stations for leak detection or other purposes.

1.8.10 Electrical Installations of Pipeline Station

1.8.10.1 Area Classification of Pipeline Installation, as basis for Selection of Electrical Equipment for liquid hydrocarbon Pipeline Station shall follow IS: 5572. The specification of Electrical equipments shall be in line with IS: 5571, "Guide for selection of Electrical Equipment for Hazardous Area".

1.8.10.2 All electrical equipment, systems, structures and fencing shall be suitably earthed in accordance with IS: 3043.

1.8.10.3 The earthing system shall have an earthing network grid with required number of electrodes. All electrical equipment operating above 250 volts shall have two separate and distinct connections to earth grids. Separate earthing grid shall be provided for instrument and electrical system.

1.8.10.4 Lightning protection shall be provided as per the requirements of 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.

1.8.10.5 Safety devices in line with NACE SP-01-77 or BIS 8062 shall be installed for preventing damage to the pipeline due to lightning or fault currents when the pipeline is installed near electric transmission tower footings, ground cables etc.

1.8.11 Safety Instrumented System (SIS)

1.8.11.1 Safety Instrumented System (SIS) is composed of software and hardware which takes the process to a safe state when predetermined conditions, as set on control parameters like pressure, temperature, levels, flow etc. are violated. SIS protects against the possibility of a process excursion developing into an incident and limits the excursion potential.

1.8.11.2 SIS requirements as a minimum are as under:

- i. Emergency Shutdown (ESD)
- ii. Surge Relief
- iii. Alarm for hydrocarbon level in the tank
- iv. Thermal Safety Valve (TSV) or Thermal Relief Valve (TRV)
- v. Hydrocarbon detectors
- vi. High level and High-High level alarms for storage tanks and line balancing tank to be integrated with SCADA of pipeline control room.

1.8.11.3 Adequate Safety Instrumented System shall be designed for mainline pumps, motors, engines, storage at receiving or delivery terminals etc.

1.8.11.4 Instrumentation and control system for the pipeline system in totality shall meet the requirement as per API Standard API-RP-551 to API-RP-556 "Manual on Installation of Refinery Instruments and Control Systems".

1.8.12 Communication

A reliable and dedicated communication system to interact between all stations including sectionalizing valve station with or without remote operation capability along the entire pipeline shall be designed and installed and maintained to ensure safe operations under both normal and emergency situations.

1.8.13 Pump Station

1.8.13.1 Pump Station shall be designed in accordance with the requirements of ASME B 31.4.

1.8.13.2 No free water in LPG being pumped shall be allowed as per IS 4576. Online water analyzer may be installed at the originating pump station to detect any free water in the LPG being pumped.

1.8.13.3 Typical facilities at a typical pump station shall consist of following:

1.8.14 Pumps

1.8.14.1 Centrifugal type pump shall conform to the requirement of API-610. Reciprocating Pump shall conform to the requirements of API 674 or API 675 or API 676.

1.8.14.2 LPG Pumps shall conform to API 610. LPG Pumps shall be provided with a high point vent to safe height minimum 3 meters above the pump in case of no pump shed or 1.5 meters above the pump house roof top or connected to a cold flare with flame arrestor.

1.8.14.3 All Pumps shall be provided with suction and discharge pressure gauges and transmitters.

1.8.14.4 Check valve shall be installed on the discharge side of all centrifugal pumps wherever installed in parallel. Wherever pumps are installed in series, shall have check valve in the header isolating the suction and discharge piping connection. The last pump in the series shall have check valve on the discharge piping. Additional common check valves shall be installed in the outlet header of the series pump configuration. The suction and discharge side of the main pumps and booster pumps shall have actuated valves.

1.8.14.5 Minimum flow circulation line shall be provided for booster pumps or main pumps in line with designer's or manufacturer's recommendation.

1.8.14.6 Mechanical Seal with seal failure alarms and trips shall be provided. However, for LPG services, Double Mechanical Seal with seal failure alarms and trips shall be provided.

1.8.14.7 Pumps protection and interlocks shall be provided in accordance with manufacturer's recommendations.

1.8.14.8 For LPG pipeline facilities, Following alarms and tripping shall be provided on pumps:

- a. Low suction pressure of booster and main pump.
- b. High discharge pressure at main pump,
- c. Low discharge pressure trip on pump against pipe rupture to avoid liquid vaporization.
- d. High Casing temperature
- e. High bearing temperature
- f. Tripping of main or booster pump in case of closure of suction or discharge MOVs.

1.8.14.9 Motor operated valve limit switch position (open or close) to be interlocked with the start of the pump.

Pump shall operate in sequence with defined logic at starting and shut down.

1.8.15 Pump Drivers

1.8.15.1 Electric Motors with fixed speed drive or variable frequency drive (VFD) may be provided as Pump Drivers. Electric Motors shall meet the requirement of API 540 "Electrical Installation of Petroleum Processing Units".

1.8.15.2 In case Internal Combustion Engines as pump drivers is provided, this shall meet the requirement of API standard 7C - 11F - "Recommended practice for Installation, Maintenance and Operation of Internal Combustion Engines" or suitable BIS equivalent codes.

1.8.15.3 Air intake shall be located in a non hazardous area. Screwed pipe fittings shall not be used on any part of the fuel system piping or on the day service tank. Seamless tubing with stainless compression fittings are recommended. If the flame arrestor or traps are installed on the exhaust, it shall comply with BS 7244.

1.8.15.4 Exhaust manifolds and turbocharger casing shall be cooled as per OEM recommendations.

1.8.15.5 The control panel of the engine shall be designed for operating in hazardous area in case the same is mounted adjacent to the engine.

1.8.15.6 All electrical equipment installed in hazardous area shall be certified for use in hazardous area including electric starter motor and starter solenoids.

1.8.15.7 The radiator fan blades shall be as per OEM recommendations.

1.8.15.8 Safety Instrumentation system on the mainline engine shall be provided. In addition to this, provision shall be made for shut down of the engine on high coolant or lubricating oil temperature.

1.8.15.9 Engines driving pumps used for pumping petroleum products class A and Class B shall be separated from the pump by means of fire wall of sufficient size to prevent liquids leaking from the pump from spraying onto the engine.

1.8.15.10 in addition, pump and pump driver (Engine or motors skids) should be equipped with vibration monitoring devices with provisions for local and/ or remote alarm shut down capabilities.

1.8.16 Instrument and Plant Air System

Depending upon requirement, pump station should have an instrument air supply system for instrumentation system, control valves etc. Electrical motor driven or engine driven air compressors shall be used. Air receivers, air storage bottles and instrument air dryer units shall be provided. Air receivers or air storage shall be designed and installed in accordance with ASME Section VIII of the Boiler and Pressure Vessel Code.

1.8.17 Delivery Storage (LPG)

High level alarm and High level alarm indication of storage vessel shall be set at 80% and 85% level of volumetric capacity respectively. The audio visual indication shall be provided at local panel and the pipeline control room. Pipeline delivery Remote Operated Valves (ROVs) (supplier's and consumer's premises) shall close on actuation of high level alarm.

1.9 Safety Devices and Features

1.9.1 Emergency Shutdown (ESD) Facilities for Stations

1.9.1.1 Pump station, delivery cum tap off station and terminal station shall be provided with an emergency shutdown system by means of which the operation can be safely stopped. Operation of the emergency shutdown system shall also shutdown all Pumps, Prime movers, Control valves and delivery manifold valves except those that are necessary for protection of the equipment.

1.9.1.2 Emergency shutdown system shall be operable from at least 2 locations away from the pump shed area of the station out of which one should be located in the field outside the pump shed building and another in the control room of the pump station.

1.9.2 Pressure Limiting Devices

1.9.2.1 Any equipment or section of the pipeline containing liquid hydrocarbon in the form of trapped volume shall be protected against excessive pressure developed due to rise in surrounding temperature by installing Thermal Relief Valves (TRVs). The discharge of TRVs shall be connected to blow down drain connected to a sump tank of appropriate capacity. For LPG installations, the discharge of TRVs shall be connected to flare system wherever available. These TRVs shall have isolation valves on both sides of safety valve. All TRV isolation valves (upstream and downstream) shall be lock open.

1.9.2.2 In case of non-availability of flare system, the discharge from safety valve shall be vented vertically upwards to atmosphere at an elevation of 3 meter (minimum) above ground or the tallest structure within a radius of 15 meter whichever is higher for effective dispersion of hydrocarbons. In this case, isolation valves on downstream of PSVs are not required. A weep hole with nipple at low point shall be provided on the vent pipe in order to drain the rain water which may get accumulated otherwise. Weep hole nipple shall be so oriented that in case of safety valve lifting and consequent fire resulting from LPG coming out from weep hole does not impinge on the structure or equipment. A loose fitting rain cap with chain (non sparking) shall be fitted on top of the vent pipe.

1.9.2.3 Pressure safety valves or other devices of sufficient capacity and sensitivity shall be installed to ensure that the normal operating pressure of the system does not exceed by more than 10%. If the normal operating pressure is the maximum allowable operating pressure of the pipeline, then the set pressure for pressure safety valve should be at a pressure 2 kg/cm² above the maximum allowable operating pressure (MAOP) or at a pressure equal to MAOP plus 10%, whichever is less.

1.9.3 Sump Tank

Discharge from safety valves shall be connected to a close blow down system having an underground storage tank of appropriate capacity. In case surge protection measures are installed, the sump tank shall have adequate capacity to store the excess liquid hydrocarbon expected to be released as result of activation of surge relief system.

1.9.4 Fire Protection System

1.9.4.1 Ultra Violet or Infra Red or Other Flame detectors or Heat detectors or a combination of flame and heat detectors shall be installed in the pump shed to give automatic alarm and/ or

shut down of the unit, isolation of the facilities in the event of occurrence of fire. The same may be coupled with suitable extinguishing system such as foam system for extinguishing the fire.

1.9.4.2 Smoke or multi sensor detectors shall be provided in control room, Motor Control Center (MCC) room and utility rooms, cable trenches etc. with provision of indication, alarm and annunciation.

1.9.4.3 Break glass type fire alarm system shall be installed at all strategic locations of the stations and shall be integrated to the Fire Alarm Panel in the control room and the same shall be extended to the marketing control room in delivery or terminal stations. Manual call point with talk back facilities shall be installed in the strategic locations of large size tank farm and to be hooked up with station fire alarm panel.

1.9.4.4 Environmental friendly fire extinguishing system shall be considered for control rooms, switch gear and battery room, computer rooms of pump station, terminal station, delivery or tap off stations.

1.9.4.5 Fire water network with fire hydrants, long range monitors and fire water storage shall be provided at all stations except scrapper stations and sectionalizing valve stations.

1.9.5 Piping Requirement for Refrigerated LPG Transfer

1.9.5.1 Piping system shall be designed as per ASME B 31.3. The refrigeration system shall maintain the LPG at a temperature at which LPG's vapour pressure does not exceed the piping design pressure.

1.9.5.2 Pipe component material specification should meet the temperature extremes for which it has been designed. Low ductility materials such as cast iron, semisteel, malleable iron and cast aluminum shall not be used in any pipe.

1.9.5.3 Shut off valves and accessory equipment shall be constructed of material suitable for operating pressure and temperature extremes to which they are subjected.

1.9.5.4 The insulation shall contain a vapour barrier and shall be weather proofed. Insulation and weather proofing shall be fire retardant. Steel surfaces covered by insulation shall be properly coated to prevent corrosion.

1.9.5.5 When cold piping is routed below ground provision like trenches, casing and other means shall be made to permit expansion and contraction of the pipeline.

1.9.5.6 When storage facility handles more than one type of product, dedicated loading and unloading pipelines shall be considered for each type of product.

1.9.5.7 The vapour load resulting from refrigeration shall be handled by one or a combination of the following method.

- (a) Recovery by a liquefaction system
- (b) Disposal by flaring

1.9.5.8 Provision shall be made for emergency alarm to signal excess pressure build up in the pipeline because of a failure of cooling medium.

Schedule 1B

MATERIALS AND EQUIPMENT

2.1 Materials and Equipments

All materials and equipments forming a permanent part of any piping system constructed according to these Regulations shall comply with the design and service requirements and shall be suitable for the intended fabrication and/ or construction methods. For sour liquid service requirements as per Schedule 1H shall be complied with.

2.2 Materials for use in Cold Climates

Materials to be used in facilities exposed to low ambient and / or low operating temperature shall have adequate impact properties to prevent brittle fracture at such low temperatures.

2.3 Material Specifications

In addition to standards and specification covered in ASME B 31.4, standards and specifications listed in Annexure II shall also be acceptable for manufacturing of various piping components forming part of the liquid hydrocarbon pipelines and associated facilities.

2.4 Steel Pipe

2.4.1 Carbon Steel line pipe for use in liquid hydrocarbon pipeline system shall be Seamless, Electric Welded (EW) or Submerged Arc Longitudinal or Helical Welded (SAWL or SAWH) conforming to Line pipe Specification API 5L Product Specification Level (PSL) - 2 or equivalent.

2.4.2 Pipes made of cast iron shall not be used in sour multiphase service. Use of ductile iron pipes is not permitted for liquid hydrocarbon pipelines.

2.4.3 Electric welded pipes manufactured to API specification 5L shall also meet additional requirements specified under Annexure III of these regulations.

2.5 Carbon Equivalent

2.5.1 The maximum limits on Carbon Equivalent (CE) for Steel line pipes shall be as follows:

For pipes having Carbon Content > 0.12%

$$CE(IIW) = C + \frac{Mn}{6} + \frac{Cr + MO + V}{5} + \frac{Ni + Cu}{15}$$

CE (IIW) value shall be $\leq 0.40\%$

For pipes having Carbon Content $\leq 0.12\%$

$$CE(Pcm) = C + \frac{Si}{30} + \frac{Mn}{20} + \frac{Cu}{20} + \frac{Ni}{60} + \frac{Cr}{20} + \frac{Mo}{15} + \frac{V}{10} + 5B$$

CE (Pcm) value shall be $\leq 0.20\%$

2.5.2 Ultrasonic testing shall be carried out for 100% of the pipe weld seam. Ultrasonic testing for pipe ends shall be mandatory.

2.6 Mill Hydrotest

Line pipes are recommended to be hydrostatically tested in pipe mill using test pressure that produces a hoop stress equal to 95% of SMYS irrespective of grade of pipe material. Test pressures for all sizes of seamless pipe, and for welded pipe with $D \leq 457$ mm (18 inch), shall be held for not less than 5 seconds. Test pressures for welded pipe with $D > 457$ mm (18 inch) shall be held for not less than 10 seconds.

2.7 Fracture Toughness

Carbon steel line pipes shall meet the fracture toughness requirements stipulated in ASME B 31.4.

2.8 Notch Toughness Requirements

2.8.1 For carbon steel pipes and other steel components of size NPS 2 inch and larger, notch toughness values shall be determined to provide protection against fracture initiation and propagation. Notch toughness values (minimum impact absorbed energy values) shall be specified based on the design operating stress and the minimum design temperature.

2.8.2 For carbon steel pipes and other components smaller than NPS 2 inch proven notch toughness properties are not mandatory.

2.9 Ductile Iron Pipe

Use of ductile iron pipes is not permitted.

2.10 Pipes and Fittings

Pipes and fittings manufactured to standards listed in Annexure II of these regulations should be used.

2.11 Equipment Specifications

Equipment used in petroleum and petroleum products pipelines manufactured to standards listed in Annexure II of these regulations shall also be acceptable.

Schedule 1C

PIPING SYSTEM COMPONENTS AND FABRICATION

3.1 General

3.1.1 This section covers the requirements for fabrication, installation and testing of piping systems components for process and utility piping of the terminals forming an integral part of liquid pipelines systems.

3.1.2 In general, all the piping system components for respective terminals or stations shall be designed, fabricated, erected, tested in accordance with the binding requirement of applicable code (ASME B31.3 or 31.4). Unless otherwise specified, the requirements specified in this section will supplement the requirements specified in the respective piping codes and project specifications.

3.2 References

3.2.1 Reference shall be made to following standards, as applicable:-

ASME B31.3 : Process Piping

ASME B31.4 : Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids

ASME VIII : Boiler and Pressure Vessel Code

OISD-STD-141 :Design and Construction Requirements for Cross Country Hydrocarbon Pipelines

3.2.2 The specifications for piping material used in the petroleum and petroleum products pipeline shall be as per Annexure-II.

3.3 Materials

3.3.1 The piping materials shall be procured strictly in accordance with the applicable Piping Material Specification (PMS) or Valve Material Specification (VMS) or material specifications prepared for the purpose duly complying with the requirements specified in applicable codes and standards.

3.3.2 Procedures for off-loading, storage, receipt, control, traceability and inspection of piping material supplied for fabrication and installation shall be prepared and implemented.

3.3.3 Once delivered to site for the fabrication or construction, the storage and preservation procedures shall be prepared and implemented until the system is commissioned, as applicable.

3.3.4 Storage of piping and piping components and equipment shall be under cover and protected against environmental degradation and /or corrosion.

3.3.5 The Carbon steel and stainless steel components shall be segregated to avoid any cross contamination.

3.3.6 All fittings and equipment shall be protected against damage during handling. Special

attention shall be given to the sealing surfaces and bevelled areas.

3.4 Fabrication

3.4.1 General Requirements

3.4.1.1 The fabrication yard shall be set-up for work with relevant materials and equipment.

3.4.1.2 All welded attachments to piping, including pads etc. shall be of a material compatible with the piping material.

3.4.1.3 Bending and forming of pipe shall be carried out in accordance with ASME B31.4 and shall be performed in accordance with documented procedures.

3.4.2 Welding and NDT

3.4.2.1 All welding and non destructive testing (NDT) shall be in accordance with applicable design or fabrication codes. Accordingly, the project specifications shall be developed to include for type of materials, applicable welding compatibility of consumables and welding procedures, Welding procedures, Pre-qualification test (PQT), evaluation and acceptance of qualification, frequency of production testing, acceptance and rejection criteria including heat-treatment requirements, as applicable.

3.4.2.2 All butt welded golden joints, which are not subjected to hydrostatic testing, shall be 100% radiographically tested as well as 100% examination by ultrasonic technique. Socket welded golden joints shall be examined by using Liquid Penetration Inspection or wet Magnetic Particle Inspection technique.

3.4.3 Welds and Threads

3.4.3.1 Internals of in-line valves and equipment that could be damaged due to heat transfer shall be protected or removed prior to welding and/or heat treatment. Manufacturer's recommendations shall be clearly defined and followed during welding of such items.

3.4.3.2 Unless otherwise stated on approved drawing or specifications, pipe threads shall conform to ASME B1.20.1. All threading shall be carried-out after bending, forging or heat treatment, but where this is not possible, suitable thread protection shall be provided.

3.4.4 Dimensional Control of Pre-fabricated Pipe-work

3.4.4.1 Dimensional control of prefabricated piping spools shall be performed in a systematic manner, assuring that the final installation will be correct. The applicable tolerances shall be specified in Piping General Arrangement (GA) drawings, fabrication drawings and/or isometrics as prepared specifically for the fabrication works.

3.4.4.2 Prefabricated pipe spools shall be cleaned and applied with protective coatings (as required) and preserved prior to installation.

3.4.4.3 Internal cleaning of pipe spools may be done by hydro flushing or hydro jetting.

3.4.5 Branch Connections

3.4.5.1 Tees, weldolets, nippolets, sockolets, and reinforcement pad connections shall be provided as applicable for the branch connections.

3.4.5.2 Reinforcement pads or saddles required by specifications and drawings shall be of the same material as the main pipe (unless specified otherwise) and shall be formed to provide a good fit to both main and branch pipe.

3.4.5.3 Branch reinforcement pads or each segment thereof shall be provided with a minimum 3.0 mm drilled and tapped hole prior to fitting to the pipe, to ensure leak detection, venting and testing facilities. Whenever possible, pad should be made in one piece before fitting onto pipe. After welding and testing the hole shall be permanently plugged, e.g. welded or metal plug in piping material.

3.5 Installation of Piping

3.5.1 General

All pipes shall be inspected before erection to ensure that they are free from loose contamination.

3.5.2 Erection of Piping

3.5.2.1 Pipe-work shall be erected on permanent supports designated for the line.

3.5.2.2 Temporary supports shall be kept to an absolute minimum, but to an extent sufficient to protect nozzles and adjacent piping from excessive loads during the erection.

3.5.2.3 Pipe-work shall be fitted in place without springing or forcing to avoid undue stressing of the line or strain being placed on a vessel or item of equipment, etc.

3.5.2.4 All temporary pipe spools and supports that are an aid to erection, testing or flushing, fastening, etc. are to be specially marked for removal identification.

3.5.2.5 All valves shall be protected against ingress of dirt, chemicals and moisture during any temporary storage.

3.5.3 Flanged Joints

3.5.3.1 Before assembly, flanges shall be adequately inspected and shall not have any damage that may interfere with the integrity of the joint.

3.5.3.2 The flanges shall be clean and free from any rust, dirt or other contamination. The joints shall be brought up flush and square without forcing so that the entire mating surfaces bear uniformly on the gasket and then mated-up with uniform bolt tension.

3.5.3.3 With the piping flange fitted and prior to bolting-up the joint, it shall be maintained that (i) the bolting shall move freely through accompanying bolt-holes at right angle to the flange faces (ii) there shall be a clear gap between two flange faces before gasket installation (iii) there shall be sufficient flexibility to install and replace gaskets.

3.5.3.4 The flange covers shall be retained on all flange connections to valve or equipment, until ready to connect the mating piping.

3.5.3.5 The equipment shall be blanked, either by pressure test blanks, spades or blinds, to stop the ingress of internal pipe debris.

3.5.3.6 The flange joint shall be made using either spiral wound metallic gaskets or metallic ring type gaskets. Plain asbestos sheet or reinforced gaskets shall not be used.

3.5.3.7 Fittings and flanges made of cast iron and ductile iron shall not be used in petroleum and petroleum products Pipelines.

3.5.4 Strain Sensitive Equipment for Flanged Connections

3.5.4.1 When the flanges are to be connected to strain sensitive mechanical equipment (e.g. pumps, compressors, turbines, etc.), then in such cases, the connecting flanges shall be fitted-up in close parallel and lateral alignment prior to tightening the bolting.

3.5.4.2 In general, flange connections to strain sensitive equipment shall be the last connection made on completion of a line or interconnecting system of lines. The connections to strain sensitive equipment shall be subject to stress analysis.

3.5.5 Gaskets

The gaskets shall be supplied, stored and installed in accordance with manufacturers' instructions. Gaskets shall not be reused. Gaskets shall not protrude into the bore of pipe.

3.5.6 Bolting

3.5.6.1 Bolting shall be in accordance with applicable piping specification for the project.

3.5.6.2 Manually torqued flange bolts and stud bolts shall extend fully through their nuts with minimum one and maximum five threads.

3.5.6.3 The flange bolts, stud bolts threads as well as nut spot faces shall be thoroughly lubricated prior to fitting.

3.5.6.4 All bolted flange connections shall have controlled tightening by means of manual torque wrenches or hydraulic bolt tightening.

3.5.6.5 If required, the bolts shall have extra over-length in order to accommodate tensioning tool.

3.5.7 Pipe Supports

3.5.7.1 Pipe supports shall be in accordance with the valid pipe support detail drawings developed for the project and/or piping support guide developed for the project.

3.5.7.2 For lines subject to stress analysis, it shall be ensured that the stress isometric drawings fully comply with the installed system with regard to pipe routing, pipe support locations and support functionality.

3.5.7.3 Piping shall not be forced to fit with support locations in such a manner that additional stress is introduced. Pipes shall not be supported by other pipes, i.e. individual supporting is required.

3.5.7.4 ¹[All stud, bolts and nuts used in petroleum and petroleum products pipelines should be as per ASTM A 194 / A193.]

3.5.8 Installation Tolerances

¹ Subs. by Cl. (i) of Reg. 2, the Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Petroleum and Petroleum Product Pipelines) Amendment Regulations, 2017 (w.e.f. 29.12.2017).

Installation tolerances of piping components shall be as required by the individual service of the piping component including requirements for maintenance access, position relative to surrounding steelwork, equipment, cable tray and heating, ventilation and air-conditioning duct routings, positioning of pipe supports relative to the structural steel, pipe stress.

3.5.9 Expansion and Flexibility Requirement

3.5.9.1 Piping shall be designed to have sufficient flexibility to prevent excessive stresses in the piping material caused from expansion or contraction, excessive bending moments at joints, or excessive forces or moments at points of connection to equipment or at anchorage or guide point.

3.5.9.2 Maximum temperature for design of above ground section of pipeline or piping shall be the maximum expected liquid temperature during operation or maximum ambient temperature whichever is higher. When maximum temperature expected during operation is below 65°C, thermal expansion and stresses in the above ground piping shall be evaluated considering pipe skin temperature of 65°C.

3.6 Preparation of Piping for Testing

3.6.1 General

3.6.1.1 The initial flushing shall be carried out prior to pressure testing. The piping shall be free from all foreign materials (e.g. dirt, grease, oxide scale, weld deposits and temporary protective coating) which could cause operational disturbances. All flushing shall be performed according to a documented procedure.

3.6.1.2 All items that can be damaged during cleaning shall be removed or blocked prior to cleaning, e.g. pressure gauges, flow meters, signal sensors, relief valves, permanent strainers, check or globe or control valves having reduced cross sectional areas, rupture discs, instrument probes, thermo wells, connection to vessels or pumps level instruments, etc.

3.6.1.3 The orifice plates shall be installed after flushing and pressure testing.

3.6.2 Hydro-flushing

3.6.2.1 Items which would be sensitive to damage during hydro flushing shall be removed, blocked off or isolated. Ball valves shall be flushed in fully open position. All piping systems shall be flushed using high pressure jet-flushing equipment. The piping system shall be hydro flushed to ensure that weld deposits are removed.

3.6.2.2 The flushing medium shall be fresh water. The flushing water chloride-ion content shall be less than 50 ppm and the pH value shall be in the range of 6.5 to 7.5.

3.6.2.3 After flushing, the piping systems shall be completely drained and protected against corrosion.

3.6.3 Pressurized Air Blowing

The pressurized air blowing may be used as an initial cleaning method for instrument air, plant air and as an alternative method for initial cleaning of small bore pipe (typical less than 2 in). This method may also be used when there are problems removing trapped liquid in the circuit, or to verify cleanness of small bore pipe or where the inspection is inadequate due to pipe shape and configuration. Safety precautions will be taken when using this method to avoid injuries.

3.6.4 Soft Pigging

3.6.4.1 If required, the soft pig may be propelled using compressed air, vacuum, or water. Pressure shall not exceed design pressure of the system. When using compressed air, a procedure covering all safety aspects shall be established. The procedure shall describe in detail the arrangement for catching or receiving the pig in a safe manner. Items which can be sensitive to damage during soft pigging shall be removed.

3.6.4.2 All systems shall be internal visual inspected for acceptable cleanness by spot check during construction.

3.7 Pressure Tests

The test pressure shall, unless otherwise specified, be in accordance with ASME B31.4. The test pressure shall be calculated based on the maximum design pressure of the piping class (not the design pressure of the individual line). Suitable temperature adjustments shall be made while calculating the test pressure.

3.7.1 Test Preparation

3.7.1.1 Pressure, temperature and time recorders shall be used for all pressure tests. The pressure shall be shown in barg. Pressure gauges and recorders used to indicate and record test pressure shall be dead weight tested for accuracy according to a procedure, dependent on type of equipment. Pressure and temperature gauges and recorders shall be calibrated in accordance with recognized calibration standards.

¹[****]

3.7.1.3 All piping shall be adequately supported before the pressure test. Spring or other variable type supports shall be blocked to prevent movement.

3.7.1.4 Unless otherwise noted, all valves are to be through body tested. If valves are included in the pressure test, the following applies: ball, plug, slab gate valves and other valves where the cavity pressure may differ from the bore pressure, shall be pressure tested in the half open position. All other valves shall be tested in the fully open position. When check valves are included in pressure test they shall be jacked open or have their internals removed.

3.7.1.5 Where the test pressure to be applied to the piping is greater than the maximum allowable test pressure for valves, the valves shall be blinded off on the side to be tested, or removed and replaced by dummy spools. Turbines, pumps, compressors and vessels shall be blinded off prior to pressure testing.

3.7.1.6 A list shall be prepared for sensitive equipment (i.e. expansion joints, relief valves, inline instruments, etc.) that shall be removed, blocked off or isolated during testing. This list shall be a part of the test procedure.

3.7.2 Test Media

3.7.2.1 For hydrostatic testing, the test medium shall in general be fresh water, except that other suitable liquid may be used if the piping or inline equipment would be adversely affected by water

¹ The words specified in Cl. 3.7.1.12 shall stand omitted by Cl. (ii) of Reg. 2, the Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Petroleum and Petroleum Product Pipelines) Amendment Regulations, 2017 (w.e.f. 29.12.2017).

and shall be subject to prior agreement.

3.7.2.2 The piping shall be properly drained as soon as possible after testing. Carbon Steel systems shall be tested with an acceptable preservation fluid to prevent rust. The anti-freezing compounds may be added if it is anticipated that the ambient temperature may fall down below the permissible value.

3.7.2.3 For pneumatic testing, the test media shall be oil free, dry air or any inert gas. The use of air for testing shall be limited to a maximum pressure of 0.7 MPa overpressure. Above this pressure nitrogen shall be used. The extent of pneumatic testing shall be approved. All safety aspects using compressible test media shall be evaluated.

3.7.2.4 For instrument or utility air systems, where the introduction of water is undesirable, test media shall be oil free dry air or any inert gas.

3.7.3 Hydrostatic Testing

3.7.3.1 The test pressure shall be maintained for a sufficient length of time to permit visual examination to be made of all surfaces, welds and connections. Over-pressuring due to static head shall be avoided.

3.7.3.2 Hydrostatic testing of station piping shall be carried out separately from main pipeline and same shall be tested at minimum test pressure of 1.25 times the design pressure. The test pressure shall be maintained for a minimum period of 4 (four) hours.

3.7.4 Pneumatic Testing

3.7.4.1 Pressure of 0.5 kg/cm² shall be introduced in the system and a leak test performed. The pressure shall gradually be increased to 50 % of the specified test pressure and kept for minimum 10 min to equalize strain. The pressure shall then be increased in steps of 10 % of the specified test pressure, until the specified test pressure is reached. At each step, the pressure shall be kept for minimum 10 min to equalize strain. The specified test pressure shall be kept for 1 hour. The pressure shall then be gradually released after examining for leakage. The piping systems shall not show any sign of plastic deformation or leakage.

3.7.4.2 All flanged joints in above ground pipelines or piping, equipment and instrument impulse tubing etc. shall be tested by pressurizing the piping system or equipment with dry compressed air or water at a pressure of 3.0kg/cm²g and checked by means of soap solution or suitable digital gauge for leaks as applicable. After hydrotesting of the pipeline sections or station piping the section shall be dewatered immediately except when the section is filled with inhibitor. After dewatering the section shall undergo swabbing.

3.7.5 After Completion of Test

3.7.5.1 The tested systems shall be depressurised by opening the depressurising valve in the test rig. After depressurisation, all vents and low point drain valves shall be opened and the system shall be thoroughly drained where the test medium is water. Where required, blowing by dry air or pressurised air shock blowing to remove any trapped water shall be performed to remove any residual or trapped water.

3.7.5.2 Systems with drying requirement shall be dried out after hydro testing with dry oil free air. The dew point shall be established depending upon location or elevation and the level of dryness required. Drying may be terminated when the dew point at the outlet is equal to the dew point at the

inlet. Other methods (e.g. vacuum drying) may also be used if the same dryness can be achieved.

3.7.5.3 Requirement for drying shall be defined taking into consideration the time for start up of system. If more than 3 months to commissioning, drying shall be followed by preservation with nitrogen to keep the pipe system completely dry and to avoid condensation of moisture. Other suitable preservation technique shall be adopted to prevent corrosion during such period.

3.7.5.4 Reinstallation of the system shall be performed in accordance with the test procedure. Where permanent or temporary strainers have remained in place for the hydrostatic pressure test, they shall be removed following the test and thoroughly cleaned before reinstalling. Ends of pipes and nozzles shall be fully protected against the ingress of foreign material by the use of caps, plugs or plate blinds sealed with gaskets. These shall not be removed until just prior to final assembly. Flange parallelism and alignment to equipment shall be checked prior to reinstatement. All lines or joints that fail to pass the pressure test shall be re-tested to the same procedure after repairs.

3.7.6 Test Acceptance Criteria

The piping systems shall not show any sign of plastic deformation or leakage.

3.7.7 Test Documentation

For all pressure tests, documentation shall be fully traceable during the commissioning period of the tested pipe. The documentation shall include, but not be limited to (i) a valid test certificate specifying date, location, line numbers, test pressure, test medium and test duration (ii) a test record chart fully specifying the pressure, temperature and time relation during the test period.

Schedule 1D

INSTALLATION AND TESTING

Pipeline shall be buried below ground level and unless construction above ground is found to be desirable for exceptional reasons.

4.1 Pipeline Cover

4.1.1 Petroleum and petroleum products pipelines shall be buried with a minimum cover as specified in Table 3

4.1.2 In rocky areas and areas with hard soils or gravels, minimum 150 mm thick padding of soft soil or sand shall be provided all around the pipe. If required protective layer of rock-shield or rock guard or concrete coating may be provided to prevent damage to coating or steel pipe during installation and testing in place of soft padding,

4.1.3 No dwellings or construction in any form shall be permitted within RoU. Offenders or defaulters shall be liable to prosecution as permitted under The Petroleum and Minerals Pipelines (Acquisition of Right of User in land) Act, 1962 and its amendments.

4.2 Excavation

4.2.1 In cultivable land and other specifically designated areas, the top 300 mm soil excavated from the trench shall be stored separately. This top soil shall be replaced in original position after backfilling and compacting of the rest of the trench.

4.2.2 The width of trench shall be such that a minimum clear distance of 200 mm for trench in normal soil and 300 mm for trench in rock is maintained between edge of pipe and the trench wall at the bottom of the trench.

Table 3: Minimum Cover Requirements for Pipelines

S. No.	Locations	Minimum Cover in meters ^[1]
i)	Normal or rocky terrain	1.2 (normal) 1.0 (rocky)
ii)	Drainage, ditches at roads or railway crossing	1.2
iii)	Minor river crossings, tidal areas and other watercourses ^[2]	1.5
iv)	Major river crossings ^[2]	2.0
v)	River with rocky bed	1.5

vi)	lined canals or drains or nalas etc.	1.5
vii)	Cased or uncased road crossing ^[3]	1.2
viii)	Cased Railways crossing ^[3]	1.7

Notes:

- (1) Cover shall be measured from the top of coated pipe to the top of the undisturbed surface of soil at a distance of 2 m or more from the edge or toe of ROU or ROW or the top of graded working strip, whichever is lower. The fill material in the working strip shall not be considered in the depth of cover.
- (2) For river or watercourses that are prone to scour and / or erosion, the specified cover shall be measured from the expected lowest bed profile after scouring or erosion. Where scour level is not known, an additional cover of at least 1 meter (Over and above the cover mentioned as above in the Table 3) shall be provided from the existing bed of the river or water course except in case of Rocky bed.
- (3) The cover shall be measured from the top of road or top of rail, as the case may be.
- (4) Whenever the above provisions of cover cannot be met due to site constraints, additional protection in form of casing or concreting, soil bags, etc. shall be provided.
- (5) When insisted by authorities, the depth shall be maintained as per the directions of the concerned authorities.

4.2.3 The location of a new buried pipeline, when running parallel to an existing buried pipeline, should be at a minimum clear distance of 5.0 meters from the existing underground pipeline when heavy conventional construction equipment is expected to be utilized. This distance may be reduced after careful assessment of construction methodologies so that it does not result in unsafe conditions during construction. In any case the minimum clear distance shall not be less than 3.0 meters. This can be permitted to be less than three meters in exceptional cases if appropriate cathodic protection measures are implemented based on CP interference survey results. Existing pipeline should be clearly marked on the ground during construction. Bi-language (local language and Hindi or English) caution signs should be installed while working in such areas.

4.2.4 While laying more than one new pipeline in the same trench, clear separation of minimum 500mm shall be maintained between adjacent pipelines.

4.2.5 No pipeline should be located within 15.0 meters of any dwelling unit or any industrial building or place of public assembly in which persons work, congregate or assemble, unless it is provided with at least 300 mm of cover over and above minimum cover specified in Table 3 or any other mitigation measure provided like higher pipe wall thickness or protection with RCC Slab. No dwelling unit or permanent structure in any form shall be permitted within the ROU or ROW.

4.3 Crossing

4.3.1 As far as possible, pipeline should cross existing facility at right angles. Turning Points (TPs) provided on either side of crossings shall be located at sufficient distance away from RoU or RoW of existing facility to facilitate installation of bends except when the pipeline runs parallel to existing facility. Minimum cover shall be as per Table 3.

4.3.2 When insisted by authorities, road or highway or rail crossing will be installed using a casing pipe, minimum diameter, thickness and length of casing pipe shall comply with API RP-1102. Carrier pipe shall be adequately supported inside casing pipe using casing insulators made of durable and electrically non-conductive materials to ensure no contact between carrier and casing pipe. Casing end seals shall be installed to prevent ingress of water and / or foreign material into casing in case the carrier pipe is protected with suitable sacrificial anodes or impressed current cathodic protection. Vent and drains shall be provided on and near ends of the casing pipe. If required, the carrier pipes outside the casing pipe shall be independently supported.

4.3.3 Carrier pipe or casing pipe may be installed by open cut, boring, jacking or other suitable trench less techniques.

4.4 Crossing of Utilities

4.4.1 When a buried pipeline has to cross any existing underground pipeline, cable, drain or other services and/or structures, the pipeline shall be laid at least 500 mm below or above such services. Where it is not possible to obtain the above mentioned clearance, special design and construction shall be used. The existing pipeline shall be properly supported during and after the construction activities.

4.4.2 When laid parallel to any existing underground pipeline, cable, drain or other services and/or structures, the underground pipeline shall be laid with a clear horizontal distance of at least 500 mm. Where it is not possible to maintain the above mentioned clearance, special design and construction shall be used.

4.4.3 A clearance sufficiently large to avoid electrical fault current interference shall be maintained between the pipeline and the grounding facilities of electrical transmission lines unless electrical fault current interference mitigation facilities are provided.

4.4.4 A minimum separation of 3 meter should be maintained between pipeline and transmission tower footings unless mitigation facilities are provided.

4.5 Cold Field Bends

4.5.1 The radius of cold field bends shall be as specified in Table – 2, Schedule 1A. The ends of each bend length shall be straight and not involved anyway in the bending. In no case shall the end of the bend be closer than 0.5 m or equal to pipe outside diameter, whichever is more, from the end of a pipe. The ovality in each pipe after bending shall be less than 2.5 percent of the nominal diameter, at any point.

4.5.2 Bends shall be checked by pulling a gauging pig fitted with gauging plate of diameter equal to 95 percent of the nominal internal diameter of the pipe. The pig shall have at least two cups not less than 300 mm apart or pipe nominal diameter whichever is larger.

4.5.3 Pipes with longitudinal welds shall be bending in such a way that welds lie in the plane passing through neutral axis of the bend. This requirement will not be applicable for spiral welded pipes.

4.5.4 Corrosion coating after bending shall be visually examined and holiday tested for defects. Any defects or disbonding of the coating caused during bending (including forced ridges in the coating) shall be repaired.

4.6 Lowering

4.6.1 Before lowering operations are commenced, particular attention should be paid to the suitability of the trench to allow the pipeline to be lowered without damage to the coating and to give a reasonably even support to the pipeline.

4.6.2 All points on the pipeline where the coating has been in contact with either the skids or with the lifting equipment during the laying operation shall be carefully inspected for damages, dents or other defects. Defect, if any, shall be completely repaired.

4.6.3 Short completed sections of the pipeline should be cleaned with compressed air in order to remove dirt from the inside of pipe sections.

4.6.4 Before lowering in, full circumference of the pipe shall be checked by holiday detector, set at an appropriate voltage suitable for the applied coating, to detect any holiday in the coating including field joint coating. Any coating defect or damage identified by holiday detection shall be repaired.

4.7 Backfilling

4.7.1 Backfilling shall be carried out immediately to the extent possible after the pipeline has been lowered into the trench.

4.7.2 Excavated soil from the trench shall be used for backfilling unless the same is not suitable. The backfill material shall contain no extraneous material.

4.7.3 In cultivable land and other specifically designated areas, top soil excavated from the trench and stored separately, shall be restored to normal conditions.

4.7.4 Slope breakers or other measures shall be installed in trenches dug in steep areas (slope of generally 10 percent and more) to prevent erosion of the back fill.

4.8 Pipeline Markers

4.8.1 Pipeline markers to indicate presence of pipeline and chainage shall be provided all along the pipeline route at a maximum spacing of 1 km. The markers shall also be provided on each side of highways (NH or SH), major district roads (MDR), railway crossings, turning points and water body crossings. At other crossings where third party activity is expected and at entrance to stations one marker shall be provided.

4.8.2 Markers at crossings shall display caution, words “High Pressure Pipeline” name of the operating company, emergency telephone contact nos. etc. in regional or Hindi and English languages.

4.9 Cleaning of Pipeline

4.9.1 Before hydro testing, the section of the pipeline shall be cleaned and checked for the geometry of the pipeline.

4.9.2 A gauging pig shall be passed through the pipeline to prove the internal diameter of the entire pipeline. The gauging plate shall have a diameter equal to 95% of the internal diameter of the thickest line pipe used in the pipeline. The gauging plate should preferably be made of Aluminum.

4.10 Testing After Construction

4.10.1 Testing

4.10.1.1 All pipeline sections shall be hydro tested after construction except for pre-tested pipes used in tie-in spools.

4.10.1.2 ¹[No welding (other than welds required for tie-in, installation of mainline valves, hot tapping and appurtenances) and/or mechanical handling of pipelines is permitted after pressure testing. The integrity of these welds shall meet the requirements as specified in API-1104.]

4.10.1.3 Cased crossings (rail or road) and rivers crossing sections shall be pressure tested before and after installation for a period of at least four (4) hours. Such sections shall be retested along with completed mainline sections.

4.10.1.4 Water should be used as test medium. When required, test water may be dosed with required quantity of corrosion inhibitors and oxygen scavenger depending upon quality of the water.

4.10.1.5 API-1110 should be used as guidance for the pressure testing of the pipeline.

4.10.2 Test Pressure and Duration

4.10.2.1 Pipeline

- (i) The minimum test pressure at any point along the pipeline shall be as at least 1.25 times the internal design pressure.
- (ii) The maximum test pressure shall not exceed the mill test pressure or pressure required to produce a hoop stress equal to 95 percent of Specified Minimum Yield Strength (SMYS) of the pipe material based on minimum wall thickness in the test section. Notwithstanding above, pipeline shall be tested at a minimum test pressure of 1.25 times of Design Pressure.
- (iii) The test duration shall be maintained for a minimum twenty four (24) hours or as required by statutory authorities.
- (iv)²[Mainline valves along with branch pipe should be pressure tested before installation.]
- (v) Mainline valves should be installed after successful pressure testing of the pipeline

¹ Subs. by Cl. (iii) of Reg. 2, the Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Petroleum and Petroleum Product Pipelines) Amendment Regulations, 2017 (w.e.f. 29.12.2017).

² Subs. by Cl. (iv) of Reg. 2, the Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Petroleum and Petroleum Product Pipelines) Amendment Regulations, 2017 (w.e.f. 29.12.2017).

4.10.2.2 Acceptable Pressure Variations

Pressure variations during testing shall be acceptable, if caused by factors other than leakage, like temperature variations. Maximum unaccounted pressure variation shall not exceed 0.3 bar. Pipelines not meeting the requirements shall be repaired and retested in accordance with the requirements of these standards.

4.10.2.3 Above Ground Station Piping

- (i) Pressure testing of station piping shall be carried out separately from pipeline.
- (ii) Station piping shall be tested at minimum test pressure of 1.25 times the design pressure.
- (iii) The test pressure shall be maintained for a minimum period of four (4) hours.

4.10.3 Dewatering and Swabbing

After hydro testing of the pipeline sections or station piping, the section shall be dewatered immediately except when the section is filled with inhibitor. After dewatering, the pipeline section shall undergo swabbing and station piping should also be blown by compressed air to remove water.

4.10.4 Geometric Survey

4.10.4.1 Survey to establish pipeline geometry using

Electronic Geometric Pigs (EGP) shall be conducted after completion and acceptance of following pipeline activities:

- i. Gauging and cleaning
- ii. Hydro testing
- iii. Installation of Mainline or Sectionalizing Valve stations
- iv. All tie-ins.
- v. Completion of all mechanical facilities on the pipeline.

4.10.4.2 Magnetic cleaning pigs shall be propelled to ensure adequate cleanliness of pipeline. Number of magnet cleaning pig runs and the type of magnet cleaning pig for each cleaning run shall be suitable for adequate internal cleaning of pipeline. Ferrous debris permitted with magnetic cleaning pig should not exceed 5 Kg/100KM.

4.10.4.3 In case debris received is more than this amount, then subsequent run(s) are required until the above limit is achieved.

4.10.5 Preservation of Pipeline

4.10.5.1 If the pipeline commissioning after pressure testing is anticipated to be delayed beyond six (6) months, suitable preservation technique shall be adopted to prevent internal corrosion during such period.

4.10.5.2 Pipeline may be preserved using inhibited dosed water with adequate quantity of corrosion inhibitors or by filling the line with any inert gas and at a positive pressure

4.10.6 Commissioning

4.10.6.1 There shall be documented commissioning procedure to cover all the activities for pipeline sections under commissioning and to ensure proper communication while commissioning work.

4.10.6.2 The commissioning operation shall be controlled and supervised by authorized personnel.

4.10.6.3 The local administration and other statutory bodies what so ever applicable shall be informed and work shall be carried out under an experienced person.

4.10.6.4 Upon completion of the commissioning process there shall be a commissioning report endorsed by the authorized person and the safety officer.

4.10.6.5 Before starting commissioning activities, following shall be ensured:

- i. Commissioning Procedure in place
- ii. Pressure testing is completed for entire pipeline and associated station piping
- iii. Pressure leak check of the above ground piping or flanged joints completed.
- iv. Pipeline has been cleaned and debris etc. removed.
- v. All mainline or sectionalizing valves are installed as per requirement.
- vi. All Golden joints are inspected and accepted.
- vii. Geometric survey of pipeline section is carried out, if applicable.
- viii. Trained and experience personnel are available or deployed to carry out commissioning.

4.11 Documentation

Besides the details mentioned in the ASME B31.4, the Pipeline entity shall also maintain following records or documents:

- i. Design and Engineering documents
- ii. Route maps, alignment sheets, crossings, drawings, Piping and Instrumentation Diagrams, Station layouts,
- iii. Vendor and subcontractor details
- iv. Inspection and maintenance reports
- v. Material certification including dimension, metallurgy, performance and functional report
- vi. A complete pipe book.

- vii. Pressure test records include location of leaks or failures, if any, and description of repair under taken.
- viii. As - built drawings including pipeline
- ix. Strength, tightness and leak test reports
- x. Complete asset of each location with identification.
- xi. NDT records of welds
- xii. Geometric survey reports, if applicable.
- xiii. Cleaning records
- xiv. Commissioning reports
- xv. Non-conformance or deviation reports
- xvi. Calibration records of Inspection, Measuring and Metering and Test equipment
- xvii. Audit compliance reports
- xviii. Statutory clearances
- xix. Approved drawings or documents
- xx. Relevant Standards and Guidelines
- xxi. Equipment and operations manuals.

Schedule 1E

CORROSION CONTROL

5.1 General

This section stipulates the minimum requirements and procedures to control the external corrosion during design, construction, operation and maintenance of exposed, buried and submerged steel pipelines used for liquid hydrocarbon services. All operators shall establish corrosion control program to comply the requirement of these regulations, unless it is demonstrated that the results of corrosion control programme of operating company meet or exceed the results of this section.

5.2 External Corrosion (New Pipelines)

5.2.1 External Coating

5.2.1.1 All the buried pipelines shall be externally coated as first line of defence against external corrosion. External coating including field coating at girth weld joints or patches etc. shall be selected after due consideration of service environment (soil type etc.), handling, shipping, storing and cathodic protection requirement.

5.2.1.2 Coating should at least fulfil the following properties:

- i. Coating shall have good dielectric strength to provide good electrical insulations between pipe surface and environment.
- ii. Coating shall have sufficient resistance to moisture transmission
- iii. Coating shall have sufficient ductility to resist cracking
- iv. Coating shall have good mechanical strength to resist damage during normal handling, storage, lowering, soil stress etc.
- v. Coating shall have resistance to disbondment, chemical degradation, change in electrical resistivity etc. with time.
- vi. Coating shall be compatible with cathodic protection system and field joint coatings or patches
- vii. Coating shall have good adhesive property with minimal defects during applications

5.2.1.3 For buried carbon steel pipelines of size NPS2 inch and above, 3 layer polyethylene or fusion bonded epoxy or coal tar enamel coating is recommended. All buried bends and fittings, field joints etc. shall be coated with heat shrink sleeves or two layers high build liquid epoxy coating with minimum DFT 450 microns or any other suitable type of coating. For heated pipelines the coating systems shall be suitably designed.

5.2.1.4 The external coating shall be applied as per established procedures in the mill and in field and in a manner that ensures effective adhesion to the pipe avoiding voids, wrinkles, etc.

5.2.1.5 Before application of the coating, the pipe surface shall be made free of deleterious materials, such as rust, scale, moisture, dirt, oils, lacquers, and varnish. The surface of the pipe shall be inspected and prepared (protrusions would be removed and the surface would be made upto the required surface finish or roughness) before applying coating in the field to avoid any irregularities that could protrude through the coating and damage it.

5.2.1.6 Before installation of pipe in trench, external coating shall be inspected visually as well through coating holiday detector. Defects or damage to coating, which can impair effectiveness of external corrosion control, shall be repaired with compatible field coating.

5.2.1.7 Care shall be taken during handling, storage and laying of pipe, to prevent any damage to coating. This can be minimised by careful handling during transportation, storage and laying by using proper pads, slings and roller or cradles.

5.2.1.8 All exposed piping or pipelines external surface shall be protected against external corrosion by applying suitable coating or paint or jacket etc. Surface preparation may be carried out compatible to such paint or coating and shall be applied according to manufacturer's instructions and guidelines.

5.2.2 Cathodic Protection (CP)

5.2.2.1 All the buried pipelines shall be protected through permanent cathodic protection in conjunction with external coating, unless it is demonstrated that the facility installed is for a limited service life and may not be corroded to the extent, to cause harm to public and environment during such period.

5.2.2.2 During construction period, temporary cathodic protection shall be provided till permanent cathodic protection system is commissioned. The temporary cathodic protection system shall preferably be installed simultaneously keeping pace with the pipeline or main laying or installation work and shall be monitored periodically.

5.2.2.3 Permanent cathodic protection system shall be commissioned within one year of completion of commissioning of pipeline system.

5.2.2.4 The cathodic protection system shall be designed and operated in such a manner that it will satisfy one or more criteria for cathodic polarization stated in NACE SP 0169 or BIS 8062-2006.

5.2.2.5 The design and installation shall be done by competent or experienced person as per applicable code, standards and practices with due consideration of pipe external coating, soil resistivity etc. to ensure safe installation and operation during its life time.

5.2.2.6 Design life of the cathodic protection system shall be commensurate with the life of the pipeline system. However, if required, augmentation of the system or parameters may be taken up based on performance results.

5.2.2.7 Special conditions such as elevated temperature, coating disbondment, bacterial attack, shielding, unusual contaminants in electrolyte etc. may exist where Cathodic Protection is ineffective. Deviation in special condition may be warranted, provided operator is able to demonstrate the objectives in these regulations have been achieved.

5.2.3 Electrical Isolation

5.2.3.1 Isolating devices such as flange or coupling assembly or prefabricated insulating devices may be installed at locations such as between over and underground junction of pipeline, facilities changes ownership, interference locations etc. for effective cathodic protection.

5.2.3.2 Where insulating devices are installed to provide electrical isolation of pipeline systems to facilitate the application of corrosion control, they shall be properly rated for temperature, pressure, and electrical properties, and shall be resistant to the liquid hydrocarbon carried in the pipeline systems. These devices shall not be installed in enclosed areas where combustible atmospheres are likely to be present unless precautions are taken to prevent arcing.

5.2.3.3 Pipes shall be installed such that the below grade or submerged portions are not in electrical contact with any casing, foreign piping systems or other metallic structures. This shall not preclude the use of electrical bonds where necessary. In case any shorting is observed with casing, suitable additional corrosion protection measures should be considered.

5.2.3.4 Insulating devices shall be protected against induced voltage due to lightening or ground fault at nearby power line. Such protection can be achieved by providing Surge Diverter or Grounding Cell across Insulating Joints or other suitable grounding technique etc.

5.2.4 Electrical Connection and Monitoring Points

5.2.4.1 Sufficient test stations shall be provided along the pipeline route to check the adequacy of cathodic protection system. This may essentially include the locations water or rail or road crossing, cased installations, CP source locations, stray current areas etc.

5.2.4.2 The electrical leads shall be connected to pipeline through thermit welding or or Pin Brazing. When thermit welding process is used for electrical lead installation on pressurized pipelines, precautions shall be taken to avoid possible failure of the pipeline during installation due to loss of material strength at the elevated welding temperatures.

5.2.5 Electrical Interference

In addition to protective measures for interference locations due to DC traction, HVDC transmission, other foreign pipeline or metallic structure presence etc., electrical interference due to following shall also be considered in cathodic protection design

5.2.5.1 Fault Currents

- (i) Fault current interference shall be taken into consideration. Fault current resulting from lightning or upset conditions of electrical facilities could result in serious damage to coating and pipe wall and danger to personnel. These adverse effects may occur where a pipeline or main is close to the grounding facilities of electrical transmission line structures, sub-stations, generating stations or other facilities that have high short circuit current-carrying grounding networks.
- (ii) Where a buried pipeline or main is close to grounding facilities, remedial measures may be necessary to control the effect of these fault currents in order to reduce the resultant rise in potential gradient in the earth near the pipeline or main to an acceptable level.

5.2.5.2 Induced Potential Interference

- (i) Pipelines or mains paralleling alternating current electrical transmission lines are subject to induced potentials. When studies or tests show that alternating current potentials will be or are being induced on a buried pipeline or main, devices shall be installed to reduce these potentials to a tolerable level.
- (ii) When such pipelines or mains are under construction, or when personnel are in contact with the pipelines or mains, special precautions shall be taken to nullify the possible effects of induced alternating current potentials.
- (iii) After installation of Permanent CP system, an Electrical interference survey shall be carried out within one year to locate any potential interference current pick-up and discharge location on the pipeline so that adequate interference mitigative measures could be installed accordingly for the pipeline.
- (iv) Pipelines installed parallel to or near cathodically protected existing foreign pipeline, overhead AC electric transmission line or DC Rail traction or adjacent to a switching yard shall be protected against induced stray current. Protective measures such as metallic bonding, increased protection current, supplementary coating, electrical isolation, galvanic anodes, De-coupling devices such as Polarization cell or any other suitable method may be adopted for such interference mitigation.
- (v) Safety devices in line with NACE-RP-01-77 shall be installed for preventing the damage to the pipeline due to lightning or fault currents when the pipeline is installed near electric transmission tower footings, ground cables etc.
- (vi) While laying pipeline near HT power lines, care should be exercised during construction to minimize possible effects of induced alternating current potentials arising out of capacity couplings.
- (vii) The anode beds should be located remote to pipeline such that there is minimum interference of anode potential gradient zone with the existing underground metallic structures. Location of anode beds shall be physically identifiable at the field and also properly marked on the as built drawing. Adequacy of remoteness of anode bed to be calculated and included in the cathodic protection design.
- (viii) Fault current resulting from lightning or upset conditions of electrical facilities could result in serious damage to coating and pipe wall and danger to personnel. These adverse effects may occur where a pipeline is close to the grounding facilities of electrical transmission line structures, sub-stations, generating stations or other facilities that have high short circuit current-carrying grounding networks.

Electrical Bonding across points shall be installed wherever pipelines and mains are to be separated.

- (ix) It is not required to provide additional shorting link metallic flange joint. However it shall be ensured to maintain electrical continuity, before opening of any flange joint. Before opening of the flange joint, a flexible cable shall be connected across the flange by connecting at any two points on the succeeding and preceding section of the flange

being opened (either through crocodile clips or fixing the wire with the bolts of any flange succeeding and preceding section of the flange being opened) for avoiding any electrical spark generation during opening of the flame.

- (x) After installation of electrical interference mitigation measures, interferences survey shall be carried out again to determine the effectiveness of the measures.

5.3 Existing Installations

The cathodic protection level shall be maintained for all buried pipeline in accordance with one or more criteria specified for cathodic polarization in BIS 8062 or NACE STD SP 0169.

Cathodic Protection systems shall also be maintained on any underground pipeline due to feeder electric system being down or main temporarily out of service.

5.4 Monitoring of Effectiveness of Corrosion Program

5.4.1 Effectiveness of corrosion program shall be evaluated every year and appropriate mitigation or corrective action shall be effected to remediate the condition which may affect the protection against external corrosion.

5.4.2 The following records may be considered for evaluating the performance monitoring:

- i. All the past leakages history and leak survey records for reason of such leakages.
- ii. All ON or ON-OFF Pipe to Soil Potential (PSP) records of inspection survey of cathodic protection
- iii. Parameters of CP rectifier (CPTR or CPPSM) units and current density of the pipeline.
- iv. External Coating survey Pearson Survey or Direct Current Voltage Gradient (DCVG) or Close Interval Potential Logging (CIPL) survey or Current Attenuation Test (CAT) records
- v. DC or AC Interference survey records
- vi. Intelligent pigging record for external corrosion and/or coating defect indications
- vii. Any repair or mitigation carried out in past
- viii. Evaluation of pipeline thickness monitoring for Rate of corrosion if corrosion coupons are installed.

5.4.3 Mitigation measures include based on indication observed but not limited to following:

- i. Augmentations of Cathodic protection facility
- ii. Repair or replacement of external coating
- iii. Electrical isolation at interference and other locations

- iv. Stray current control
- v. Interference mitigation
- vi. Any other measure

5.4.4 When any mitigation measure is not effective to adequately control the metal loss to acceptable level, segment shall be replaced and suitably protected.

5.5 Records

Pipeline entity shall also maintain following records or documents related to corrosion control:

- i. Cathodic Protection Design documents
- ii. Soil Resistivity Survey Report
- iii. Electrical Interference Report and details of remedial measure with location
- iv. Inspection and maintenance reports
- v. Material certification including dimension, metallurgy, performance and functional report
- vi. Material test reports
- vii. Approved drawings or documents
- viii. All records of welder's qualification, welding joints and testing shall be maintained.

Schedule 1F

OPERATION AND MAINTENANCE

6.1 General

6.1.1 A detailed “Standard Operating Procedure” (SOP) is required to be developed for each pipeline operating unit based on the experience and expertise within the Company and the type of facilities provided and the conditions which are operated with adequate safety.

6.1.2 The procedures set forth in the SOP shall serve as a guide, but do not relieve the individual or operating company from the responsibility of taking action based on the circumstances or situation.

6.1.3 Suitable safety equipment shall be made available for personnel use at all work areas and operating facilities where hydrocarbon is present. Such safety equipment shall include at least the following:

- i. Tight-fitting goggles or full face shield;
- ii. Protective gloves
- iii. Protective boots;
- iv. Protective pants and jacket or boiler suits;
- v. Easily accessible shower and eye shower of clean running water at strategic locations.
- vi. Safety helmet

6.1.4 Protective clothing shall be of cotton fabric or other anti-static material.

6.2 Operation Procedures or Manuals

Each operating company shall develop a comprehensive standard operating procedure (SOP) which shall include the following but not limited to

- i. System Description
- ii. Operation set (trip or alarm) points
- iii. Initial start up
- iv. Normal operations
- v. Normal shutdown procedure
- vi. Conditions under which emergency shutdown is required
- vii. Emergency shutdown (ESD) procedures including conditions causing ESD.

6.3 Display of Operating Instructions

6.3.1 The gist of operating instructions, emergency shutdown (ESD) procedure, ESD trip and pressure shall be displayed or made readily available in the respective control room and also near all important operating equipments.

6.3.2 If a piping system is de-rated to a lower operating pressure in lieu of repair or replacement, the new MAOP shall be determined and displayed prominently at an appropriate place in the control rooms.

6.4 Management of Change

Modify the plans and procedures of operating practice from time to time as experience dictates and requires changes in operating conditions through the Management of change (MOC) document. This document shall be serially numbered and maintained at the headquarters with copies at the locations. The MOC shall include the reasons or justifications requiring the change of operating conditions and the benefit resulting thereof. Along with the completion of the changes, the MOC shall be closed with amending the “as built” drawing and the changes made in the SOP as applicable.

6.5 Operating Pressure

6.5.1 Care shall be exercised to assure that at any point in the piping system the maximum steady state operating pressure and static head pressure with the line in a static condition do not exceed at that point the internal design pressure and pressure ratings for the components used as specified and that the level of pressure rise due to surges and other variations from normal operation does not exceed the internal design pressure at any point in the piping system and equipment by more than 10%.

6.5.2 If a piping system is de-rated to a lower operating pressure in lieu of repair or replacement, the new maximum steady state operating pressure shall be determined.

6.5.3 For existing systems utilizing materials produced under discontinued or superseded standards or specifications, the internal design pressure shall be determined using the allowable stress and design criteria listed in the issue of the applicable code or specification in effect at the time of the original construction.

6.6 Communications

A dedicated communications facility shall be maintained to assure safe pipeline operations under both normal and emergency conditions. Also a back-up communication link should be available to ensure safe operation in an emergency and break of the normal communication.

6.7 Emergency Response and Disaster Management Plan (ERDMP)

A comprehensive ERDMP shall be developed in accordance to the Petroleum and Natural Gas Regulatory Board (Codes of Practices for Emergency Response and Disaster Management Plan (ERDMP)) Regulations, 2010. The copies of the ERDMP for the pipeline and the station specific shall be maintained at each control room along with necessary maps and records to properly administer the plan, such as

- i. Necessary operational data
- ii. Pipeline patrolling records
- iii. Corrosion monitoring or survey records
- iv. Leak or tapping records
- v. Routine or unusual inspection records
- vi. Pipeline repair records

6.8 Right of Way or Right of Use

6.8.1 Patrolling

6.8.1.1 Each operating company shall maintain a periodic pipeline patrol program to observe surface conditions on and adjacent to the pipeline right of way, indication of leaks, construction activity other than that performed by the company, and any other factors affecting the safety and operation of the pipeline. Special attention shall be given to such activities as road building, excavations, and like encroachments to the pipeline system.

6.8.1.2 Patrolling (ground) shall be carried out at least once in a week (urban and non-urban areas) or aerial survey or other advance techniques shall be performed at least once in month. Underwater crossings shall be inspected periodically for sufficiency of cover, accumulation of debris, or for any other condition affecting the safety and security of the crossings, and at any time it is felt that the crossings are in danger as a result of flood, storms, or suspected mechanical damage.

6.8.1.3 Line walk by the officials of the Company shall be done at least once in a year for the entire length of the pipeline preferably to be done after monsoon.

6.8.1.4 Villagers or public along the right of way shall be adequately made aware of the possible consequence of hydrocarbon leaks and this shall be included as a part of regular audit.

6.8.1.5 Regular liaison shall be maintained with Police stations, Panchayat and district authorities along the right of way about the possible consequence of hydrocarbon leaks and pilferage.

6.8.1.6 Night patrolling by line walkers or alternative security surveillance system shall be implemented with increased frequency where the pipeline location is vulnerable from the pilferage point of view.

6.8.2 Markers

6.8.2.1 Markers shall be installed and maintained over each line on each side of road, highway, railroad, and stream crossings to properly locate and identify the system. Markers are not required for pipelines offshore.

6.8.2.2 Pipeline markers at crossings, aerial markers when used, and other signs shall be maintained so as to indicate the location of the line. These markers shall show the name of the operating company, and where possible, an emergency telephone contact. Additional pipeline markers shall be installed along the line in areas of development and growth to protect the system from encroachment. API RP 1109 shall be used for guidance.

6.8.2.3 Markers to identify the width of Right of Way has to be provided at visible locations and should be so placed that it does not hinder agricultural activity or any movement

6.8.3 Right of Way or Right of Use Maintenance

6.8.3.1 The right of way should be maintained so as to have clear visibility and to give reasonable access to maintenance crews.

6.8.3.2 Access shall be well maintained to valve locations.

6.8.3.3 Diversion route of water flow shall be maintained where needed to protect against washouts of the line and erosion of the landowner's property.

6.9 Pigging

6.9.1 The frequency of descaling of pipelines transporting crude petroleum and petroleum products shall be as under:

- i. Non ATF Petroleum Products Pipelines – Once in six months.
- ii. ATF pipelines also carrying other petroleum products – Once in three months
- iii. Dedicated ATF Pipelines – Once in a year
- iv. Crude Oil Pipelines – Once in three months.
- v. LPG Pipelines – Once in a year

6.9.2 Record of quantity and quality of deposits (pig residue) collected after descaling shall be examined to monitor condition of the Pipeline. -Depending upon the outcome of the chemical analysis and review, pigging frequency may be increased.

6.9.3 Instrumented or Intelligent Pigging

The first inspection of cross country pipeline by Instrumented or Intelligent pigging survey (IPS) shall be carried out at the earliest but not later than 10 years of commissioning. The result of this inspection shall be compared with original commissioning data in order to assess the health of the pipeline and subsequent periodicity of intelligent pigging. The interval between two Instrumented or Intelligent pigging shall in no case exceed 10 years.

6.10 Maintenance Procedure or Manual

6.10.1 A detailed maintenance procedure or manual shall be developed for equipment or facility wise installed in the entire pipeline system considering the recommendations given by the Original Equipment Manufacturer (OEM) keeping in mind the local conditions. The manual shall include preventive maintenance schedule with periodicity i.e. daily, weekly, monthly, half yearly and yearly activities to be carried out during each schedule of maintenance.

6.10.2 Procedures for emergency repair of piping or pipelines using repair clamps, hot tapping and stopple plugging, and other repair methods should also be included as part of manual.

6.10.3 For repair or maintenance works, work permit system in line with the industry or Statutory Authorities shall be developed and compiled.

6.10.4 A comprehensive manual for CP system monitoring, surveys, interference, mitigation programmes as well as external and internal corrosion monitoring programmes shall be developed and complied.

6.11 Load Lifting Equipment

All the lifting equipment, wire ropes, tackles etc., shall be inspected once in a year as per Factory's Act, local Statutory Authorities requirement. Relevant statutory authority's guidelines or procedures shall be referred for guidance.

6.11.1 Pipeline Maintenance Equipment

The specialized pipeline maintenance equipment required for maintenance of pipeline shall be ensured to be made available. An indicative list of equipment required to be kept by the pipeline operator at suitable locations or service provider (s) locations as mentioned below:

- (1) Truck – 1 no.
- (2) Tractor – 1 no.
- (3) Trailer – 2 wheel - 2 nos.
- (4) Air compressor – 2 nos.
- (5) Jeep (large capacity) – 3 or 4 nos.
- (6) Welding Generator – 2 nos.
- (7) Welding transformer – 1 no.
- (8) Power hacksaw machine – 1 no.
- (9) Battery charger – 1 no.
- (10) Drilling machine – Heavy duty – 2 nos.
- (11) Drilling machine – Light duty – 1 no.
- (12) Pipeline bending machine – 1 no.
- (13) Oxygen cylinder – 2 nos.
- (14) Acetylene cylinder – 1 no.
- (15) Water Pump (5 BHP) – 3 nos.
- (16) Hot Tapping (1 set) and Stoppling Machine (2 sets)
- (17) High Pressure Testing pump – 1 no.
- (18) Gas cutter, regulator, nozzle – 1 set
- (19) Dope kettle – 1 no.
- (20) Aluminum ladder – 1 no.
- (21) Cold cutting machine – 2nos.
- (22) Semi Rotary Pump – 2 nos.
- (23) Pneumatic Pump (for oil recovery) – 1 No.
- (24) Bench vice – 1 no.
- (25) Chain pulley block – 2 ton – 1 no.
- (26) Hand blow for Smithy – 1 no.
- (27) Pipe lifting clamp – 3 nos.
- (28) Pneumatic grinder – 2 nos.
- (29) Pneumatic Power Wrench – 1 no.
- (30) LP gas cylinder – 1 no.
- (31) Grinding machine – light duty – 1 no.
- (32) Grinding machine – heavy duty – 1 no.
- (33) Diesel engine driven water pump – BHP-15 – 1 no.
- (34) Engine driven hydraulic pump – 1 no.
- (35) Four wheel trailer – 1 no.
- (36) Four wheel tractor trailer – 1 no.
- (37) Holiday detector – 1 no.
- (38) Insulation flange tester – 1 no.
- (39) Pearson Survey and Holiday Detector – 1 no.
- (40) Multi meter – 1 no.
- (41) AVO meter – 2 nos.

- (42) Multi Combination Corrosion – Testing Meter – 1 no.
- (43) Emergency Generator – 1 no.
- (44) Tents etc for making repairing base camp with all facilities to suit the remote place
- (45) Communication system
- (46) Lighting arrangement
- (47) Hand tool set including spanners, Files, cutters, brass hammer and Chisel

6.11.2 Mainline Block (Sectionalizing Valves)

Pipeline block or Sectionalizing valves shall be inspected, serviced where necessary and shall be checked by operating partially or fully (as applicable) at least once in a year to assure proper operating conditions or fit for the purpose it is meant.

6.11.3 Inspection of Cathodic Protection System

6.11.3.1 Pipe to Soil Potential (PSP) Readings shall be taken as follows:

- i. PSP readings at feeding points shall be monitored fortnightly.
- ii. The PSP reading (ON potential) at the test lead points for entire pipeline shall be taken once in a quarter. The PSP survey results shall be plotted graphically to identify and locate cathodic holidays.
- iii. Instant pipe to soil “OFF” potential reading at test lead points of the entire pipeline shall be taken once in a year. (Minimum acceptable criteria shall be as per BIS 8062 or ASME B31.8 Appendix K or NACE SP – 0169 as applicable.)
- iv. The ON or OFF Pipe to Soil Potential (PSP) survey data along with Pearson survey or Current Attenuation Test (CAT) or Direct Current Voltage Gradient (DCVG) survey and soil resistivity and soil chemical analysis data shall be plotted graphically in one page or sheet to identify coating holidays.

6.11.3.2 The Criteria of protection shall be as under:

- i. Pipe to soil polarized potential of at least (-) 0.85 volts with respect to copper or copper sulphate half cell. In areas where anaerobic bacteria are active, minimum PSP should be more negative than -0.95 volts instead of -0.85 volts.
- ii. A minimum of 100 mV of cathodic polarization between the structure surface and a stable reference electrode containing the electrolyte. The formation of decay of polarization can be measured to satisfy this condition.
- iii. Over protection of coated pipeline shall be avoided by ensuring that polarization potential is not more negative than (-) 1.2 volts with respect to copper or copper sulphate half cells.

6.11.3.3 The instant OFF PSP at the Test Lead Points (TLPs) should not be less negative than (-) 0.85 volt and should not be more negative than (-) 1.2 volt. Such measurement wherever influenced by multiple pipelines in the same ROW or ROU to be valid after switching off the other pipeline.

6.11.3.4 Current consumption data shall be taken once in a year at the test stations where current measurement facility exists.

Cathodic protection rectifiers shall be inspected once in three months.

6.11.3.5 All protective devices shall be inspected once in three months.

Interference bonds shall be inspected once a year.

6.11.3.6 Polarization cells [electrolytic type] shall be inspected every three (3) months and electrolyte level top up to be done after every inspection.

6.11.3.7 At the crossing location of one pipeline with other pipeline, current and PSP data shall be taken once in 3 months.

6.11.4 Coating Survey

6.11.4.1 Close Interval Potential survey (CIPS) or Continuous Potential Logging (CPL) “On” and “Off” survey for every meter of pipeline ROW should be carried out once in 5 years.

6.11.4.2 Coating survey i.e. Pearson or Current Attenuation Test (CAT) or Direct Current Voltage gradient (DCVG) Survey shall be carried at probable coating defect location identified by CPL survey done once in 5 years. The type of survey should be decided based on coating condition. In case CAT survey is selected, it shall be done at intervals not exceeding 50 Meters.

6.11.4.3 Survey Results to be collated as Status Report and compared with Original Post Commissioning survey results. If there is deterioration in the results, appropriate corrective action needs to be taken.

6.11.5 Insulating Joint or Insulating Coupling

Insulating joints and couplings shall be inspected once in a year.

6.11.6 Soil Testing

If any industrial effluent is flowing over the ROW or ROU or any environmental change is noticed on the ROW, the soil samples shall be tested for determining the efficacy of the existing coating and wrapping of the pipeline.

6.11.7 Back Up Power for CP System

Wherever the availability of power supply from State Electricity Board to the CP system is not reliable suitable back up power (battery bank or Inverter or DG or Solar or TEG or Any other suitable) shall be provided so as to provide minimum 90% time power to CP system.

6.11.8 Safety Appliances

Safety appliances provided against lightning, stray current interference from foreign objects at pipeline crossings etc shall be maintained once in six months and updated records shall be maintained.

6.11.9 Electrical Equipment

6.11.9.1 Maintenance and Inspection of Electrical equipment shall be carried out in line with the industry or good engineering practices or requirement of statutory authorities.

6.11.9.2 Internal Corrosion Monitoring facilities i.e. corrosion coupons and probes based on electric resistance technique (ER probes), electrochemical noise technique (ECN probes) and / or Linear polarization technique (LPR probes), etc., shall be installed at the stations to monitor the internal corrosion. If the rate of corrosion is more than 1 MPY, suitable doses of corrosion inhibitor shall be dosed.

6.11.10 Inspection of Pipes, Valves and Fittings

Above ground piping and accessories shall be inspected visually once in a year for external corrosion. Ultrasonic thickness measurements shall be taken on exposed sections of the pipe once in 3 (three) years for sour crude and product and once in 4 (four) years for sweet crude and product. Thickness measurement shall be taken at 4 locations (i.e. 12, 3, 6 and 9 O'clock positions) at the exits, bends and at every ten meter interval of exposed piping and also at 5 meter interval for underground piping after insulating coupling (wherever exist). Inspection of pipes, valves and fittings shall be carried out as per relevant industry practice or statutory authority requirement.

6.11.11 Inspection of Pumps, Compressors, Control and Protective Equipment

Periodic inspection and maintenance shall be carried out for control and protective equipment including pressure limiting devices, regulators, controllers, relief valves and other safety devices as per recommendations of OEM (Original Equipment Manufacturer) or good engineering practices or relevant statutory authority requirements.

6.11.12 Leak Detection System

If any leak detection system is installed on the pipeline system, it shall be checked for effectiveness of operation once in a year. Additionally, a daily, monthly and yearly reconciliation record of crude or product received from tank, line fill quantity and delivered quantity shall be maintained to ascertain the transportation loss through pipeline. This loss should not be more than 0.015% of the transported quantity through the pipeline on yearly basis. In case this quantity is more than 0.015% of the yearly product transported, an internal investigation shall be carried out to ascertain the probable cause of the loss.

6.11.13 Telecommunication System or Equipment

6.11.13.1 Detailed System functional tests shall be carried out once in six months.

6.11.13.2 Telecommunication equipment shall be inspected as per manufacturer's recommendation.

6.11.14 Telemetry System or Equipment

6.11.14.1 Detailed System functional tests shall be carried out once in six months.

6.11.14.2 Telemetry equipment shall be inspected as per manufacturer's recommendation.

6.11.15 Safety Instrumentation

6.11.15.1 Operation system interlock checking shall be carried out once in a year. Calibration, Maintenance and Inspection of Safety Instrumentation shall be carried out as per industry practice or recommendations of OEM or Statutory Authority requirements.

6.11.15.2 Testing of Pressure or Thermal Safety valves or Surge relief system shall be carried out once in a year and proper authenticated document shall be maintained.

6.11.15.3 Emergency Shut Down (ESD) systems shall be checked with actuation once in a year.

6.11.16 Fire Fighting Equipment

6.11.16.1 Maintenance and Inspection of Fire Fighting Equipment shall be carried out as per industry practice or recommendations of OEM or Statutory Authority requirements.

6.11.16.2 Trial run of the emergency equipment, Mock drill shall be done on regular basis as per industry practice or Statutory Authority requirements.

6.12 Pipeline Repairs

6.12.1 General

6.12.1.1 Repairs shall be carried by the Company as per their maintenance or job safety plan and shall be performed under qualified supervision by trained personnel aware of and familiar with the hazards to public safety, utilizing strategically located equipment and repair materials. The maintenance plan shall consider the appropriate information contained in API Publication 2200, API Publication 2201, API RP 1107 and API RP 1110 and any other relevant code or industry or good ensuing practices. It is essential that all personnel working on pipeline repairs understand the need for careful planning of the job, be briefed as to the procedure to be followed in accomplishing the repairs, and follow precautionary measures and procedures. Personnel working on repairs to pipelines shall be informed on the specific properties, characteristics, and potential hazards associated with precautions to be taken following detection of a leak, and safety repair procedures set forth. Approvals, procedures, and special considerations shall be observed for welding, as well as making hot taps on pipelines, vessels, or tanks which are under pressure. Piping in the vicinity of any repair shall be adequately supported during and after the repair.

6.12.1.2 Each individual pipeline operating company shall develop the methods or procedures for carrying out various types of repairs in the pipeline in line with the requirement of Statutory Authorities or industry practice.

6.12.1.3 In case of corrosion of the pipe due to which thickness of the pipe is reduced to the extent that maximum allowable operating pressure is required to be reduced from original design to meet requirement of this standard, then either the pipe section shall be repaired or replaced or the pipeline shall be de-rated to commensurate with remaining strength of the pipe.

6.12.1.4 All dents as per requirements of ASME B31.4 and all pipes containing leak shall be removed or repaired.

6.12.1.5 Pipeline shall be repaired by any one or the following:

- i. By cutting out cylindrical piece of pipe containing the defect and replacing the same with a pre-tested pipe of minimum 2 meter length meeting the required pipe specification.
- ii. ¹[By installing full encirclement welded split sleeves or leak clamps to contain internal pressure and shall have a design pressure of not less than the maximum allowable operating pressure. This shall be fully welded both circumferentially and longitudinally. These repairs shall conform to the requirements as specified in ASME 31.4.]
- iii. All repairs shall be performed as per (a) and (b) above and shall be tested by radiography examination and / or ultrasonic examination.
- iv. In case of repair of coated pipe, all damaged coating shall be removed and new coating shall be applied.

6.12.2 Railroads and Highways Crossings

6.12.2.1 When an existing pipeline is to be crossed by a new road or railroad, the operating company shall analyze the pipeline in the area to be crossed in terms of the new anticipated external loads. If the sum of the circumferential stresses caused by internal pressure and newly imposed external loads (including both live and dead loads) exceeds 0.90 SMYS (specified minimum yield strength), the operating company shall install mechanical reinforcement, structural protection, or suitable pipe to reduce the stress to 0.90 SMYS or less, or redistribute the external load acting on the pipeline. API 1102 provided methods that may be used to determine the total stress caused by internal pressure and external loads.

6.12.2.2 Installation of uncased carrier pipe is preferred. Adjustments of existing pipelines in service at a proposed railroad or high way crossing shall conform to requirements of industry practices or Statutory Authority requirements.

6.12.3 Inland Waters Platform Risers

Riser installations shall be visually inspected annually for physical damage and corrosion in the splash zone and above. The extent of any observed damage shall be determined, and, if necessary, the riser installation shall be repaired or replaced.

6.13 Pump Station, Terminal and Tank Farm Operation and Maintenance

6.13.1 General

6.13.1.1 Starting, operating and shutdown procedures for all equipment shall be established and the operating company shall take appropriate steps to see that these procedures are followed. These procedures shall out line preventive measures and systems checks required to ensure the proper functioning of all shutdown, control and alarm equipment.

6.13.1.2 Periodic measurement and monitoring of flow and recording of discharge pressures shall be provided for detection of deviations from the steady state operating conditions of the system.

¹ Subs. by Cl. (v) of Reg. 2, the Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Petroleum and Petroleum Product Pipelines) Amendment Regulations, 2017 (w.e.f. 29.12.2017).

6.13.2 Controls and Protective Equipment

Controls and protective equipment, including pressure limiting devices, regulators, controllers, relief valves and other safety devices, shall be subjected to systematic periodic inspections and tests, at least annually. However the following can be reaffirmed with inspection done during the year:

- i. in good mechanical condition;
- ii. Adequate from the standpoint of capacity and reliability of operation for the service in which they are employed.
- iii. set to function at the correct pressure;
- iv. Properly installed and protected from foreign materials or other conditions that might prevent proper operation.

6.13.3 Storage Vessels

6.13.3.1 Storage vessels, including atmospheric and pressure tanks, handling the liquid or liquids being transported shall be periodically inspected and pertinent records maintained. Points to be covered include:

- i. stability of foundation;
- ii. condition of bottom, shell, stairs, roof;
- iii. venting or safety valve equipment;
- iv. Condition of firewalls or tank dikes.
- v. Earthing continuity, Rain Water drain system as pre-monsoon check

6.13.3.2 Storage vessels and tanks shall be cleaned in accordance with the industry practice.

6.13.4 Signs

- (a) Suitable signs shall be posted to serve as warnings in hazardous areas, high noise area preferably with area segregation.
- (b) Classified and high voltage areas shall be adequately marked and isolated.
- (c) Caution signs shall be displayed indicating name of the operating company and, where possible an emergency telephone contact.

6.13.5 Prevention of Accidental Ignition

6.13.5.1 Smoking shall be prohibited in all areas of a pump station, terminal, or tank farm in which the possible leakage or presence of vapor constitutes a hazard of fire or explosion.

6.13.5.2 Flashlights or hand lanterns, when used, shall be of the approved type.

6.13.5.3 Welding shall commence only after compliance of the safety precautions taken as listed in the work permit.

6.13.5.3 Consideration should be given to the prevention of other means of accidental ignition. See NACE RP-01-77 for additional guidance.

6.14 Corrosion Control

Protection of ferrous pipe and components from external and internal corrosion, including tests, inspection and appropriate corrective measures, shall be as prescribed in ASME B31.4.

6.15 Qualifying a Piping System for a Higher Operating Pressure

6.15.1 In the event of up-rating an existing piping system when the higher operating pressure will produce a hoop stress of more than 20% of the specified minimum yield strength of the pipe, the following investigative and corrective measures shall be taken;

- (i) The design and previous testing of the piping system and the materials and equipment in it be reviewed to determine that the proposed increase in maximum steady state operating pressure is safe and in general agreement with the requirements of this Code;
- (ii) The conditions of the piping system be determined by leakage surveys and other field inspections, examination of maintenance and corrosion control records, or other suitable means;
- (iii) Repairs, replacement, or alterations in the piping system disclosed to be necessary by steps (1) and (2) be made.

6.15.2 The maximum steady state operating pressure may be increased after compliance with (a) above and one of the following provisions;

- (i) If the physical condition of the piping system as determined by (a) above indicates that the system is capable of withstanding the desired increased maximum steady state operating pressure in accordance with the design requirement of this Code and the system has previously been tested for a duration and pressure not less than that required in ASME B31.4, for a new piping system for the proposed higher maximum steady state operating pressure, the system may be operated at the increased maximum steady state operating pressure.
- (ii) If the physical condition of the piping system as determined by (a) above indicates that the ability of the system to withstand the increased maximum steady state operating pressure has not been satisfactorily verified, or the system has not been previously tested to the levels required by this Code for a new piping system for the proposed higher maximum steady state operating pressure, the system may be operated at the increased maximum steady state operating pressure if the system shall successfully withstand the test required by this Code for a new system to operate under the same conditions.

6.15.3 In no case shall the maximum steady state operating pressure of a piping system be raised to a value higher than the internal design pressure permitted by this Code for a new piping system constructed of the same materials. The rate of pressure increase to the higher maximum allowable steady state operating pressure should be gradual so as to allow sufficient time for periodic observations of the piping system.

6.15.4 Records of such investigations, work performed, and pressure tests conducted shall be preserved as long as the facilities involved remain in service.

6.16 Abandoning a Piping System

In the event of abandoning a piping system, it is required that;

- i. Facilities to be abandoned in place shall be disconnected from all sources of the transported liquid, such as other pipeline, meter stations, control lines, and other appurtenances;
- ii. Facilities to be abandoned in place shall be purged of the transported liquid and vapor with an inert material and the ends sealed.

6.17 Training of Personnel

For the operation of the facility in a safe and appropriate manner, it is required that the operating and maintenance personnel shall suitably be trained every year on the following aspects:

- i. Upgradation of operating and maintenance skills
- ii. Updation of safety methods and procedures
- iii. Technical Upgradation in the field of operation or maintenance.

6.18 Records

For operation and maintenance purposes, the following records shall be properly maintained:

- i. Necessary operational data;
- ii. Pipeline patrol records;
- iii. Corrosion records;
- iv. Leak or tapping and break records;
- v. Records pertaining to routine or unusual inspections, such as external or internal line conditions;
- vi. Pipeline repair records

Schedule 1G

SAFETY AND FIRE PROTECTION

7.1 General

All installations except intermediate pigging station and sectionalizing valve stations shall have following fire protection facilities. For intermediate pigging station and repeater cum cathodic protection system, only portable fire extinguishers as detailed in subsequent Para shall be provided.

7.2 Automatic Fire Detection and Alarm System

7.2.1 Detection System:

7.2.1.1 Smoke or multi sensor detectors shall be provided in control room, Motor Control Center (MCC) room and utility rooms with provision of indication, alarm and annunciation.

7.2.1.2 Pumping unit sheds shall be provided with flame or heat or a combination of flame and heat detectors.

7.2.2 Fire Alarm System

- i. Manual call points at strategic location shall be installed with hooter in fire alarm panel or sounders in rooms, corridors etc.
- ii. Electric Operated Fire siren with provision for assured power supply in case of power failure to be provided. Range of fire siren shall be minimum 1 km.
- iii. Additionally hand operated sirens shall be provided at strategic locations with similar range of operation.

7.3 Fire Fighting Equipment

7.3.1 Fire Fighting Equipment shall be provided at all installation as detailed below:

- i. Booster Pump area: 1 (One) No. 9 Kg DCP per two pumps and 2 (two) No. 6.5 Kg CO₂ extinguisher.
- ii. Main line pump shed (Engine or Motor Driven): 1 (one) No. 75 Kg DCP, 1 (one) No. 9 Kg DCP and 2 (two) No. 6.5 Kg CO₂ extinguishers per two pumps.
- iii. Scrapper Barrel area : 1 (one) No. 9 Kg DCP extinguisher.
- iv. Sump Pump, Transmix Pump and Oil Water Separator Pump : 1 (one) No. 9 Kg DCP extinguisher.
- v. Control Room: 2 (Two) Nos. 2.5 Kg Clean Agent or 1 (one) No. 4.5 Kg CO₂ extinguisher.

- vi. UHF or Radio Room: 2 (Two) Nos. 2.5 Kg clean Agent and 1(one) No. 4.5 Kg CO₂ extinguisher.
- vii. UPS or Charger Room: 1(one) No. 4.5 Kg. CO₂ extinguisher.
- viii. Meter Prover or Separator Filter: 1 (One) No. 9 Kg DCP extinguisher.
- ix. Repeater Station or CP- Repeater Station or SV station: 1 (one) No. 9 Kg DCP and 1 (one) No. 4.5 Kg CO₂ extinguisher.
- x. Mainline Emergency Equipment Centre: 4 (Four) Nos. 9 Kg DCP and 2 (Two) Nos. 4.5 Kg CO₂ extinguishers.
- xi. Air Compressor area : 1 (one) No. 4.5 Kg CO₂ and 1 (one) No. 5 Kg DCP extinguisher.
- xii. Workshop: 1 (one) No. 9 Kg DCP extinguisher and 1 (one) No. 4.5 Kg CO₂ extinguisher.
- xiii. Security Cabin: 1 (One) No. 9 Kg DCP extinguisher per cabin.
- xiv. Oil Sample Storage Room: 1 (one) No. 9 Kg DCP extinguisher per 100 m² or minimum 1 No. 9 Kg extinguisher per room whichever is higher.
- xv. Effluent Treatment Plant area : 1 (one) No. 75 Kg. and 2 (Two) nos. 9 Kg. DCP Extinguisher.
- xvi. Transformer area: 1 (one) No. 9 Kg. DCP extinguisher per transformer.
- xvii. Office or Store or Canteen: 1 No. 9 Kg DCP extinguisher for 100 m².
- xviii. MCC or DG Room or HT Room: 2 (Two) number of 4.5 kg CO₂ based in each room or per 100 m² floor area.
- xix. Intermediate pigging station: 1 (one) no. 75 kg and 1 (one) number 4.5 kg CO₂ based.
- xx. Delivery or Terminal station: 1 (one) no. 75 Kg and 1 (one) 9 Kg DCP based and 1 (one) number 4.5 kg CO₂ based.

7.3.2 For LPG installation following shall be minimum No. of extinguishers, namely:-

- i. LPG Pump- 1x 9Kg DCP / 50 m² Houses.
- ii. Office or Canteen or Stores- 2x 9Kg DCP in each building.
- iii. MCC or DG Room or HT room- 2 x 4.5 Kg CO₂ in each room or per 100 m² floor area. Four (4) sand buckets and stand shall be provided in DG room.

Note-1. Existing 10 kg DCP extinguishers to be replaced with 9 kg capacity DCP extinguishers as and when due for replacement.

7.3.3 Spares: 20% spares each for CO₂ and DCP extinguishers shall be stored. All fire extinguishers shall bear ISI or equivalent mark. Manuals of each fire extinguisher shall be provided at every location. The quantity and size of fire extinguishers required shall be provided based on the nature of occupancy and class of fire or risk to be protected.

7.3.4 The following shall also be considered:

- i. Where cleanliness and contamination of sensitive electrical equipment are of importance or likely to get affected only CO₂ or Clean Agent fire extinguishers shall be provided.
- ii. Extinguishers shall be installed within 15 m of the equipment so that travel distance for person is not more than 15 m.

7.4 First Aid and Safety Equipment

The following minimum number of Personal Protective Equipment, First Aid Equipment and Safety instruments shall be provided as indicated against each item at each pump station or delivery or terminal station.

- i. Safety helmets - 1No./person (minimum 08 nos.).
- ii. Stretcher with blanket- 2 Nos.
- iii. First aid box- 1 Nos.
- iv. Rubber hand gloves for electrical purpose- 2 Nos.
- v. Fire proximity suit- 1 No.
- vi. Resuscitator - 1 No.
- vii. Red or green flags – 2 Nos. In each color
- viii. Self contained breathing apparatus with one spare cylinder (capacity 30 min) – 1 set with spare cylinder.
- ix. Water gel blanket- 1 No.
- x. Portable multi gas detector – 1 No.
- xi. Sand bucket – 5 Nos.
- xii. Low temperature rubber hand gloves - 4 pairs (For LPG installations only)
- xiii. Low temperature protective clothing- 2 sets (For LPG installations only)

7.5 Windsock

Windsock shall be provided on an appropriately elevated structure like the control room or firewater pump house. Wind socks shall be installed in such a way at several places that at least one wind sock shall be visible from any point in the installation.

7.6 Emergency Power Supply

Emergency lighting shall be provided for operating areas like generator room, diesel compressor room, PCC or MCC room and control room. Emergency power supply shall also be provided to panels of all fire alarms or detection system or other fire fighting system.

7.7 Communication System

- i. Communication system like telephone, walkie-talkie etc. shall be provided.
- ii. All intermediate stations including IP stations or Repeater stations shall be provided with proven communication system. Security at unmanned station shall be trained to deal with communication and emergency handling.

7.8 Fire Water System

7.8.1 The Fire water system shall be provided at all pump stations and at all delivery and terminal Stations consisting of:

- i. Fire water storage
- ii. Fire water Pumps
- iii. Fire water distribution piping network
- iv. Fire hydrant or Monitors

7.8.2 The single largest risk shall be considered.

7.8.3 The basis of design of fire protection facilities should presume that no external fire-fighting agencies would be available for main pump station, intermediate pump station and pipeline terminal station for duration of minimum 4 hours.

7.8.4 All LPG pumps (booster and mainline pumps), Pig launcher and receivers, metering area, filtering area and receipt and delivery manifold area shall be fully covered by medium velocity spray system.

7.8.5 Heat detectors through thermal fuses or quartz bulbs (QB to blow at 79 °C) or Electro-pneumatic (EP) detectors for detection of fire for automatic actuation of medium velocity water sprinkler system shall be provided. The QB or EP detectors shall be placed directly overhead or inside the hazard.

7.8.6 Terminal station co-located in any marketing or refinery may be exempted for fire water storage, fire fighting pumps. Only fire water network with hydrants and monitors in the network connected to the fire water storage and pump to the co-located installation is acceptable.

7.9 Design Flow Rate

7.9.1 The fire water pumping requirement shall be calculated based on the following for other than LPG pipeline installations:-

- i. Spray rate of 10.2 liter per min per square meter (lpm/ m²) of area for pump house shed based on outer foundation column measurement (length x breadth).

- ii. Supplementary streams based on using 4 single hydrant outlets and 1 monitor simultaneously. Capacity of each hydrant outlet as 36 m³ / hr and of each high volume monitors as 144 m³/hr shall be considered at a pressure of 7 kg / cm² (g).

Design fire water flow rate shall be maximum of flow rate calculated for (i) or (ii) above, whichever is higher

7.9.2 The fire water pumping requirement shall be calculated based on the following for LPG pipeline installations:

¹[7.9.2.1] The Fire water pumping requirement for medium velocity spray system shall be calculated based on following cooling rate:

- (i) Pump Shed: Medium velocity sprinkler system having remote and local operated deluge valve with spray density 20.4 liters per min per meter square area (lpm/m²) of the pump shed to be calculated considering outer foundation column distances.
- (ii) Scraper area, Metering area or Filtering area and receipt or delivery manifold area Medium velocity sprinkler system with spray density 10.2 lpm/m² of surface area to be considered. Pump house shall be considered as single risk area. Alternatively, it can be divided into suitable number of zones with minimum 10 meter width

²[7.9.2.2] The fire water system in the plant shall be designed to meet the highest fire water flow requirement of a single largest area risk at a time plus 288 m³ /Hr for operating 2 Nos. of fire water monitors or supplementary hose requirements.

Note:

- i. If the pipeline installation is having tank farm, the design fire water requirement shall be calculated based on relevant design standards. .
- ii. If the pipeline installation is having LPG storage facilities line, horton spheres, bullets and mounted bullets, relevant standards , to be followed for the design fire water requirement.

7.10 Fire Water System Design

- i. The fire water pressure system shall be designed for a minimum residual pressure of 7.0 kg/cm² (g) at the hydraulically farthest point of fire water network.
- ii. A fire water ring main shall be provided all around perimeter of the pump station and delivery or terminal stations facilities with hydrants or monitors.
- iii. There shall be minimum two (2) numbers of monitors located in such a way that it covers the pump area, scrapper area and separator filter or strainer or flow meter area. Fire hydrant network shall be in closed loops to ensure multidirectional flow in the system. Isolation valves shall be provided where the length of the pipe section is more than 300 meter.

¹ 'Cl. 7.9.3' shall stand renumbered as 'Cl. 7.9.2.1.' by the Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Petroleum and Petroleum Product Pipelines) Amendment Regulations, 2017 (w.e.f. 29.12.2017).

² 'Cl. 7.9.4' shall stand renumbered as 'Cl. 7.9.2.2.', *ibid.* (w.e.f. 29.12.2017).

7.11 Fire Water Storage

7.11.1 Water requirement for firefighting shall be met through water storage tanks of steel or concrete or masonry. The effective capacity of the tanks above the level of suction point shall be minimum 4 hrs aggregate capacity of the pumps. Where make up water supply system is 50% or more this storage capacity may be reduced to 3 hrs of aggregate capacity of pumps.

7.11.2 Storage tank or reservoir shall be in two interconnected compartments to facilitate cleaning and repairs. In case of steel tanks there shall be a minimum of two tanks.

7.12 Fire Water Pumps

7.12.1 Centrifugal fire water pumps shall be installed to meet the designed fire water flow rate and head. Pump shall have flooded suction.

7.12.2 Motor driven Jockey pump shall be installed to pressurize fire water network as per design requirement.

7.12.3 The fire water pumps including the standby pumps shall preferably be diesel driven. Where electric supply is reliable 50% of the pumps may be motor driven.

7.12.4 At least one standby fire water pump shall be provided for 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.

7.12.5 The fire water pumps shall be provided with automatic starting facilities.

7.13 Fire Hydrant Network

7.13.1 Fire water ring main shall be sized for 120% of the design water flow rate. Velocity of the water shall not exceed more than 5 m/s in the fire water ring main. In case of sea water service, the fire water main pipes shall be concrete or mortar lined internally or thermoplastic material.

Fire water steel pipe ring main, when installed above ground shall be at a height of 300 to 400 mm above finished ground level and should be adequately supported at regular intervals. Pipes made of composite material shall be laid underground. Above ground portion of such networks shall be of carbon steel and translation shall be by flanged connection stand post for monitors and hydrants shall be carbon steel.

7.13.2 Underground fire water mains shall have minimum 1 m cover and shall be provided with suitable coating or wrapping

7.13.3 Double headed hydrants with two separate landing valves on 3” or 4” stand post shall be used. All hydrant outlets shall be 1.2 meter above ground level or working platform level.

7.13.4 Fire water monitors shall be provided with independent isolation valves.

7.13.5 The deluge valve shall be located at 15 meters from the risk being protected. A fire wall shall be provided for the protection of the deluge valve and for operating personnel.

7.13.6 Hose Box with 2 Nos. of hoses and a foam making branch pipe (FB-5X) or multipurpose branch or short branch as per the requirement shall be provided between two hydrant stand posts.

7.13.7 Fire Hydrants or monitors shall be located at a minimum distance of 15 m from the hazardous facility or equipment. In case of buildings this distance shall not be less than 2 m and not more than 15 m from the face of building. Provisions of hydrants within the building shall be in accordance with IS: 3844.

7.13.8 At least one hydrant post shall be provided for every 30 m of external wall measurement or perimeter of the battery limit. Monitors shall be placed at 45 m interval.

7.14 Medium Velocity Sprinkler System

7.14.1 The medium velocity spray system provided at all critical areas shall have spray nozzles directed radially to the facilities intended for cooling at a distance of 0.6 m from the surface of the equipment or facility. Only one type and size of spray nozzle shall be used in a particular facility.

7.14.2 All spray nozzles shall be inspected for proper positioning, corrosion and cleaned if necessary at intervals not more than 12 months or earlier based on actual experience. Care shall be taken in positioning nozzles so that water spray does not miss the targeted surface and not reduce the efficiency or calculated discharge rate.

7.15 Gas Monitoring System

- i. The Gas Monitoring system shall be provided for early warning on build up of dispersed gas concentration below LFL (lower flammable level) limits. These detectors for the gas monitoring system shall be located close to the potential source of leakage.
- ii. The control equipment shall be able to generate at least two alarms at different level of LEL concentration.
- iii. The detectors shall be located at least 0.3 meter away from potential source of leakage at height not more than 0.3 meter from the mounting level.
- iv. Detectors shall be placed in the pump shed and near scraper or filter, cold vent and cold flare area.
- v. Each station should have minimum 2 Nos. of spare detectors to facilitate immediate replacement.

7.15.1 Material Specifications

All material used in fire water system using fresh water shall be of the type indicated below:

- i. Pipes - Carbon Steel (CS) IS: 3589 or IS: 1239 or IS: 1978 or Composite materials as per API 15 LR or API 15 HR or its equivalent shall be used.
- ii. In case saline or brackish water or treated effluent water is used, the fire water main of steel pipes shall be internally cement mortar lined or glass reinforced epoxy coated or made of pipe material suitable for the quality of water. Alternatively, pipes made of composite materials shall be used.

- iii. Cast iron pipes shall not be used for fire water services.
- iv. Isolation valves shall be gate valve with open and closed indication. Material shall be cast steel for normal water and copper nickel for saline or brackish water service.
- v. Hydrant Stand post shall be Carbon Steel. Monitors –carbon steel or Stainless steel
- vi. Outlet valves or landing valves- Gunmetal or Aluminum or Stainless steel or Aluminum-Zinc alloy
- vii. Fire Hose- Reinforced rubber lined hoses (63 mm), 15 m standard length conforming to IS: 636 (type A) or Non percolating synthetic hose (Type B) or UL or equivalent standard.
- viii. The above ground fire water main, hydrant post shall be painted with corrosion resistant “Fire Red” paints as per IS: 5
- ix. Hose boxes, water monitors and hydrant outlets shall be painted with “Yellow” paint as per IS:5

7.15.2 Hoses, Nozzles and Accessories

- i. Hose Box- 1 No. for catering to two hydrant stand post.
- ii. Fire hoses – 2 Nos. Per hose box – Minimum 10 Nos.
- iii. Foam making branch pipe: 1 no. in each hose box.
- iv. In addition to the nozzles provided in the hose boxes there shall be 1 set of spare nozzles for each category viz- Jet Nozzle with branch pipes, Fog Nozzle, Universal Nozzle, water curtain Nozzle.
- v. Minimum 2 Nos. or 25% spare hoses shall be stored.

7.16 Records

Besides the details mentioned in the ASME B 31.4, petroleum and petroleum products pipelines entity shall also maintain following records or documents:

- i. Design or specification documents
- ii. Route maps, alignment sheets, crossings, drawings, Piping and Instrumentation Diagrams, station layouts Pipe Book or Installation Records
- iii. Surveillance inspection and maintenance reports
- iv. Records and maps showing the location of CP facilities and piping
- v. CP Monitoring report
- vi. Leak burst and repair records
- vii. History cards of equipment
- viii. Pipeline Pigging Report

- ix. Material certification including dimension, metallurgy, DT and NDT, strength, tightness, performance and functional report
- x. Welding records
- xi. Procedure Qualification Record (PQR), Welding Procedure Specification (WPS) and Welder qualification records
- xii. Third Party technical audit report of infrastructure before liquid IN.
- xiii. Commissioning reports
- xiv. Non-conformance or deviation reports.
- xv. Calibration records of Inspection, Measuring and Metering and Test equipment.

Schedule 1H

MISCELLANEOUS

8.1 Materials for Sour Multiphase Service

8.1.1 NACE Standard MR-01-75 'Sulphide Stress Corrosion Cracking Resistant Metallic Materials for Oil Field Equipment defines limiting concentrations on hydrogen sulphide in the fluid transported' for it to be considered as sour service.

Note:

While past experience has indicated this to be the accepted minimum concentration at which sulphide stress corrosion cracking may occur, the presence of other constituents in the phases making up the multiphase fluid, such as carbon dioxide in the gas and salt in the water or larger amounts of free water or gas, may cause problems to occur at lower concentrations of hydrogen sulphide.

8.1.2 In addition to the applicable requirements of ASME B31.4 and this standard, all materials used in sour multiphase service shall meet the following requirements.

- i. Pipe, valve, fittings, flanges bolting and other equipment exposed to or which are necessary to contain sour multiphase fluids may be susceptible to stress corrosion cracking and hydrogen induced stepwise cracking and thus due consideration shall be given to material selection in design.
- ii. All Materials used for sour multiphase service shall conform to the requirements of NACE Standard MR-01-75, 'Sulphide Stress Corrosion Cracking Resistant Metallic Material for Oil Field Equipment'. Depending upon the service and the materials involved, the additional tests for Sulphide Stress Corrosion Cracking (SSCC) and Hydrogen Induced Cracking (HIC) as specified in NACE standards MR-01-75 and TM-02-84 respectively, should also be conducted for long and short term behavior of material under corrosive environments.
- iii. Pressure containing components (excluding pipe) intended for sour multiphase service shall be fully identified with a permanent marking.

Annexure - I

Minimum Inter Distances for Various Station Facilities (Other than LPG)

S. No.	From or To	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Booster or Mainline Pump Shed	X	16	X	16	30	30	30	16	30	30	X	X	X	X
2	Scraper Launcher or Receiver	16	X	X	16	30	16	16	16	30	16	X	X	X	X
3	Filters or Metering or Sampling point or Sump Tanks	X	X	X	16	30	16	30	16	30	16	X	X	X	X
4	Control Room UPS or SCADA- Telecom or Office building	16	16	16	X	16	16	X	X	30	X	16	16	16	16
5	Fire Pump House or Fire water storage tanks	30	30	30	16	X	12	X	16	60	X	X	30	30	30
6	Compound Wall	30	16	16	16	12	X	X	6	16	X	5	16	16	16
7	Elect Substation or Switch Yard or Transformers	30	16	30	X	X	X	X	X	#	#	16	30	30	30
8	Motor Control Centre or Power Control Centre or Variable Frequency Drive	16	16	16	X	16	6	X	X	#	#	16	16	30	30
9	API Oil Water Separators (open type)	30	30	30	30	60	16	#	#	X	#	X	30	30	X
10	Service Building	30	16	16	X	X	X	#	#	#	X	16	16	16	16

	(Stores or Amenities)															
11	Station Block Valves	X	X	X	16	X	5	16	16	X	16	X	X	X	X	X
12	Metering System	X	X	X	16	30	16	30	16	30	16	X	X	X	X	X
13	Sump Tank (U/G)	X	X	X	16	30	16	30	30	30	16	X	X	X	X	X
14	API Separator (closed type)	X	X	X	16	30	16	30	30	x	16	X	X	X	X	X

Notes:

- I. All distances are in meters. All distances shall be measured between the nearest points on the perimeter of each facility.
- II. # - Safety distances as per OISD-STD-118.
- III. For other station facilities not covered in the above shall be governed by OISD- STD-118.
- IV. x - Any distance suitable for constructional and operation convenience.
- V. Firewater hydrant or monitors shall be installed at a minimum 15 m away from the equipment or facilities to be protected.
- VI. For the distance from compound wall, the distance mentioned in this table and the requirement of local bylaws (if any) whichever is higher shall govern.
- VII. At pipeline's loop line terminal location, distance between scraper barrel and compound wall shall not be less than 5 meter.
- VIII. For SV station (motor operated) distance between sectionalizing valve to premise boundary shall be minimum 5 meter. All other safety distances at SV or CP stations to be kept as per operational requirement and applicable local statutory authorities.

List of Specifications of Piping Materials used in Petroleum and Petroleum Products Pipeline

Standard Number	Title of Standard
Steel Pipe	
API 5L : 2012	Specification for Line pipes
ASTM A106 : 2014	Standard Specification for Seamless Carbon steel Pipe for High Temperature service
ASTM A333 : 2013	Seamless and Welded Steel Pipe for Low-Temperature Service and Other Applications with Required Notch Toughness
Valves	
API SPEC 6D : 2014	Specification for Pipeline and Pipeline Valves
ISO – 14313 : 2007	Petroleum and natural gas industries -- Pipeline transportation systems -- Pipeline Valve
ASME B16.34 : 2013	Valves Flanged, Threaded and Welding End
BS EN ISO 15761 : 2002	Steel gate, globe and check valves for sizes DN 100 and smaller for the petroleum, and natural gas industries.
ISO 17292 : 2004	Metal ball valves for petroleum, petrochemical and allied industries.
BS 1873 : 1975	Specification for Steel globe and globe stop and check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries.
Flanges and Blanks	
ASME B16.5 : 2013	Pipe flanges and flanged fittings - NPS 1/2 inch through NPS 24 Metric/Inch Standard
ASME B16.36 : 2009	Orifice Flanges
MSS SP-44 : 2006	Steel Pipeline Flanges
Fittings	
ASME B16.9 : 2012	Factory-Made Wrought Butt welding Fittings
MSS SP-75 : 2014	High Strength, Wrought, Butt Welding Fittings
MSS SP 97 : 2012	Integrally Reinforced Forged Branch Outlet Fittings - Socket Welding, Threaded and Butt welding Ends.

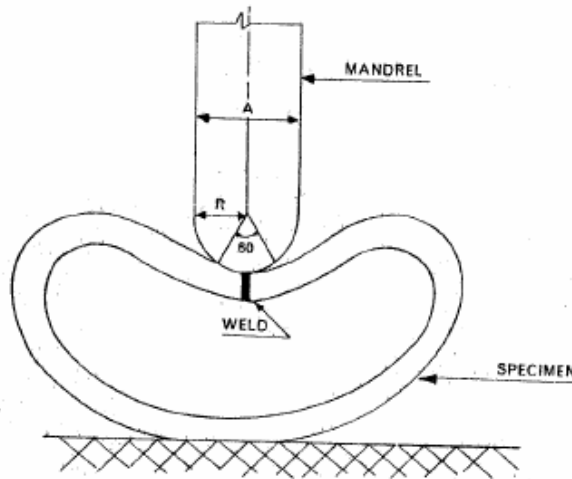
IS 1239 (PART 2) : 2011	Steel Tubes, Tubular and Other Wrought Steel Fittings - Specification - part 1: Mild Steel Tubular and other wrought steel pipe fittings.
Stud Bolts and Nuts	
ASTM A194 : 2014	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.'
ASTM A193 : 2014	Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
ASTM A153 : 2009	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
ASME B18.2.1 : 2012	Square, Hex, Heavy Hex and Askew Head Bolts and Hex, Hex Flange, Lobed Head and Lag Screws (Inch Series).
ASME B18.2.2 : 2010	Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
Gaskets	
ASME B16.20 : 2012	Metallic gaskets for pipe flanges: Ring joint, Spiral wind and Jacketed.
High Pressure SS Tubing and Fittings	
ASTM A269 : 2014	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
Pressure Safety Valve and Pressure Measuring Equipment	
API 526 : 2009	Flanged Steel Pressure Relief Valves
BS EN 837-1 : 1998	Pressure gauges - Part 1: Bourdon tube pressure gauges; dimensions, metrology, requirements and testing.
BS EN 837-2 : 1998	Pressure Gauges - Part 2: Selection and Installation Recommendations for Pressure Gauges.
BS EN 837-3 : 1998	Pressure gauges - Part 3: Diaphragm and capsule pressure gauges. Dimensions, metrology, requirements and testing.
ASME Section VIII : 2010	Boiler and Pressure Vessel Code: Rules for Construction of Pressure Vessels : Filters

Additional Requirements for Electric Welded Pipes

Electric Welded pipes shall meet following requirements.

Reverse Bend Tests

Reverse bend tests shall be performed on the pipe piece cut from the crop end, selected from the front end of the first length and the back end of the last length produced from each coil. The specimen shall be 100 mm to 115 mm long and shall be reverse bend tested in accordance with procedure given below:



Selection of Mandrel

The reverse bend test shall be carried out with a mandrel, whose radius (R), width (A) shall be calculated for any combination of diameter, wall thickness and grade with the formula:

$$A = 2R = \frac{1.4(D - t)t}{e(D - t) - 1.4t} - t$$

Where, D - Outside diameter of pipe

t - Wall thickness of pipe

1.4 - Peaking factor

e - Strain

Minimum values of 'e' shall be as follows:

Grade of Steel	Min 'e' value
API 5L B	0.1375
API 5L X-42	0.1375
API 5L X-46	0.1325
API 5L X-52	0.1250
API 5L X- 56	0.1175
API 5L X- 60	0.1125
API 5L X- 65	0.1100
API 5L X- 70	0.1025
API 5L X- 80	0.0950

Procedure

The mandrel is to be plugged into the specimen, with the weld in contact with mandrel, to such a depth that the angle of engagement between mandrel and specimen reaches 60⁰ (see Fig. above). If the combination of diameter and wall thickness of pipe and radius of mandrel is such that the angle of engagement does not reach 60⁰, the mandrel shall be plugged into the specimen until opposite walls of the specimen meet.

Acceptance Criteria

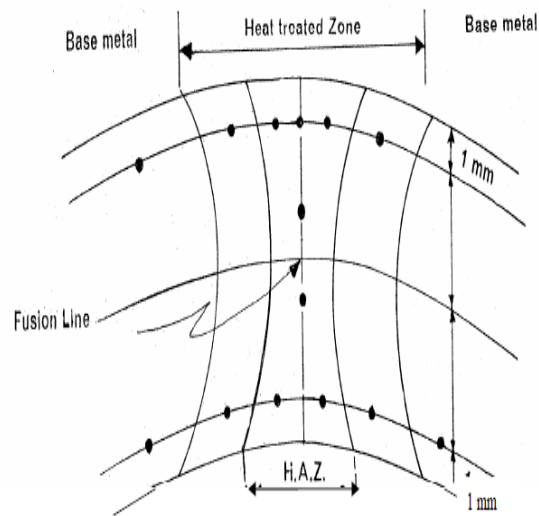
A specimen which fractures completely prior to the specified engagement of mandrel and specimen, or which reveals cracks and ruptures in the weld or heat affected zone longer than 4 mm, shall be rejected. Cracks less than 6 mm long at the edges of the specimen shall not be cause for rejection.

Micrographic and Hardness Examination

A test specimen shall be taken across the longitudinal weld from one length of finished pipe from each lot of maximum 100 lengths from the same heat manufactured from the same process.

These specimens shall be polished and etched for micro-examinations. The examinations shall provide evidence that heat treatment of weld zone is adequate and there is no untempered martensite left.

The Manufacturer shall make hardness measurements on each specimen as indicated in Fig. below in accordance with ASTM E-32. The maximum difference in hardness between base material and any reading taken in the heat affected zone shall be less than 80 points Vicker's HV₁₀.



Location where hardness measurement to be carried out

Annexure - IV

List of Applicable Standards and References

Standard Number	Title of Standard
ASME B31.4 : 2009	Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids.
API 1102 : 2007	Steel Pipelines Crossing Railroads and Highways.
API 1104 : 2013	Welding of Pipelines and Related Facilities.
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Foot Note: Principal regulations were notified vide No. G.S.R. Infra/ T4S/ P&PPPL/01 /2014, dated 12th February, 2016 and subsequently amended vide F. No. INFRA/PNGRB/T4S/P&PPPL/04/2016, dated 29th December, 2017. And F. No. PNGRB/Tech/18-penalty-T4SReg./(9)/2024/(E-5488)/10 dated 23rd July 2025.