NATURAL GAS TRANSMISSION PIPELINES

AND

CITY GAS DISTRIBUTION NETWORKS

OISD STANDARD 226

Oil Industry Safety Directorate
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Ministry of Petroleum & Natural Gas
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NATURAL GAS TRANSMISSION PIPELINES

AND

CITY GAS DISTRIBUTION NETWORKS

Prepared by:

COMMITTEE ON NATURAL GAS PIPELINES

OIL INDUSTRY SAFETY DIRECTORATE
8th Floor, OIDB Bhavan,
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Preamble

Indian petroleum industry is the energy lifeline of the nation and its continuous performance is essential for sovereignty and prosperity of the country. As the industry essentially deals with inherently inflammable substances throughout its value chain – upstream, midstream and downstream – Safety is of paramount importance to this industry as only safe performance at all times can ensure optimum ROI of these national assets and resources including sustainability.

While statutory organizations were in place all along to oversee safety aspects of Indian petroleum industry, Oil Industry Safety Directorate (OISD) was set up in 1986 Ministry of Petroleum and Natural Gas, Government of India as a knowledge centre for formulation of constantly updated world-scale standards for design, layout and operation of various equipment, facility and activities involved in this industry. Moreover, OISD was also given responsibility of monitoring implementation status of these standards through safety audits.

In more than 25 years of its existence, OISD has developed a rigorous, multi-layer, iterative and participative process of development of standards – starting with research by in-house experts and iterating through seeking & validating inputs from all stake-holders – operators, designers, national level knowledge authorities and public at large – with a feedback loop of constant updation based on ground level experience obtained through audits, incident analysis and environment scanning.

The participative process followed in standard formulation has resulted in excellent level of compliance by the industry culminating in a safer environment in the industry. OISD – except in the Upstream Petroleum Sector – is still a regulatory (and not a statutory) body but that has not affected implementation of the OISD standards. It also goes to prove the old adage that self-regulation is the best regulation. The quality and relevance of OISD standards had been further endorsed by their adoption in various statutory rules of the land.

Petroleum industry in India is significantly globalized at present in terms of technology content requiring its operation to keep pace with the relevant world scale standards & practices. This matches the OISD philosophy of continuous improvement keeping pace with the global developments in its target environment. To this end, OISD keeps track of changes through participation as member in large number of International and national level Knowledge Organizations – both in the field of standard development and implementation & monitoring in addition to updation of internal knowledge base through continuous research and application surveillance, thereby ensuring that this OISD Standard, along with all other extant ones, remains relevant, updated and effective on a real time basis in the applicable areas.

Together we strive to achieve NIL incidents in the entire Hydrocarbon Value Chain. This, besides other issues, calls for total engagement from all levels of the stake holder organizations, which we, at OISD, fervently look forward to.

Jai Hind!!!

Executive Director

Oil Industry Safety Directorate
FOREWORD

Oil Industry in India is more than 100 years old. Over years, a variety of practices have been in vogue because of collaboration / association with different foreign companies and governments. Standardisation in design, operating and maintenance practices was hardly in existence at a national level. This lack of uniformity, coupled with feedback from some serious accidents that occurred in the recent past in India and abroad, emphasised the need for the industry to review the existing state of art in designing, operating and maintaining oil and gas installations.

With this in view, the Ministry of Petroleum & Natural Gas in 1986 constituted a Safety Council assisted by the Oil Industry Safety Directorate (OISD) staffed from within the industry in formulating and implementing a series of self-regulatory measures aimed at removing obsolescence, standardizing and upgrading the existing standards to ensure safer operations. Accordingly, OISD constituted a number of functional committees comprising of experts nominated from the industry to draw up standards and guidelines on various subjects.

The present standard on “Cross-country Natural Gas Pipelines and City Gas pipeline” were prepared by the Functional Committee on ‘Natural Gas Pipelines’. This standard is based on the accumulated knowledge and experience of functional committee members and various national and international codes and best practices. This standard is meant to be used as supplement and not as a replacement for existing codes and practices.

This standard in no way supersedes the requirements of statutory bodies like IBR, CCE, Factory Inspectorate or any other Government Body which must be followed as applicable.

This standard will be reviewed periodically for improvements based on the new experiences and better understanding. Suggestions may be addressed to:

The Co-ordinator
Committee on Natural Gas transmission Pipeline & City Gas distribution networks,
Oil Industry Safety Directorate
Government of India, Ministry of Petroleum & Natural Gas
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NOTE

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These documents are intended only to supplement and not to replace the prevailing statutory requirements.
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<td>Engineers India Limited, New Delhi</td>
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<td><strong>City Gas Networks</strong></td>
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<td>Gujarat Gas Company Limited, Ahmedabad</td>
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</tr>
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<td>Sh. J. P. Ojha</td>
<td>Indian Oil Corporation Ltd., Noida</td>
</tr>
<tr>
<td>Sh. Sanjeev Lowe</td>
<td>BP India Services Private Ltd., New Delhi</td>
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<td>Sh. C. M. Sharma</td>
<td>Oil Industry Safety Directorate, New Delhi</td>
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<td>Sh. S.C. Gupta</td>
<td>Oil Industry Safety Directorate, New Delhi</td>
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<tr>
<td><strong>MEMBER CO-ORDINATOR</strong></td>
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<tr>
<td>SH. S. K. NANDY</td>
<td>Oil Industry Safety Directorate, New Delhi</td>
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In addition to the above, several other experts from the industry contributed in the preparation, review and finalization of this document.
## PART-1
STANDARD ON NATURAL GAS TRANSMISSION PIPELINES

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PART-I

NATURAL GAS TRANSMISSION PIPELINES

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1.0 INTRODUCTION:

There is an imminent need to transport huge quantity of gas from source to consumption centre economically and this can be possible only through building pipeline infrastructure in the country with a view to facilitating the evolvement of nation-wide gas grid and the growth of city or local gas distribution newt works. Considering the importance of use of natural gas in various industrial and automotive sectors, major developments in transportation & distribution of natural gas through pipeline systems are in vogue.

The primary purpose of this standard is to establish minimum requirements for design, materials, construction, inspection, testing, commissioning operation and maintenance, corrosion protection, modifications, abandonment, safety of transmission pipelines and city gas pipelines and also for protection of employees, public and facilities against the hazard associated with transportation and distribution of gas through pipeline system.

2.0 SCOPE:

This standard outlines the minimum requirement for safety in design, construction, inspection, testing, commissioning, operation, maintenance, modifications, abandonment, corrosion protection, safety of onshore natural gas cross country pipelines, offshore section of a predominately onshore pipeline (such as creek/estuary crossings) and spur lines including associated facilities and installations as outlined in Annexure-I.

This standard shall be applicable from the date of issuance mentioned on title page for all new projects/extension or expansion of existing system. For new pipeline under construction and commissioning phase and also for existing pipelines and associated facilities under operation phase, the requirements related to safety & fire protection system, operation & maintenance, pipeline integrity management, defect detection, assessment & mitigation specified in this standard shall be applicable. It shall be obligatory on the part of Owner/Operator to implement/comply these requirements within 2 years of issuance of this Standard for pipelines already in operation and within 2 years of commissioning of pipelines which are under construction phase.

Notes:

1. Pipelines transporting liquid hydrocarbons are covered under OISD-STD-141
2. Pipeline transporting Liquefied Petroleum Gas and other High Vapour Pressure (HVP) Liquid are covered under OISD-STD-214.

3.0 DEFINITIONS:

All definition/explanatory notes mentioned heir in shall be used for this standard.

Authorized person
A person or representative of the company trained and assigned to carry out a specific job.
Cross country pipeline
Cross country pipeline means all pipeline located beyond the boundary of any facility including pipelines after separator (exploratory well) and its associated facilities which are required for transportation of natural gas from one point to another excluding piping within the separation and / or gas processing plant up to plant isolation valves

Consumer
The organization or individual to whom Natural Gas is delivered through the cross country pipeline.

Cold Work
It is an activity which does not produce sufficient heat to ignite a flammable mixture (mixture of flammable gas with an oxidizing agent) or a flammable substance.

Chief Controller
Means Chief Controller of Explosives.

Competent Authority
Any person authorized by Central Government, by notification in the official Gazette, to perform the functions of the competent authority under the PMP Act’1962.

Competent Person:
A person recognized by the concerned statutory authority for the purpose in respect of which the competency is required.

Custody transfer meter
A gas measuring device which measures the quantity and / or energy of gas delivered from one agency to another agency for transfer of custody.

Design Factor
It is percentage factor of Specified minimum strength of the material considered for determining wall thickness based on location class of the pipeline.

Design Pressure
The maximum internal pressure which the pipeline can be subjected to as determined by design procedure applicable to materials and locations involved.

Delivery Station
Delivery station is the station on the pipeline used for receipt of natural gas and delivery to consumer(s) / city gate station.

Hot work
It is an activity which involves welding, burning, soldering, brazing, sand blasting, chipping by spark producing tools, use of power driven tools, non flame proof electrical work including other work which can produce sufficient energy to cause ignition where potential flammable mixture (mixture of flammable gas with an oxidizing agent) or a flammable substance exists.

Intermediate Compressor Station
An intermediate compressor station is any installation having compressor between
originating compressor station and terminal / final / last delivery station on the pipeline for boosting the pressure of the gas so that it reaches to next station.

**Intermediate Pigging Station (IPS)**
An intermediate pigging station is an installation having facility for receiving and launching of pigs for pipeline pigging operations and is located between originating and delivery stations.

**Maximum Allowable Operating Pressure (MAOP)**
The maximum pressure at which the pipeline is allowed to operate. MAOP may be equal to the design pressure.

**Maximum Operating Pressure (MOP)**
The highest pressure at which the pipeline is operated during a normal operating cycle corresponding to a declared pipeline capacity.

**Natural Gas:** Means gas obtained from bore holes and consisting primarily of hydrocarbons and includes-
(i) gas in liquid state, namely liquefied natural gas and regasified liquefied natural gas,
(ii) Compressed natural gas
(iii) Gas imported through transnational pipelines including CNG or liquefied natural gas
(iv) Gas recovered from gas hydrates as natural gas
(v) Methane obtained from coal seams namely coal bed methane but does not include helium occurring in association with such hydrocarbons.

**Nominal Pipe Size (NPS)**
It indicates the standard pipe size when followed by a number. (e.g. NPS ¾, NPS 10, etc.)

**Nominal wall thickness**
It is the thickness of the pipe used in design calculation.

**Onshore**
Areas other than Offshore as defined below, forming the scope of this standard. Feeder lines from Jetty or other storage point and spur lines will form part of onshore pipeline.

**Offshore**
Areas beyond the line of high water along that portion of the coast that is in direct contact with the open sea and beyond the line marking the seaward limit of inland coastal waters.

**Operating Company**
Shall mean individual, partnership, corporation or public agency / organization or any other entity that operates cross country pipeline.

**Originating Compressor Station**
An originating compressor station is the first installation in the cross country pipeline having compressor for boosting the pressure of the gas to be transported so that it reaches

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to next station in the cross country pipeline.

**Operating Pressure**
It is the pressure corresponding to a particular flow rate at which pipeline is operated. Operating pressure may be less than or equal to MAOP.

**Originating Station**
Originating station is the first installation in the cross country pipeline where the natural gas is received for further transportation.

**Owner**
Shall mean individual, partnership, corporation or public agency / organization or any other entity that owns the cross country pipeline.

**Purging**
It is the process of replacing the atmospheric air within a container (pipeline, vessels, filters etc) by an inert substance in such a manner so as to prevent the formation of explosive mixture.

**Right-of–Use (RoU) / Right-of-Way (RoW)**
The area or portion of land within which the pipeline operating company has acquired the right through PMP Amendment Act 2011 or in accordance with the agreement with the land owner or agency to lay and operate the cross country natural gas pipeline.

**Regassified Liquid Natural Gas**
The natural gas obtained after gasification of liquid natural gas.

**Spur /Branch Pipeline**
Pipeline originating from cross country pipeline (also called as trunk pipelines) for dedicated terminal and / or customer location(s).

**Sectionalizing Valve (SV)**
Valve used in the cross-country pipeline system for isolation of a particular pipeline section whenever required. This valve is also referred to as Main Line Valve (MLV).

**Specified Minimum Yield Strength (SMYS)**
It is the minimum yield strength specified by specification or standard under which material is purchased from the manufacturer.

**Shall**
The word ‘shall’ is used to indicate that the provision/ requirement is mandatory.

**Should**
The word ‘should’ is used to indicate that the provision/ requirement is recommendatory as per sound engineering practice.

**Sour Gas**
Gas Containing hydrogen sulphide (H₂S) at 65 psia (4.8 bar) or greater.

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Terminal Station / Final Station
Terminal Station is the last station on the pipeline used for receipt of natural gas and delivery to consumer(s) / city gate station.

4.0 STATUTORY ACTS AND REGULATIONS
Natural Gas pipeline and its associated facilities are covered under various regulations and require specific approval from concerned authorities. Various regulations, inter alia applicable are as under:

ii. Policy for development of Natural Gas Pipelines and City or Local Natural gas Distribution Networks.
iv. The Environment (Protection ) Act -1986
v. Water (Prevention & Control of Pollution) Act 1974
vi. Air (Prevention & Control of Pollution) Act 1981
vii. The Petroleum and Mineral Pipelines (Acquisition of Right of Users in Land) Amended Act,2011
viii. Manufacture ,Storage & Import of Hazardous chemical Rules-1989
ix. National Highway Act, 1956
x. Railway Act, 1989
xi. The factories Act, 1948
xii. Indian Electricity Act, 1910 / CEA Regulations, 2010

In addition all other statutory approvals required for laying of the pipelines across rail, road and water body (canals/ rivers etc.) crossings and other utility crossings as notified by local authorities / State etc shall be applicable.

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

The initial integrity of the pipeline is established through proper design, material selection and sound construction practices. After the pipeline has been commissioned and is in operation, a programme of condition monitoring and maintenance should be undertaken to ensure integrity is maintained.

The selection of design for pipeline system shall be based on the following evaluation of the properties and required flow rate of the fluid to be transported, together with the environment in which the pipeline is to be installed.

a) Gas composition including hydrogen sulphide, oxygen and water vapour content
b) Sweet or sour natural gas, single or multiphase flow conditions.
c) Operating pressures and temperatures and density.
d) Type of Pipeline System (Gathering/Transmission/Distribution/Service lines).
e) Location class through which pipeline shall pass.

5.1 Pipeline Design
Design of Natural Gas pipeline shall be in accordance with ASME B 31.8 unless specified. In case of discrepancies, this standard shall precede over ASME B 31.8. Section(s) of cross country gas pipeline to be installed across estuaries and creeks
etc. affected by tidal fluctuations, waves and currents and cannot be installed using
conventional onshore equipment could be designed in accordance with Det Norske
Veritas (DNV) Standard FS-101/ OISD-Std-139.

5.1.1 A design life of minimum 25 years for pipeline system shall be considered by the
owner for designing various system and facilities beyond which pipeline system can
be considered for abandonment. The life of pipeline can be extended beyond the
design life subject to satisfying the comprehensive pipeline integrity test.

5.1.2 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/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:

(a) Buoyancy control and stability analysis for pipeline section to be installed in
areas subjected to flooding/submergence,
(b) Crossing analysis of rivers by trenchless techniques, wherever soil data is
favourable for such operation,
(c) Evaluation of potential for earthquake occurrence across fault location and
carrying out requisite seismic analysis to ensure safety and integrity of the
pipeline system.

5.1.3 A significant factor contributing to the failure of a pipeline is the damage caused to
the pipeline by activities along the route of the pipeline associated with human
dwellings and commercial/industrial installations. An appropriate Location Class
related to the number of buildings meant for human occupancy shall be determined
along entire pipeline route in accordance with Annexure-II. Pipelines and its
associated facilities shall be designed selecting appropriate design factor as per para
5.2.1

5.1.4 Design temperature
Appropriate temperature range for design of pipeline / piping system shall be
determined based temperature of natural gas proposed to be transported through the
pipeline, ambient / sub-soil temperature and type of anti-corrosion coating to be used.

Maximum temperature
Maximum temperature for design of above ground section of pipeline / piping shall be
maximum expected gas temperature during operation or maximum ambient
temperature whichever is higher.

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

Minimum temperature
Minimum temperature for design shall be minimum expected gas temperature during
operation or minimum ambient / sub-soil temperature whichever is lower. In no case
minimum temperature for carbon steel pipelines be less than (-) 29°C.
When maximum gas temperature during operation is below 65 °C, thermal expansion and stresses in the above ground section of pipeline / piping shall be evaluated considering pipe temperature of 65 °C.

Particular attention shall be given to tensile properties of the material when the design temperature exceeds 120 °C (250 °F). Appropriate temperature derating factor as per Table-1 below shall be considered in design.

<table>
<thead>
<tr>
<th>Gas Temperature in degree Celsius (Fahrenheit)</th>
<th>Temperature derating factor (T)</th>
</tr>
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<tbody>
<tr>
<td>Less than 120 °C ( 250 °F)</td>
<td>1.000</td>
</tr>
<tr>
<td>120 °C (250 °F) to 149 °C (300 °F)</td>
<td>0.967</td>
</tr>
<tr>
<td>149 °C (300 °F) to 177 °C (350 °F)</td>
<td>0.933</td>
</tr>
<tr>
<td>177 °C (350 °F) to 204 °C (400 °F)</td>
<td>0.900</td>
</tr>
<tr>
<td>204 °C (400 °F) to 230 °C (450 °F)</td>
<td>0.867</td>
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For intermediate gas temperatures, the derating factor is determined by interpolation.

5.1.5 Pipe diameter 4” and above shall be used for cross country pipelines. Pipe wall thickness less than 5.5 mm should not be used for cross country pipelines.

5.2 Design of Components

5.2.1 Steel Pipe

The least nominal wall thickness “t” for the steel pipe, shall be calculated in accordance with ASME B 31.8.

The internal design pressure shall be determined by the following formula

\[ t = \frac{P \times D}{2 \times S \times F \times E \times T} \]

Where
- \( t \) = Nominal wall thickness, in mm;
- \( P \) = Internal design pressure, in N/mm²;
- \( D \) = Specified outside diameter of the pipe, in mm;
- \( S \) = Specified minimum yield strength (SMYS) in N/mm² of pipe material;
- \( F \) = Design factor obtained from Table 2;
- \( E \) = Longitudinal joint factor, which for electric welded (EW), longitudinal seam submerged arc welded (LSAW), helical seam submerged arc welded (HSAW) and seamless types of pipes, manufactured in accordance with API specification 5L and considered as 1;
- \( T \) = Temperature derating factor to be used in design formula is determined from Table-1 above;
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<tr>
<td>Crossings of roads, without casing:</td>
<td>0.72</td>
</tr>
<tr>
<td>(a) Unimproved public roads</td>
<td>0.60</td>
</tr>
<tr>
<td>(b) Roads, highways, or public streets, with hard surface</td>
<td>0.50</td>
</tr>
<tr>
<td>Crossings of roads, with casing:</td>
<td>0.72</td>
</tr>
<tr>
<td>(a) Unimproved public roads</td>
<td>0.60</td>
</tr>
<tr>
<td>(b) Roads, highways, or public streets, with hard surface</td>
<td>0.50</td>
</tr>
<tr>
<td>(c) Railway crossings</td>
<td>0.50</td>
</tr>
<tr>
<td>Pipelines on bridges</td>
<td>0.50</td>
</tr>
<tr>
<td>Parallel Encroachment of pipeline mains</td>
<td>0.60</td>
</tr>
<tr>
<td>River Crossing- open cut</td>
<td>0.60</td>
</tr>
<tr>
<td>Horizontal direction Drilling (HDD)</td>
<td>0.50</td>
</tr>
<tr>
<td>Compressor station piping, IP station, regulating stations or measuring station</td>
<td>0.50</td>
</tr>
<tr>
<td>Near concentration of people in Location Classes 1 and 2 *</td>
<td>0.50</td>
</tr>
<tr>
<td>Fabricated assembly (Scrapper traps, SV stations, pressure /flow control and metering facilities etc., )</td>
<td>0.60</td>
</tr>
</tbody>
</table>

In setting the values of the design factor, F, due consideration has been given and allowance has been made for the various under thickness tolerances provided for in the pipe specifications listed and approved for usage in this Code.

* Near concentration in Class 1 and 2 means places of public assembly (school, temple, church, hospital, club etc.) used by 20 or more people frequently.

**Note:**
Higher thickness may be used if required to control stresses or stability during installation and operation.

Thicker pipe in Location Class 1 is required throughout the assembly and for a distance equal to lesser of 5 diameters or 10 ft in each direction beyond the last fitting.

Location Class Division 1(with design factor 0.80) as defined in ASME B 31.8 shall not be used in design of pipeline as per this standard.

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5.2.2 Pipe Wall Thickness

Pipe wall thickness calculations shall be carried out as per Para 5.2.1. Corrosion allowance to account for expected loss of wall thickness due to internal corrosion that may be caused due to constituents of the gas and other service conditions shall be added to the calculated thickness unless otherwise internal corrosion mitigation measures are adopted.

Pipe thickness shall be checked and revised as required to minimize the number of field hydrostatic testing sections, considering combined testing of pipes in different class locations.

5.2.3 Evaluation of Stresses

The hoop, longitudinal, shear, bending, tensional and other stresses shall be evaluated taking into account all relevant loads. Stress analysis of above ground as well as buried pipeline / piping shall be carried out in accordance with appropriate provisions of ASME B31.8. Wherever required, the adequacy of flexibility provided in the pipeline shall be established through appropriate design calculations as specified in flexibility requirements.

5.2.4 Additional Protective measures

5.2.4.1 While designing the pipeline system, the design engineer shall provide reasonable protection to prevent damage to the pipeline from unusual external conditions. Some of the protective measures which the design engineer may provide are: encasing the carrier pipe with steel casing pipe of larger diameter; adding concrete protective coating; increasing the wall thickness of the pipe; lowering the pipeline to a greater depth and/or indicating the presence of the pipeline with additional warning signs/markers.

5.2.4.2 Anti-buoyancy Measure
Pipeline crossing water bodies, marshy areas, swamps and areas with high water table shall be checked for buoyancy and if required suitable anti-buoyancy measures such as concrete weight coating, gravel filled geotextile bags, anchors etc. shall be provided. The specific gravity of the installation under operating conditions shall be minimum 1.1.

5.2.5 Corrosion

All underground pipes and its component shall be protected against corrosion using suitable external anti corrosion coating / painting and cathodic protection system. All above ground piping and its component shall be protected against corrosion by providing suitable anti corrosion coating. Wall thickness allowance in pipe for protection against corrosion may not be required if pipe and its components are protected against corrosion by any of the above method.
5.3 Location and layout of Pipeline installations

5.3.1 Location
Originating, intermediate and terminal facilities of cross country pipeline such as Originating Compressor Station / Originating Station, Intermediate Compressor Station, Intermediate Pigging Station, Tap-off Station, Metering and Regulating Stations and Sectionalizing Valve Stations etc. should 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 HAZOP and risk analysis.
(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

In addition to above, compressor station should be located at such clear distances from adjacent property not under control of the pipeline owner / operator so as to minimize the hazard of communication of fire to the compressor station from structures on adjacent property.

5.3.2 Layout

The following aspects shall be considered while establishing station layout

i. Station equipment and their specification.
ii. P&I diagram for the station.
iii. Utility requirement.
iv. Flaring / cold venting requirements
v. Operation & maintenance philosophy of station equipment.
vi. Fire station & allied facility wherever required.
vii. Proximity to overhead power lines. Overhead power lines should not be allowed directly above station equipment / buildings.
viii. HT Pole structure, Transformers, Breaker and MCC room etc to be located in non-hazardous area.
ix. Requirement of space and access around the compressor shed / building and other equipment to permit the free movement of firefighting equipment.

5.3.3 Separation Distances

Inter-distances between various station facilities and utilities shall be as per ANNEXURE - III.
5.3.4 Piping layout
Station piping may be installed above ground or buried. Buried piping inside the terminal area shall have a minimum cover of 1.0 m from top of pipe to finished ground level.

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

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.

Platforms and crossovers shall be provided for ease of operation and maintenance of above ground piping where required.

5.4 Protection of Facilities

5.4.1 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.

5.4.2 Proper industry type boundary wall at least 3 M high with 0.6 M barbed wire on top shall be provided all around the installation i.e. dispatch station, compressor station, tap-off points and sectionalizing valve stations in line with MHA (Ministry of Home Affairs) guidelines.

5.4.3 Emergency exit with proper gate shall be provided in the earmarked zone wherever required.

5.4.4 Natural Gas pipeline system should be equipped with following:

(1) Supervisory Control And Data Acquisition (SCADA) System.
(2) Leak detection system with provision for identification / location of leak and isolation of affected section.
(3) Facilities for controlled blow down.
(4) Accessories & kit for arresting leak

5.5 SCADA REQUIREMENTS

5.5.1 Gas pipeline system should be monitored and controlled using SCADA system to ensure effective and reliable control, management and supervision of the pipeline.

5.5.2 Compressor Stations, Intermediate Pigging Stations, Dispatch and Receiving Stations, Sectionalizing Valve stations with remote operation capabilities as well as Telecom Repeater Stations / Cathodic Protection Stations (in case located independent of other facilities) should have suitable field signals’ connectivity with the control system.

5.5.3 Application software modules/ functions should be based on the requirement of pipeline operating company.

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6.0 PIPELINE SYSTEM & COMPONENTS

6.1 Isolation Valves
Isolation valve shall be provided for isolating sections of pipeline station piping in order to:

a) Limit the hazard and damage from accidental discharge from pipeline / piping;

b) Facilitate repair maintenance of pipeline / piping.

6.1.1 Station Isolation valves
Block valves with remote shut off provision from the control room shall be provided at the inlet and outlet of the compressor station piping to isolate the pipeline from compressor station facilities in case of emergency at compressor station. In addition Block valves may be considered at entry and exit of pipeline in compressor / tap-off station near boundary.

6.1.2 Main Line Valves (MLV) / Sectionalizing Valves
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 pressure relief, security, proximity to occupied buildings shall be taken into consideration in deciding the location of the valves. The maximum distance between the location of any two section isolation valve stations shall be as given in Table - 3 below, based on the location class and taking into consideration factors like the terrain features, requirement of safety and operation, etc.

<table>
<thead>
<tr>
<th>Location Class</th>
<th>Maximum Distance in km</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>32</td>
</tr>
<tr>
<td>2</td>
<td>24</td>
</tr>
<tr>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>

Note: Based on the above location class no. of Block / Sectionalizing valves to be installed shall be worked out. Valve spacing adjustments should not exceed 10% of the applicable distances listed above (due to non-availability of land). However, the total number of valves as per the design requirement shall remain same.

6.1.3 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. The facilities within valve station shall be secured by providing a suitable boundary wall around the installation with a gate. Overhead power lines shall not cross directly over the valve station facilities. Piping / pipeline within the Sectionalizing valves station shall be designed considering design factor as per Table – 2 of this standard. The provisions of

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remote operated feature should be as per the operation and control philosophy to be adopted for the pipeline by the owner / operating company. At locations where valve stations are combined with compressor/repeater stations, the requirements of safe distance and statutory clearance, as applicable, shall be followed.

6.1.4 Valve shall be installed buried and provided with a stem extension in such a way that the center of actuator is at approximately 1.0 m above the finished ground level considering ease of operation. Sectionalizing valve on the main pipeline shall preferably be ball valves of full bore type conforming to the minimum requirements of API 6D / ISO-14313.

6.1.5 Pipeline sectionalizing valve may be either gas actuated or manually/electrically/pneumatically/hydraulically operated. In order to minimize potential leak sources, valves used in mainline shall be with butt-weld ends. Flanges may be used where frequent access or removal of equipment is required. 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. Valve surface shall be applied with suitable corrosion protection coating.

6.1.6 Sectionalizing Valve(s) shall be provided with blow down or vent line connection to isolate the pipeline section and evacuate the pipeline section in case of an emergency and repair. The size and capacity of the connections for blowing down the line shall be such that under emergency condition the section of line can be vented as rapidly as practicable but in no case shall be less than 1/3rd of the dia of mainline pipe.

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

6.2 Pigging Facilities

6.2.1 Main gas pipelines and feeder lines, spur lines and branch lines of 4” and above size and length greater than 10 km shall be provided with pigging facilities.

6.2.2 Spacing between consecutive pigging stations shall be determined based on the diameter of pipeline, nature of pigging operation and capability of the pigs. Spacing in excess of 200 km shall be avoided.

6.2.3 Pigging stations shall be provided with all-weather access road from the nearest road

6.2.4 Pigging facilities should be designed to be suitable for:

a) access to the pig traps;
b) handling of pigs;
c) isolation requirements necessary for pig launching and receiving;

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d) venting and draining of carried over muck / condensate during pigging operation;
e) direction of pigging including bi-directional pigging;
f) minimum permissible bend radius and the distances between bends/fittings;
g) fittings/branch connections and compatibility of line pipe material;
h) variation in pipeline diameter and wall thickness

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

6.2.4 Pig Traps / Pig Barrels

Pig traps shall be capable of handling displacement pigs, cleaning pigs, swabbing pigs, caliper pigs and intelligent pig. In case of feeder pipelines, spur lines and branch pipelines lines more than 10 kms shall be provided with pigging facility. All anticipated pigging operations, including possible internal inspection shall be considered when determining the dimensions of traps. The launching and receiving barrels and its closures shall be designed in accordance with ASME or equivalent standard. Arrangements for launching, retraction, handling and lifting of pigs, cleaning and instrumented pigs shall be provided at the scraper station. These stations shall be provided with access road from the nearest metal road.

Diameter of pig barrel shall be suitable for handling all type of pigs. Barrel for launcher may be 2 size higher and barrel for receiver may be 3 size higher than main gas transporting pipe size. The pig barrel shall be provided with quick opening end closures equipped with safety locking device in compliance with Section VIII, Division I, UG-35(b) of BPV Code. Both barrel and quick opening closure shall be designed as per relevant ASME Code or equivalent standard.

Suitable arrangements for launching, retraction, handling and lifting of pigs shall be provided

Pig signalers shall be installed on the pipeline and pig barrels to track the passage of pigs.

These stations shall be provided with access road from nearest metal road

6.2.6 Centre line elevation of pig barrel shall be such as to allow easy insertion / retraction of pigs and operation of quick opening closure. Elevation of approximately 1.0 m above finished grade / pavement level is recommended.

6.3 Bends
The minimum radius of Cold Field Bend shall be as per Table -4 below:
Table – 4

Minimum Radius of Cold Field Bends

<table>
<thead>
<tr>
<th>Nominal Pipe Size (inch)</th>
<th>Minimum Bend Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPS 12 and below</td>
<td>21D</td>
</tr>
<tr>
<td>NPS 14 and NPS 16</td>
<td>30 D</td>
</tr>
<tr>
<td>NPS 18 and larger</td>
<td>40 D</td>
</tr>
</tbody>
</table>

Use of Mitre bends shall not be permitted. Factory made bend of not less than 3D is permitted.

Note:
Where ‘D’ is the outside diameter of steel pipe.

6.4 Insulating Joints

Insulating joints shall be provided to electrically isolate the buried pipeline from the above ground pipeline. Insulating joints shall be monolithic type and shall allow smooth passage of pigs. Insulating joints separating buried and above ground pipeline shall be installed in above ground portion of pipeline, immediately after the buried /above ground transition point.

6.5 Check valves

Check Valves shall be installed to provide automatic blockage of reverse flow in the piping system, within the station, wherever required. Installation of check valves in piggable section of the pipeline are not recommended.

6.6 Flow/Pressure Control Valve

Design of control valves shall meet the requirement of part I of API 550 / API-RP-553, ISA (Instrument Society of America) S- 75.01 -75.03, IEC -79 and IEC-529.

6.7 Branch Connections

Branch connections of size below NPS 2 are not recommended in buried pipeline section.

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

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 / bar tees in order to enable smooth passage of all types of pigs. Such flow tees...
/ bar tees shall comply with the requirements of ASME B 16.9, MSS-SP-75 or equivalent.

6.8 Flanged or threaded joints, Bolts, Nuts, Gasket and other fittings

6.8.1 Threaded joints shall not be used in cross country pipelines, spur lines and branch lines.

6.8.2 The number of flanged or threaded joints in station piping shall, to the extent, be kept minimum. Flanges shall conform to ANSI 16.5 or ASME B 16.47 Series A or MSS-SP 44 or equivalent.

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

6.8.4 Steel butt welding fittings shall comply with ANSI 16.9 / MSS-SP-75 or equivalent, Weld’o’lets shall comply MSS SP 97. Steel socket welding fittings shall comply with ANSI B 16.11.

6.9 Metering facilities

Appropriate type of meters shall be installed at all custody transfer points meeting requirements of American Gas Association (AGA) standard. Dry gas filters may be installed at the upstream of the meters if required by the manufacturer of meters.

The meters shall be duly calibrated prior to installation. Facilities for meter proving may be provided as per pipeline owner / operator’s operation philosophy.

6.10 Supports and Anchors

Supports and anchors shall be fabricated from suitable materials. Supporting elements required to be welded to the gas piping shall comply with the following:

(i) If the gas piping is designed to operate at a hoop stress of less than 50% of SMYS, supports or anchors shall be directly welded to the pipe.

(ii) If the pipe is designed to operate at a hoop stress level of 50% or more of SMYS, support element are not permitted to be welded directly to the pipe. Support elements shall be welded to a member that completely encircles the pipe. Encircling member shall be welded to the pipe continuously and cover the entire circumference.

6.11 Electrical Installations of Pipeline Station

6.11.1 Area Classification of Pipeline Installation, as basis for Selection of Electrical Equipment for Natural Gas Pipeline Station shall follow IS-5572 and OISD –STD-113. The specification of Electrical equipment shall be in line with IS: 5571, “Guide for selection of Electrical Equipment for Hazardous Area”. Safety in electrical system to be
designed as per OISD-RP-149. Fire protection in Electrical installations shall be designed as per OISD-STD-173.

6.11.2 All electrical equipment, systems, structures and fencing shall be suitable earthed conforming to IS 3043. 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 power. 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 in line with OISD-STD-173.

6.11 Instrument and Control System

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.

6.13 Communications

A reliable and dedicated communications system to interact between all stations including sectionalizing valve station with remote operation capability along the entire pipe line shall be designed and installed and maintained to ensure safe operations under both normal and emergency situations.

6.14 COMPRESSOR STATION

The compressor station shall be designed in accordance with the requirements of ASME B 31.8.

Centrifugal type process gas compressors shall be designed in accordance with API-617. Reciprocating Compressors shall be designed in accordance with API-618.

Typical facilities at a gas compressors stations is enclosed at Annexure- IV and shall consist of following.

6.14.1 Compressor

The gas piping for compressor station shall be designed in accordance with Para 5.2.1 to 5.2.3 of this standard.

Other Compressors shall be designed in accordance with API-618 / API-11P.
6.14.2 Gas after coolers

Coolers may be installed to bring down the compressed gas temperature to desired level before it is introduced in the downstream pipeline.

6.14.3 Fuel Gas Conditioning System

The fuel gas, if required for gas turbines / gas engines may require treatment before its use.

Typical fuel gas conditioning system includes filter separator unit with condensate handling system, gas measurement system, gas heating system (if required) and pressure regulation and blow down system.

The fuel gas after conditioning should meet the requirements specified by Original Equipment Manufacturer (OEM) of gas turbines / engines.

6.14.4 Power Generation System

The compressor station shall have its own gas based power generation system or an alternate power supply system. In addition, minimum one diesel generator shall be provided to meet the emergency power requirement in case of failure of normal power supply system.

6.14.5 Instrument and Plant Air System

The compressor station may require instrument and plant air for instrumentation system, control valves and compressor’s dry gas seals, cleaning of intake air filters of gas turbines, etc. For SV stations and IP stations gas at instrument air pressure can be used. Electrical motor driven or diesel driven air compressors should be used. Air receivers, air storage bottles and instrument air dryer units should be provided. Air receivers or air storage should be designed and installed in accordance with ASME Section VIII of the Boiler and Pressure Vessel Code.

6.14.6 Condensate handling system:

When condensate is expected in the pipeline, facilities shall be provided for removal of condensate received in the form of liquid in the filter separator. Liquid accumulated in separator shall be sent condensate to blow down drum when required

6.14.7 Building / Shed Requirements

The compressor station should have following main buildings/sheds, in general:-

(i) A compressor building/shed to house the compressors.
(ii) Switchgear building for electric power.

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(iii) Power generator building/shed.
(iv) Workshop/ Maintenance building.
(v) Warehouse store.
(vi) Office building.
(vii) Control room building.

All compressor station buildings which house gas piping in sizes larger than NPS-2 or gas handling equipment shall be constructed in accordance with OISD-STD-163.

7.0 SAFETY DEVICES & FEATURES

The safety system for compression facilities and gas transportation system shall consist of following:

7.1 Emergency Shutdown System

7.1.1. Compressor station shall be provided with an emergency shutdown system by means of which the gas can be vented out of the system. Operation of the emergency shutdown system shall also shut down all gas compressing equipment, all gas fired equipment, gas delivery system and shall de-energize the electrical facilities located in the vicinity of gas headers and in the compressor shed, except those that provide emergency lighting and those that are necessary for protection of the equipment.

7.1.2 Emergency shutdown system shall be operable from at least 2 locations away from the gas area of the station out of which one should be located in the field outside the compressor building.

7.2 Pressure limiting devices

7.2.1 Over pressure shut off valves shall be provided upstream and downstream of controlling regulators along with alarm provision in case of failure of the regulator.

7.2.2 Pipe size shall be such that gas velocities in the piping shall not be more than 20 mtr / sec for unfiltered gas and 40 mtr/ sec for filtered gas at peak condition. Sound pressure level shall be the maximum limit prescribed by environment dept.

7.2.3 Any equipment or section of the pipeline containing Natural Gas 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 vent line system. All TRVs shall have lock open type isolation valve upstream of relief valve. In addition lock open isolation valve downstream of relief valve shall be provided if vent is connected to flare header.

7.2.4 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 exceeded 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

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pressure 4 kg / Cm² above the MAOP or at a pressure equal to 10% of MAOP, whichever is less.

7.3 Vent Lines

7.3.1 Vent line shall be designed and installed to vent out the gas from relief valves to atmosphere in accordance with OISD-STD-106. Blow down piping connected to vent line shall extend to location where the discharge of gas shall not create a hazard to the compressor station or the surrounding area.

7.3.2 The discharge from safety valve shall be vented vertically upwards to atmosphere at an elevation of 3 meter (minimum) above working level or the tallest structure within a radius of 15 meter whichever is higher for effective dispersion of hydrocarbons. In this case, isolation valves on down stream of safety valve are not required. Isolation valve shall be provided downstream of safety valve if the safety valve discharge line is connected to flare header.

7.4 Fuel gas control

7.4.1 An automatic device designed to shut off the fuel gas when the gas engine/turbine stops shall be provided on each gas Engine/turbine operating with pressure gas injection. The engine distribution manifold shall be automatically vented simultaneously.

7.4.2 All fuel gas lines within a compressor station shall be provided with master shutoff valve located outside of the building. An automatic device designed to shut off the fuel gas when the engine stops shall be provided on each gas engine operating with pressure gas injection.

7.5 Station bye pass

Compressor station bye pass system shall be provided to facilitate flow of gas in the pipeline without entering the compressor station.

7.6 All gas compressor units shall be equipped with shutdown or alarm devices to operate in the event of inadequate cooling or lubrication of the units.

7.7 All compressor buildings or Compressors skids shall have fixed gas detectors to detect leakage of gas inside the unit and generate alarm and trip signals for the unit in case the gas concentration in air is more than 20% of lower explosive limit.

7.8 Heat detectors shall be installed in the Gas Turbine or compressors skids enclosure to initiate shut down of the unit, isolation of the compartment and release of clean agent fire suppressant inside the unit in the event of occurrence of fire.

7.9 Smoke detectors shall be installed in the control room of compressor station building, and cable trenches in electrical substation to initiate alarm in case of detection of smoke.

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7.10 Conventional break glass type fire alarm system shall be installed at all strategic locations of the stations.

7.11 Fire water network with fire hydrants, long range monitors and fire water storage shall be provided in line with clause 13.0 of this standard.

8.0 MATERIALS

8.1 General

Materials for use in the pipeline system shall comply with the design and service requirement and shall be suitable for the intended fabrication and/or construction methods.

8.2 Steel Pipe

Carbon steel line pipe for use in Natural Gas Pipeline System shall be Seamless, High Frequency Electric Resistance Welded (HFERW) or Longitudinal/Helical Submerged Arc Welded (LSAW/HSAW) conforming to Line Pipe Specification API 5L Product Specification Level 2 (PSL-2) or equivalent.

Pipes made of Cast iron are not permitted to be used for transportation of gas.

8.2.1 Carbon Equivalent (CE)

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

\[
CE \text{ (Pcm)} : \quad 0.20 \\
\text{CE (I IW)} : \quad 0.40
\]

Carbon Equivalent (CE) shall be calculated based on the formula given below:

For Carbon content less than or equal to 0.12%,

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

If heat analysis indicates that boron content is less than 0.01%, then product analysis need not include boron.

For Carbon content more than 0.12%,

\[
CE = C + \frac{\text{Mn}}{6} + \frac{(Cr + Mo + V)}{5} + \frac{Ni + Cu}{15}
\]

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8.2.2 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. The pressure shall be held for a minimum period of 15 seconds.

8.2.3 Fracture Toughness

Carbon steel line pipes shall meet the fracture toughness requirements stipulated in ASME B 31.8

8.3 Notch Toughness Requirements

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

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

8.4 Requirements for Sour Gas Service

8.4.1 Gaseous hydrocarbon shall be considered as sour in line with NACE Standard MR-01-75. At lower concentrations of H₂S, as the presence of other constituents in the gas e.g., CO₂ and salts in water etc., can also cause stress corrosion, hence the concentration of such constituents shall also be evaluated in gaseous hydrocarbon.

8.4.2 All materials, used in sour gas service, shall conform to the material requirements specified in NACE Standard MR-01-75. Depending upon service and materials involved, 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 & short term behavior of material under corrosive environments.

9.0 CORROSION CONTROL

9.1 General

9.1.1 All above ground and buried pipelines shall be adequately protected against external corrosion.

9.1.2 Above ground sections of pipelines shall be electrically isolated from the buried pipeline sections. This requirement, however, need not be applied to above ground pipeline section on suspension and / or bridge crossings.

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9.1.3 Above ground sections of pipeline shall be protected from atmospheric corrosion by suitable coating or paint.

9.1.4 Buried section of pipeline likely to be affected by external corrosion shall be protected by combination of anticorrosion coatings and cathodic protection.

9.1.5 For station piping, depending upon the requirement underground piping should be protected by anti-corrosion coating and / or cathodic protection system.

Buried station piping need not be electrically isolated from above ground piping.

Buried station piping, except at sectionalizing valve station, tap-off stations and intermediate pigging stations, should be electrically isolated from pipeline.

9.2 **External coating for buried pipeline**

9.2.1 **Functional Requirements**

Anti-corrosion coating shall be selected duly considering the varying ground conditions found during soil resistivity survey carried out along the pipeline route. Selected coating shall meet the following functional requirements:

a. Provide electrical isolation between the external surface of the pipeline and environment.
b. Exhibits sufficient adhesion to pipe surface to effectively resist under film migration of moisture.
c. Have sufficient ductility to prevent cracking during field bending
d. Have adequate mechanical properties to resist damage during handling, laying and operational stresses.
e. Suitable for the pipeline operating temperature range.
f. Compatibility with Cathodic Protection System.

9.2.2 **Coating Specification**

Specification for anti-corrosion coating shall specify, as a minimum, the following requirements:

a. Type of the coating system;
b. Minimum coating thickness (in case of multilayer coating, thickness of each layer should be specified)
c. Properties of base materials;
d. Properties of as applied coating;
e. Operating temperature range which the coating must withstand without deterioration of its physical and electrical properties;
f. Minimum surface preparation and coating application requirements;

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g. Adhesion requirements for materials, application and curing, including possible requirements for health, safety and environmental aspects
h. Inspection and Testing requirement;
i. Repair of damaged coating.

9.2.3 Field joint coating

The field joints shall be protected with a coating material that is compatible with line pipe coating material. The coating shall be such that it can be easily applied in field conditions. The coating shall be carried out with heat shrink wrap around sleeves or cold applied tape or epoxy or 100% solids polyurethane or any other suitable type of field coating compatible with mainline coating.

9.3 Cathodic Protection System:

9.3.1 In addition to anti-corrosion coating, buried pipelines shall also be provided with permanent cathodic protection system. CP system shall be designed in accordance with NACE-RP-0169.

9.3.2 In case, permanent cathodic protection system is not likely to be available within six (6) month from the start of pipeline laying, sacrificial anode based Temporary Cathodic Protection (TCP) system shall be provided till commissioning of permanent cathodic protection system.

9.3.3 When Impressed Current Cathodic Protection (ICCP) system is used, continuous power supply to the ICCP system shall be ensured by suitable back up power availability and maintained. All CPTRU stations shall be provided with current interrupter devices to facilitate ON / OFF PSP survey.

9.3.4 Test Lead Points (TLPs) shall be installed at the following locations: Distance between two consecutive TLPs shall not exceed 1.0 (one) KM in inhabited areas. In uninhabited areas, however, the distance may be increased to 1.5 (one and half) KM.

(a) Both sides of the cased crossing in case width of case crossing is more than 20 m.
(b) Both sides of the river / canal crossing in case the width is more than 50 m.
(c) Crossing of two or more pipelines.
(d) At isolating joints with facilities for measurement of details for both sides of the isolating joints.
(e) At sectionalizing valve station.
(f) Bridge crossing.
(g) At close vicinity of foreign pipeline anode ground bed
(h) At location where pipeline is connected to earth electrode, galvanic anode for CP and corrosion coupons.

9.3.5. Test leads should be attached to the pipe by Thermit welding or other low heat methods such as pin brazing etc., Brazing / electric welding of test leads on to pipeline is not

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permitted. However, for charged pipeline, only pin brazing shall be used for cable to pipe connection. During TLP installation on pressurized pipelines or mains, precautions shall be taken to avoid possible failure of the pipeline or mains due to loss of material strength at the elevated welding temperature.

9.3.6 Test Lead attachments to the pipeline shall be completed before taking up hydro testing of the pipeline section. It is recommended that TLP wire connection to the pipe shall be completed as soon the pipe is lowered in trench and corresponding pipe no shall be noted. Since pipeline chainage are determined after pipe book compilation, this pipe no noted for the TLP would facilitate to assigned correct pipeline chainage marking of the TLPs subsequently. In fact these TLP chainages can be utilized as proper reference to correctly marked and locate all the Km post on the pipeline ROU / ROW.

9.4 Electric Interference Mitigation

9.4.1 Pipelines installed parallel to / near cathodically protected exiting foreign pipeline, AC transmission line or DC traction shall be protected against induced stray current. Protective measures such as metallic bonding, increased protection current, supplementary coating, electrical isolation, galvanic anodes, or any other suitable method may be adopted for such interference mitigation.

9.4.2 Safety devices in line with NACE-RP-0177 shall be installed to prevent damage to the pipeline cathodic protection system due to lightning or fault currents when the pipeline is installed near electric transmission tower footings, ground cables etc.

9.4.3 While laying pipeline near HT power lines, care should be exercised during construction to minimize possible effects of alternating current potentials.

9.4.4 The anode beds should be located such that there is minimum interference with the existing underground metallic structures.

10.0 CONSTRUCTION

10.1.1 Construction plan should be prepared before commencement of construction to assist in control of the work. The plan shall cover description of the construction methodology; the health, safety and environment plan; inspection and quality requirements, personnel and equipment required, and installation / testing procedures.

10.1.2 Existing facilities, such as roads, railways, rivers, canals, footpaths, pipelines, cables and buildings likely to be affected by the construction of the pipeline shall be identified and safety measures necessary to protect the existing facilities during construction should be implemented.

10.1.3 Appropriate guidelines / measures provided in OISD-GDN-192 and OISD-STD-147 related to safety during construction should be implemented.

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10.2 **Pipeline Cover**

10.2.1 Gas pipelines shall be buried with a minimum cover as specified in Table 5 unless above ground construction is desirable due to technical, economic or topographical reasons.

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

10.2.3 No dwellings shall be permitted within ROU.

**Table 5**

**Minimum Cover Requirements for Pipelines**

<table>
<thead>
<tr>
<th>SL No.</th>
<th>Locations</th>
<th>Minimum Cover In Mtr</th>
</tr>
</thead>
<tbody>
<tr>
<td>i)</td>
<td>Areas of agricultural, horticultural activity, limited or no human activity, Industrial, commercial and residential area</td>
<td>1.0</td>
</tr>
<tr>
<td>ii)</td>
<td>Rocky terrain</td>
<td>1.0</td>
</tr>
<tr>
<td>iii)</td>
<td>Drainage, ditches at roads/railway crossing</td>
<td>1.0</td>
</tr>
<tr>
<td>iv)</td>
<td>Minor river crossings/canal /drain/nala/ditches</td>
<td>1.5</td>
</tr>
<tr>
<td>v)</td>
<td>Major river crossings (below scour level)</td>
<td>2.5</td>
</tr>
<tr>
<td>vi)</td>
<td>River with rocky bed (below scour level)</td>
<td>1.5</td>
</tr>
<tr>
<td>vii)</td>
<td>Area under influence of tides</td>
<td>1.5</td>
</tr>
<tr>
<td>viii)</td>
<td>Cased/Uncased road crossing</td>
<td>1.2</td>
</tr>
<tr>
<td>ix)</td>
<td>Cased railway crossing</td>
<td>1.7</td>
</tr>
</tbody>
</table>

**NOTES:**

(i) The depth of cover shall be measured from the top of the pipe coating to the top of the undisturbed surface of soil 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;

(ii) The cover shall be measured from the top of road or top of rail, as the case may be;

(iii) For river/watercourses that are prone to scour and erosion, adequate safe cover shall be provided below the predicted scour profile expected during the life time of the pipeline;

(iv) When scour level is not known, an additional cover of at least 1 m shall be provided from the existing bed of the river/water course except in case of rocky river bed;

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(v) The minimum cover requirements shall be applicable for all Location Classes;
(vi) Whenever the above provisions of cover cannot be provided due to site constraints, additional protection in form of casings, bridging, etc. shall be provided.
(vii) Soft soil/sand padding of minimum 150 mm thickness to be provided around the pipe where gravel or hard soil is encountered. In case of rocky areas rock-shield along with 150 mm of soft soil / sand padding around the pipe should be provided.
(viii) For river / watercourses that are prone to scour and / or erosion, the specified cover shall be measured from the expected lowest bed profile after scouring / erosion.

In case the pipeline is to be laid through populated area (which otherwise could not be avoided), additional protective measures to be provided be by way of providing higher wall thickness pipe or laying at a greater depth or by providing casing pipe.

10.3 Excavation

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

10.3.2 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.

10.4 Location

10.4.1 The location of a new buried pipeline, when running parallel to an existing underground pipeline, should be at a minimum clear distance of 5.0 metres from the existing buried 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 metres. These areas shall be distinctly identified on ground during construction. Bilingual (local language and Hindi / English) caution signs should be installed while working in such areas.

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

10.4.3 No pipeline should be located within 15.0 metres of any private dwelling 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 para 10.2.
10.5 Cold field bends

10.5.1 The radius of cold field bends shall be as specified in clause 6.3. Pipes with measured wall thickness greater than the nominal wall thickness (with positive tolerance) shall normally be used for making cold field bends.

10.5.2 The ends of each bend length shall be straight and not involved anyway in the bending. In no event shall the end of the bend closer than 0.5 m or equal to pipe diameter, whichever is small from the end of a pipe or be within one meter of a girth weld. The ovality in each pipe after bending shall be less than 2.5 percent of the nominal diameter, at any point.

10.5.3 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.

10.5.4 Pipes with longitudinal welds shall be bend in such a way that weld lies in the plane passing through neutral axis of the bend. As far as possible, the bend should be installed such that longitudinal weld lies in the upper quadrants between 10°O clock and 2 °O clock position.

10.5.5 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.

10.6 CROSSINGS

10.6.1 As far as practical, crossings should be made at right angles. Turning Points (TPs) provided near crossings shall be located at least 50 m from the boundary of the crossings, on stable and firm ground except for the stretches which runs parallel to road.

Minimum cover shall be as per Para 10.2.

Use of casings for crossings shall be avoided unless required by the authorities having jurisdiction over the facility being crossed.

When road / highway / rail crossing is 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. Casing end seals shall be installed to prevent ingress of water and / or foreign material into casing. Vent and drains shall be provided on near ends of the casing pipe. If required, the carrier pipes outside the casing pipe shall be independently supported.

Carrier pipe / casing pipe may be installed by open cut, boring, jacking or other suitable trenchless techniques.

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10.6.2 Road/ Highway Crossings

The angle of crossings for national and state highways shall be as close to 90 degrees as possible, but in no case less than 80 degrees to the centre line of the road/highway. The angles of crossing for other roads (like seasonal roads, unpaved village roads, cart-tracks, etc.) should be as close to 90° as possible. Installation of carrier pipe at road / highway crossings without casing shall be checked for allowable stresses in accordance with API RP-1102.

10.6.3 Railway Crossings

The angles for all railway crossings shall be as close to 90 degrees as possible, but in no case less than 85 degrees to the centreline of the railway line. Casing pipe shall be as installed as per requirements of the railway authorities.

10.6.4 Water Crossings

10.6.4.1 Crossings should be located in a comparatively straight reach of the water body, where the banks are stable, minimum evidence of erosion of bed, sufficient area for construction is available. Angle of crossing should be as close to 90° as possible. For major canals / rivers courses, the angle of crossing should be as close to 90 degrees as possible.

Special considerations shall be required for submerged crossings which are characterized by their perennial nature, meandering course, steep and potentially erodible banks, potentially scouring bed, large erodible flood plain and wide water course (high water mark to high water mark) both during the design and installation of such crossings. For river crossings the following additional requirements shall be considered:

a. To ensure the stability of the underwater pipeline, it may be necessary to add weight to sink and hold the pipeline in position.

b. A detailed stress analysis for the pipe section for river crossings should be carried out, taking into consideration the effect of all loads during laying and it shall be ensured that the stresses remain within permissible limits in accordance with ASME B 31.8.

10.6.4.2 River crossings installed by open-cut bottom pull method may necessitate additional weight coating to hold the pipeline in place during installation and operation.

10.6.4.3 Pipeline profile of crossings installed by other techniques such as Horizontal Directional Drilling (HDD) or Micro Tunnelling should be selected carefully to ensure stability of hole and ease of pulling / pushing of pipe during installation.

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10.6.4.4 Stress analysis should be carried out taking into consideration the effect of all loads during installation to ensure pipe stresses during installation, testing and operation are well within permissible limits set by ASME B 31.8. Higher thickness, if required to limit the stresses shall be used.

10.6.5 Crossing of Utilities

10.6.5.1 When a buried pipeline has to cross any existing underground pipeline, cable, drain or other services, the pipeline shall be laid at least 500 mm below such existing utility / services in a manner that will not obstruct access to such services for inspection, repair, or maintenance. Where it is not practicable to obtain the above mentioned clearance, special design and construction shall be used. A minimum 6mm thick and 5 meter width, Non Toxic Rodent Resistant PVC sheet will be continually installed between cable and pipe as a measure of preventing fault current accessing pipeline. A warning sign board (above) ground shall be installed on the ROU / ROW to indicate HT cable crossing.

10.6.5.2 When laid parallel to, along or near existing underground HT power cable underground pipes should maintain a horizontal clearance of 5 m. Wherever this distance cannot be met, a minimum 6 mm thick and 5 meter width, Non Toxic Rodent Resistant PVC sheet be continually installed between cable and pipe as a measure of preventing fault current accessing pipeline. In any case this horizontal distance shall not be less than 3m.

10.6.5.3 In case of existing communication cables, conductors or conduit, underground pipes shall maintain a vertical clearance of at least 500 mm and horizontal clearance of 500 mm. Where these clearances cannot be maintained, extra precaution shall be taken to ensure the maximum possible clearance and to prevent future contact.

10.6.5.4 A minimum separation of 3.0 metre should be maintained between pipeline and transmission tower footings.

10.6.5.5 Interference with, or from, other systems through the application of cathodic protection shall be dealt by mutual action of the parties involved.

10.7 Welding and Inspection

10.7.1 Welding

(a) All welding shall be in accordance with ASME B 31.8.
(b) Welding procedures and welders shall be qualified as per API 1104, however, welding procedures and welders, for station piping may be qualified as per section IX of the ASME Boiler and Pressure Vessel Code. Welder re-qualification shall be required if the welder has not performed any welding for the welding process qualified for the past 6 months
(c) The open ends of welded sections of pipeline shall be closed by use of suitable night caps
to prevent the ingress of foreign bodies and water.

(d) The weld joints shall be numbered and marked along with the welder identification, adjacent to the weld joint on the progressive direction of main line.

(e) Notches or laminations on pipe ends are not permitted and must be removed by cutting the pipe as a cylinder and rebeveling of pipe end prior to welding.

10.7.2 Welding Inspection

(a) No cut piece of mainline pipe of length less than two (2) meter shall be used in the pipeline. It shall be ensured that there shall not be more than three (3) circumferential welds in eight meters in buried pipeline for pipe size NB 6 and above. Cut pipes shall have details of pipe reference numbers painted to the inside of each pipe end.

(b) All NDT (non-destructive testing) including radiographic examination shall be performed in accordance with the requirements of API 1104.

(c) 100% of welds in gas pipeline and gas piping in compressor station and other pipeline stations shall be non-destructively tested over their entire circumference by radiographic examination or ultrasonic testing. In addition each weld shall be visually examined for quality of weld.

(d) Weld repair areas shall be subjected to additional radiography or ultrasonic testing after repair. Repair welders shall be qualified in line with para 10.7.1(b).

10.8 Dents

10.8.1 All dents that affect the curvature of the pipeline at the longitudinal weld or circumferential weld shall be removed. The depth of dent shall be measured as the gap between the lowest point of the dent and the original contour of the pipe. The maximum permissible depth of dents in pipes up to and including 12.75” inch (324 mm) nominal outside diameter shall be 5 mm. For pipes over 12.75” inch (324 mm) nominal outside diameter, the permissible depth of dent shall be 2 percent of the nominal pipe diameter. Length of the dent in any direction shall not be more than one-fourth of nominal diameter of the pipe. Dents beyond permissible limits shall be removed by cutting out the damaged portion of the pipe as cylinder and replacing with a pre tested pipe.

10.8.2 All dents as mentioned in para 10.8.1 and a dent containing a stress concentrator, such as a scratch, gouge, groove, or arc burn, shall be removed by cutting out the damaged portion of the pipeline as a cylinder and replacing with a pre tested pipe section. Buckled pipe shall also be replaced as a cylinder.

10.9 LOWERING

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

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10.9.2 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.

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

10.9.4 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.

10.10 BACKFILLING

10.10.1 Backfilling shall be carried out immediately after the pipeline has been laid in the trench. Excavated soil from the trench shall be used for backfilling unless the same is not suitable. The backfill material shall contain no extraneous material and/or hard lumps of soil, which could damage the pipe and/or coating or leave voids in the backfilled trench. Where applicable, top soil excavated from the trench and stored separately, shall be restored.

10.10.2 Slope breaker and other measures shall be installed in trenches dug in steep areas (slope of generally 10 percent and more) for the purpose of preventing erosion of the back fill. When backfilling the trenches in sloping terrains or steep areas, wherein the chances of wash out of backfill exist, sheet piling or drainage ditches to allow water run-off across the trench should be provided.

10.10.3 Restoration of ROW / ROU shall be carried out to the satisfaction of land owners and necessary restoration certificates shall be obtained from individual land owners / cultivators. Subsequently, ROW / ROU shall be closed and returned to land owners through notification / announcements.

10.11 Markers

10.11.1 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/SH), major district roads (MDR), all metalled roads, railway crossings and water body crossings. At other crossings where third party activity is expected and at entrance to stations one marker shall be provided.

10.11.2 Markers at crossings shall display caution, words “Gas Pipeline” name of the operating company, emergency telephone contact nos. etc. in regional / Hindi and English languages.
11.0 TESTING AND COMMISSIONING

11.1 Hydrotesting of Pipeline

11.1.1 All Pipelines shall be pressure tested in-place after construction except for pre-tested pipes used in tie-in spools.

11.1.2 All electrical connection and monitoring points on the pipelines shall be completed before pressure testing. No welding (other than tie-in welds) and / or mechanical handling of pipe is permitted after pressure testing. Pipe used for making repairs after a leak shall be pre-tested to the same test pressure as the originally installed pipe.

11.1.3 Carrier pipe in cased crossings (rail/road) and river 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 at 1.25 (for Class 1 & Class 2) OR 1.4 times (for Class 3 & Class 4), the design pressure.

11.1.4 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 minimum 10 mm thick Aluminium plate and shall have incisions at every 45 degrees.

11.1.5 Water should be used as test medium. Test water shall be dosed with required quantity of corrosion inhibitors and oxygen scavenger depending upon quality of the water.

11.1.6 API-1110 may be used as guidance for the pressure testing of the pipeline.

11.2 Test Pressure and Test Duration- Mainline

11.2.1 Pipeline

(a) The minimum test pressure at any point along the pipeline shall be as given in Table 6.

(b) The maximum test pressure normally shall not exceed the mill test pressure or pressure required to produce a hoop stress equal to 95 percent of SMYS of the pipe material based on minimum wall thickness in the test section, whichever is more.

(c) The test pressure shall be maintained for a minimum period of twenty four (24) hours.

(d) 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 bars. Pipelines not meeting the requirements shall be repaired and retested in accordance with the requirements of this standard.

(e) Mainline valves should be installed after successful pressure testing of the pipeline.

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Table 6: Minimum Test Pressure

<table>
<thead>
<tr>
<th>Location Class</th>
<th>Pressure Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.25 x Design Pressure</td>
</tr>
<tr>
<td>2</td>
<td>1.25 x Design Pressure</td>
</tr>
<tr>
<td>3</td>
<td>1.40 x Design Pressure</td>
</tr>
<tr>
<td>4</td>
<td>1.40 x Design Pressure</td>
</tr>
</tbody>
</table>

11.2.2 Station Piping

Pressure testing of station piping shall be carried out separately from pipeline. Station piping shall be tested at minimum test pressure of 1.4 times the design pressure. The test pressure shall be maintained for a minimum period of four (4) hours.

11.2.3 Low Pressure Leak Check

All flanged joints in above ground pipeline / piping, equipment, instrument impulse tubing, etc. shall be tested by pressurizing the piping system / equipment with dry compressed air or gas at a pressure of 7.0 kg/cm²g and checked by means of soap solution / suitable digital gauge for leaks.

11.3 Geometric Survey

Survey to establish pipeline geometry using Electronic Geometric Pigs (EGP) shall be conducted after completion and acceptance of following pipeline activities:
(i) Gauging
(ii) Pressure Testing
(iii) Cleaning and swabbing
(iv) Installation of Mainline / Sectionalizing Valve stations
(v) All tie-ins
(vi) Installation of launching and receiving pig traps.

11.4 Preservation of Pipeline

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

Pipeline shall be preserved using inhibited dosed with adequate quantity of corrosion inhibitors or by filling the line with non-flammable non-toxic gas and at a positive
pressure.

11.5 Documentation

Following records shall be made and maintained:
(i) A complete pipe book including
(ii) Pressure test records including location of leaks or failures, if any, and description of repair under taken.
(iii) As-built drawings including pipeline route maps, alignment sheets, crossings drawings, Piping and Instrumentation Diagrams, station layouts, piping isometric, earthing grid, single line diagrams, instrument and cable layouts, loop diagrams, etc.
(iv) Equipment manuals supplied by manufacturers.
(v) Complete asset of each location with identification.
(vi) NDT records of welds
(vii) Geometric survey reports and repairs, if any, carried out.

11.6 Commissioning

11.6.1 A proper commissioning procedure shall be prepared for removal of air from the system and to prevent intermixing of air and the hydrocarbons.

11.6.2 Before starting commissioning activities, following shall be ensured:

a) Pressure testing is completed for entire pipeline and associated station piping.
b) Swabbing of the pipeline has been completed for removal of water from the pipeline.
c) Low pressure leak check (with air) of the above ground piping / flanged joints completed.
d) Pipeline has been cleaned and ferrous material / debris etc. removed.
e) All mainline / sectionalizing valves are installed as per requirement.
f) All golden joints are inspected and accepted.
g) Geometric survey of pipeline, section is carried out, when specified.
h) Coating survey has been carried out either by Pearson, Direct current voltage Gradient (DCVG), Close Interval Potential Logging Survey (CIPS) or Current Attenuation Test (CAT).
i) Temporary modifications required at the stations for commissioning have been completed in all respect.
j) Commissioning check list prepared and ensured availability of all materials tools, tackles and consumable.
k) Firefighting facilities are ready.
l) All caution boards displayed
m) Trained and experience personnel are available / deployed to carry out commissioning.
n) Pre-commissioning safety audit by PNGRB nominated agency completed and compliance submitted.
11.7 Gas Charging

11.7.1 A detailed procedure for gas charging into pipeline / piping shall be developed keeping in view the methodology used for pipeline / piping dewatering and / or drying.

11.7.2 If required inertization of the station piping and pipeline should be carried out by use of nitrogen. Care should be taken to ensure explosive mixture of gas and air in the pipeline / piping does not form. Residual oxygen content in the pipeline / piping immediately preceding gas should be less than 1 percent (vol/vol).

11.7.3 Nitrogen plug shall proceed before charging of natural gas.

11.7.4 Natural gas shall not be directly used for displacement of air in pipeline / vessels.

11.7.5 Venting shall be controlled at the pig-receiving end so that proper backpressure is maintained to control pig train speed of 3 to 4 km /hr. The desired portion of the pipeline shall be commissioned in this manner. The pipeline system shall subsequently be slowly pressurized up to its operating conditions.

12.0 OPERATION AND MAINTENANCE

A detailed operation and maintenance procedure for control system and safety interlocks shall be developed.

12.1 Operating Procedures

A comprehensive operating manual shall be developed which shall include as a minimum following:

a. System Description
b. Operational set points
c. Initial start up
d. Temporary operations
e. Normal operations
f. Normal shut down procedure
g. Condition under which emergency shutdown is required.
h. Emergency Shut Down (ESD) procedures including conditions causing ESD.

12.2 Display of Operating Instructions

The gist of operating instructions, emergency shutdown (ESD) procedure, ESD Trip set pressures shall be displayed in the control room and near all important operating equipment.

12.3 Maintenance Procedure

(a) A detailed maintenance procedure shall be developed for 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.

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

(c) For repair / maintenance works, work permit system in line with OISD-STD-105 shall be developed and complied.

12.3.1 Maintenance of ROU / ROW and inspection of crossings

ROU / ROW and access to various stations including valve location shall be maintained to ensure reasonable access to maintenance crews. Road and railway crossings shall be inspected at least once in three (3) months.

Water body crossings shall be inspected at least twice a year i.e. prior to and after monsoon or flash flood for exposure, accumulation of debris, or for any other condition that may affect the safety and security of the crossings.

12.3.2 Pipeline Patrolling

(a) Patrolling of ROU/ROW shall be carried out once in 30 days for location class 3 and 4 and once in 90 days (once in a quarter) for location class 1 and 2 to observe surface conditions, leakage, construction activity, encroachments, soil washouts and any other factors affecting the safety and operation of the pipeline.

(b) Line Walk by the official of the company at least once in a year shall be carried out after the monsoon. The latest techniques like satellite imaginary, helicopter etc. can be used for patrolling.

(c) The operating company shall analyse the existing pipeline for new anticipated external loads, when the pipeline is to be crossed by a new road or railroad. The operating company shall install mechanical reinforcement, structural protection, or suitable pipe, in case the design parameters considered are exceeding in order to ensure redistribution of the external loads acting on the pipeline.

(d) Villages / public along the right of away shall be adequately made aware of the possible consequence of gas leaks and this shall be included as a part of regular audit.

12.3.3 Pipeline Pigging

Pigging operation shall be carried out for all piggable pipelines at least once in a year for two phase / multiphase flow or more frequently if there is significant liquid hold-up in the pipeline affecting its throughput. For dry gas, pigging shall be carried out once in 5 years span. Records of quantity and quality of deposits (pig residue) collected after pigging shall be chemically examined. Depending upon the outcome of the chemical analysis and review, pigging frequency shall be increased.

12.3.4 Intelligent Pigging

Intelligent pigging survey (IPS) shall be carried out once in 10 years and this data shall

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be compared with the data collected during electronic geometric pigging / calliper pigging before commissioning to assess the health of the pipeline. In case IPS is carried out once in 5 years then pigging operation as stated in clause 12.3.3 for dry gas may not be required. Pipelines transporting sour gas shall be inspected using intelligent pigging once every 5 years.

12.3.5 Inspection of Cathodic Protection System

A. 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.

The Criteria of protection shall be as under

(a) Pipe to soil potential of at least (-) 0.85 volts with respect to copper/copper sulphate half-cell. In areas where anaerobic bacteria are active, minimum PSP shall be more negative than - 0.95 volts instead of - 0.85 volts.

(b) 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.

(c) Over protection of coated pipelines shall be avoided by ensuring that polarisation potential is not more negative than (-) 1.2 volts with respect to copper/copper sulphate half cells.

iii. Instant pipe to soil “OFF” potential readings at test lead points of entire pipeline shall be taken once in a year. For the purpose of logging the instant OFF PSP, care shall be taken to minimize the effect of polarization decay. by logging the reading within the first 1 or 2 seconds of simultaneous switching of all Cathodic protection station affecting that section of the pipeline. The PSP survey results shall be plotted graphically to identify and locate cathodic holidays.

iv. Current consumption data should be taken at the test stations where current measurement facility exists.

B. Cathodic protection rectifiers shall be inspected once in two months.

C. All protective devices shall be inspected once in two months.

D. Interference bonds shall be inspected once a year.

12.3.6 Coating Survey

Pearson Survey / Direct Current Voltage gradient (DCVG) / Continuous Potential

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Logging (CPL) survey / Current Attenuation Test (CAT) shall be carried out once in 5 years. Insulating joints and couplings shall be inspected once in a year.

12.3. 7 Internal Corrosion Monitoring

Unless gas composition requires special corrosion monitoring facilities (i.e. corrosion coupons and probes based on electric resistance technique (ER probes), electrochemical noise technique (ECN probes) or Linear polarisation technique (LPR probes), etc., the internal corrosion shall be monitored based on:

a) Chemical analysis of residue obtained during pigging operation
b) Intelligent pigging results
c) UT measurement at critical locations

12.3.8 Inspection of Pipes, Valves and fittings

Inspection of pipes, valves and fittings shall be carried out as per OISD-STD-130.

12.3.9 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 and following OISD standards

12.4 Documentation for Operation and Maintenance

The following records shall be maintained for operation and maintenance purposes:

(i) All records as per para 11.5 of this document.
(ii) Necessary operation data
(iii) Pipeline patrolling records
(iv) Records and maps showing the location of CP facilities and piping.
(v) CP monitoring report, test and survey reports.
(vi) Leak burst & repair records
(vii) Records pertaining to inspections, such as external or internal line conditions
(viii) Pipeline repair records
(ix) History cards of equipment
(x) Near miss, minor and major incidents.
(xi) Leak burst and repair records
(xii) Pipeline pigging records

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13.0 SAFETY AND FIRE PROTECTION SYSTEM

13.1 General

All installation except sectionalizing valves without remote operation capabilities shall have gas detection and fire alarm system described herein.

13.1.1 Gas Detection System
(a) A gas detection system equipped with sound and visual alarm shall be installed to indicate that one-fifth of lower flammable limit is reached.
(b) The gas detectors shall be located close to the potential source of leakage.
(c) Smoke detectors shall be provided in control room, motor control center and utility room with provision of indication, alarm & annunciation.

13.1.2 Fire Alarm System
(a) Manual call points shall be installed at strategic operating locations.
(b) Electric operated fire sirens with audible range of 1 km shall be installed. Provision shall be made for continuous availability of power to this system during emergency shutdown.
(c) Manual operated fire sirens shall be provided at strategic places.

13.2 Fire Fighting Equipment

Firefighting equipment shall be installed as described below.

13.2.1 Fire Extinguishers
a. Compressor area: One (1) number 10 kg Dry Chemical Powder (DCP) based and one (1) number 6.8 kg CO₂ based per two compressors and one (1) number mobile 75 kg DCP based.

b. Pigging Area, Metering Area and Gas Filtration Area: One (1) number 10kg DCP based at each location.

c. Air compressors: One (1) number 2 kg CO₂ and one number 5 kg DCP based.

d. Office/ Canteen/ Stores: Two (2) number 10kg DCP based in each building.

e. MCC/DG Room/HT room: Two (2) number 4.5 kg CO₂ based in each room or per 100 m² floor area. 4 sand buckets with stand shall be provided near to DG room.

f. Repeater / CP stations: One (1) number 10 kg DCP based and one (1) number 2 kg CO₂ based.

100% spares for CO₂ cartridges and 50% spares for DCP cartridges shall be stored.
All fire extinguishers shall bear ISI or equivalent mark.

13.2.2 A trolley containing first aid fire protective accessories shall also be provided as indicated below:

a) At compressor station and at those delivery and terminal stations (delivering 4 MMSCMD & above gas to the consumer):

A trolley containing one number each of Fire Proximity Suit, BA Set, Water Jet Blanket, Resuscitator, First Aid Box, Safety Torch, spare fire hoses, special purpose nozzles, Foam branch pipes, Portable Oxygen & LEL Meter, Mega Phone shall readily be available at the location and positioned to have easy access to it during emergency situation.

b) At intermediate Pigging Station, Sectionalizing Valve Station, Delivery Stations etc., not covered under a) above:

A trolley/container having following shall be provided with the following:

- Helmet – 2 Nos. minimum
- First Aid Box – 1 No. minimum
- Rubber Hand Gloves for electrical purpose – one pair minimum
- Ear muff – 2 Nos. minimum
- Ear plug – 10 Nos. minimum
- PCV Suit – 1 No. minimum
- Cotton Hand gloves – 15 pairs minimum
- Safety torch – 1 No. minimum

c) Installations having provision of fire tender equipped with above mentioned equipments are excluded from providing such trolley at site.

13.3 Fire Water System

Facilities should be designed on the basis that city fire water supply is not available close to the installation. The Fire water system shall be provided at all compressor stations and terminal stations (delivering 4 MMSCMD and above gas to consumer) consisting of:

a. Fire water storage
b. Fire water Pumps (Main and Jockey)
c. Fire water distribution piping network
d. Fire hydrant / Monitors
e. Water sprinkler / deluge system

Medium velocity water sprinkler need to be provided at Compressors station, scrapper area and metering area, condensate collection area.

Fire water system shall be designed to fight two major fires simultaneously anywhere in the installation.

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13.3.1 Design Flow Rate

The fire water pumping requirement for medium velocity spray shall be calculated based on the spray rate given below or flow through two (2) nos. of fire water monitors (i.e. 288 m³/hr) whichever is higher. Entire compressor area, Pig launching and receiving area, filter area, metering area and condensate collection area shall be covered with medium velocity water spray system. Spray rate for various areas shall be

a. Compressor area: 20.4 lpm/ m² considering area based on outer foundation volume measurements (length x breadth)
b. Scraper area / Metering area / filter area: 10.2 lpm/ m² of area.
c. Other area: 3 lpm/m² of area

13.3.2 Fire Water System Design

(a) The Fire water pressure system shall be designed for a minimum residual pressure of 7.0 kg/cm²(g).
(b) A fire water ring main shall be provided all around perimeter of the compressor and delivery stations facilities with hydrants / monitors.
(c) There shall be minimum two (2) numbers of monitors located in such a way that it covers the compressors area, scraper area and filter 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 mtr.

13.3.3 Fire Water Storage

(i) 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.

(ii) Storage tank/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.

13.3.4 Fire Water Pumps

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

(ii) Motor driven Jockey pump (not more than 10 M³ / Hr of water flow) shall be installed to maintain the fire network pressure at 7.0 Kg/Cm² at farthest end of the network.

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(iii) The fire water pumps including the stand by pumps shall preferably be diesel driven. Where electric supply is reliable 50% of the pumps may be motor driven.

(iv) A minimum of 50% stand by pump(s) (minimum one no) of the same type, capacity and head as the main pumps shall be provided.

(v) The fire water pumps shall be provided with automatic starting facilities.

13.3.5 Fire Hydrant Network

(i) 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 / mortar lined internally or thermoplastic material.

(ii) Fire water steel pipe ring main shall be laid above ground at a height of 300 mm to 400 mm above finished ground level. Pipes made of composite material shall be laid underground.

(iii) The mains shall be supported at regular intervals not exceeding 6 mtrs. For pipeline size less than 150 mm diameter, support interval shall not be more than 3 m.

(iv) The steel pipe ring main shall be laid underground at the following places:
   (a) Road crossings
   (b) Where above ground piping is likely to cause obstruction to operation, vehicle movement and likely to get mechanical damage.

(v) Under ground fire water mains shall have at least 1 mtr earth cushion in open ground and 1.5 mtrs under roads with concrete / steel encashment.

(vi) The underground fire water steel pipe network shall be provided with suitable coating / wrapping or concrete / masonry.

(vii) Double headed hydrants with two separate landing valves on 3” / 4” standpost shall be used. All hydrant outlets shall be 1.2 mtr above ground level.

(viii) Fire water monitors shall be provided with independent isolation valves.

(ix) Hose Box with 2 Nos. of hoses and a nozzle shall be provided at each hydrant points.

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

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(xi) Fire Hydrants/ monitors shall be located at a minimum distance of 15 mtrs from the hazardous facility / equipment. Case of buildings this distance shall not be less than 2 mtr and not more than 15 mtr from the face of building. Provisions of hydrants within the building shall be provided in accordance with IS: 3844.

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

13.3.6 Medium Velocity Sprinkler System

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 mtr from the surface of the equipment / facility. Only one type of spray nozzles shall be provided in a particular facility. All spray nozzles shall be inspected for proper positioning, corrosion and cleaned if necessary at an interval of not more than 12 months or earlier based on the experience.

13.3.7 MATERIAL SPECIFICATIONS

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

a) Pipes - Carbon Steel (CS) IS: 3589 / IS: 1239 / IS: 1978 or Composite materials as per API 15 LR / API 15 HR or its equivalent shall be used.
   In case saline / brackish water / 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.

Cast iron pipes shall not be used for fire water services.

b) Isolation valve, Deluge Valve, - Gate / butterfly type isolation valve with open / close indication made of cast steel. Other material such as cupro-nickel for saline / brackish water may be used.

c) Hydrant Stand post, Monitors – Carbon Steel / Gunmetal

d) Outlet valves/ landing valves- Gunmetal / Aluminium/ Stainless steel / Aluminium-Zink alloy

e) Fire Hose- Reinforced rubber lined hoses (63 mm), 15 mtr std length conforming to IS: 636 (type A) / Non percolating synthetic hose (Type B) / UL or equivalent standard.

f) The above ground fire water main, hydrant post shall be painted with corrosion resistant “ fire Red” paint as per IS: 5

g) Water monitors, hydrant point and hose box shall be painted “ Luminous Yellow” as per IS: 5
13.3.8 HOSES, NOZZLES, ACCESSORIES AND SPARES.

(i) Fire hoses – 2 nos. / per hose box / per hydrant – point- minimum 10 nos.
(ii) 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 and spray Nozzle.
(iii) Minimum 2 Nos. or 25% spare hoses shall be stored.

13.4 First Aid and Safety Equipment

The following accessories / first aid items shall be provided at each station.

a. Safety helmets- 1 no. /person (min 10 nos.).
b. Stretcher with blanket- 2 Nos.
c. First aid box- 1 nos.
d. Rubber hand gloves for electrical purpose- 2 nos.
e. Low temperature rubber hand gloves - 4 pairs.
f. Fire proximity suit- 1 no.
g. Resuscitator - 1 No.
h. Red / green flags – 2 nos. in each colour
i. Self-contained breathing apparatus with one spare cylinder (cap 30 min) – 1 set with spare cylinder.
j. Water jel blanket- 1 nos.
k. Portable Gas detectors – 2
l. Explosive meter – 1 No.

13.5 Inspection of firefighting equipment and system shall be carried out inline with OISD – STD-142.

13.6 Windsock

Windsock shall be provided on an appropriately elevated structure like the control room / fire-water pump house in such a manner so as to avoid blind areas.

13.7 Emergency Power supply

Emergency lighting shall be provided for operating areas and control room.

13.8 Communication System

(i) Communication system like telephone / PA or paging, walkie-talkie, optical fibre cable based communication system shall be provided.
(ii) All intermediate stations including IP stations / Repeater station shall be provided with proven communication system. Security at unmanned station shall be trained to deal with communication and emergency handling.

13.9 Emergency Plan

A mutual aid scheme for the firefighting and emergency rescue operation shall be made involving local industries and local govt. agencies. Mock drill involving all mutual

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partners shall be conducted at least once a year. The emergency plan shall be prepared based on the following:

a) Risk Analysis, HAZOP Study and Risk scenarios  
b) Flow balance  
c) Organisation structure  
d) Emergency Trainings  
e) Responsibility

14.0 PIPELINE INTEGRITY MANAGEMENT (PIM)

14.1 A comprehensive manual containing program and practices shall be developed for existing pipeline / after construction of the new pipeline to manage pipeline integrity taking into consideration consequence classification / category of pipeline, and risk involved in each segment of the pipeline.

14.2 The integrity management program framework should take into consideration continual / periodic assessment and an evaluation process to know the current health of the pipeline & to prevent any failure in future.

14.3 To maintain safe operating conditions in case of an adverse condition detected, pipeline should be shut down until the required repairs are completed and clearance for operation is given.

14.4 The methods selected to assess the integrity of the pipeline initially shall be one and / or combination of the followings:

(a) Internal inspection tool or tools capable of detecting corrosion and deformation anomalies including dents, gouges, grooves e.g. Geometric Survey.  
(b) Pressure testing in accordance with clause 11.2 of this standard.

14.5 The integrity assessment during the lifetime shall consist of an initial (base line) & continual assessment.

14.6 The factors to be considered for risk are:
(a) Results of previous integrity assessment,  
(b) Coating type and condition  
(c) leak history  
(d) Repair history  
(e) Cathodic protection history

14.7 System should be available for detecting leaks of pipeline system. The capability of the leak detection system shall be evaluated and modified if necessary.
15.0 ABANDONMENT OF PIPELINE:

15.1 A pipeline system that is no longer required for transportation of gas shall be taken out of service with all hazardous fluids removed from the system. In case a operating company decides to abandon full or part of the pipeline system permanently or temporarily after obtaining necessary approval from the statutory authority (if required), it shall prepare a detailed plan considering the following:

(a) Large scale venting of natural gas should be avoided. It should be ensured that most of the natural gas contained in the system is utilized by consumer.
(b) Pipeline section and facilities shall be disconnected from all source of supply of gas prior to abandonment.
(c) Pipeline system and facilities to be abandoned shall be purged with nitrogen gas or inert materials and ends hall be sealed. If the facilities are purged with air, it shall be ensured that combustible mixture is not present in the system.

15.2 Decommissioning

Plans and procedures shall be developed for safe decommissioning, dismantling, demolition, and disposal of the pipeline.
(i) Maintenance of the facility shall continue till full dismantling of facilities have been completed.
(ii) Cathodic protection system shall be maintained with periodic inspection.
(iii) Environmental impact assessment be carried out on account of decommissioning.

16.0 MANAGEMENT OF CHANGE / SAFE CONTROL OF OPERATIONS (SCO):

For Safe Control of Operations (SCO), a systematic Management of Change process shall be developed in line with OISP-GDN-178 to identify and consider the impact of changes to pipeline systems and their integrity. Management of Change shall address technical, physical, procedural and organizational changes of the system, whether permanent or temporary.

17.0 DEFECT ASSESSMENT:

Effective defect detecting systems like, line walk surveys, surveillance, patrolling, leak detection tests, internal audits, external audits shall be put in place for detection of defects and damages of pipe work. Defective or Damaged pipelines shall be identified and restored to safe operating conditions by the use of appropriate repair methods.

The defects shall be categorized into damage, moderate damage, severe damage, extreme damage as follows:

After analysis of intelligent pigging data, estimated repair factor (ERF) is calculated for all the metal loss defect as given in the ASME B 31G.
ERF = MAOP / P-safe is calculated.

**For the defect having ERF less than 1:** no rectification is required and is categorised say as sub-critical

**For the defect having ERF equal to 1:** Rectification is required and is categorised say as critical.

**For the defect having ERF greater than 1:** Rectification is required immediately and is categorised say as super critical.

The selection of the most appropriate repair method, consistent with safety of operation, shall be selected be based on assessment of the defect.

**18.0 REPAIR OF PIPELINE:**

18.1 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 requirements of this standard, then either the pipe section shall be repaired or replaced or the pipeline shall be derated commensurate with remaining strength of the pipe.

18.2 All dents as per para 10.8 of this standard and all pipes containing leak shall be removed or repaired.

18.3 Pipeline shall be repaired by any one of 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 of meeting the required pipe specification.

(ii) By installing full encirclement welded split sleeves 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. Length of full encirclement split sleeves shall not be less than 100mm.

(iii) All repairs performed as per (i) and (ii) above shall be tested by radiography examination.

(iv) In case of repair of coated pipe, all damaged coating shall be removed and new coating shall be applied to replacement pieces of pipe, welded patches and full encirclement welded split sleeves used in making repairs.
19.0 REFERENCES

This standard shall be read in conjunction with the following standards, codes and publications:

(i) ASME B31.8 Gas Transmission and Distribution Piping Systems.
(ii) API -617 Centrifugal Gas Compressors
(iii) API- 618 Reciprocating Gas compressors
(iv) API- 11P Other small gas compressors
(v) API 1102 Recommended Practice for Steel Pipelines Crossing Railroads and Highways.
(vi) API 1104 Standard for Welding Pipelines and Related Facilities.
(vii) API 1107 Recommended Pipeline Maintenance Welding Practices.
(viii) API 1109 Recommended Practice for Marking Liquid Petroleum Pipeline Facilities.
(ix) API 1110 Recommended Practice for Pressure Testing of Liquid Petroleum Pipelines.
(x) API 500C Classification of Locations for Electrical Installations at Pipeline Transportation Facilities.
(xi) API- 5L Specification for Line pipes
(xii) API- 6D Pipeline Valves
(xiii) ASME Section VIII Boiler and Pressure Vessel Code
(xiv) ASME Section IX Welding Qualifications
(xv) MSS-SP-50 Pipe Hangers and Supports Materials, Design and Manufacture.
(xvi) MSS-SP-69 Pipe Hangers and Supports - Selection and Application.
(xvii) NACE-RP-01-69 Recommended Practice Control of External Corrosion on Underground or Submerged Metallic Piping Systems.
(xviii) NACE-RP-01-75 Recommended Practice - Control of Internal Corrosion in Steel Pipelines Systems.
(xix) ISA S-75.01 Flow evaluation for sizing control valve
(xx) ISA S-75.02 Control valve test procedure
(xxi) IEC – 79 Electrical Apparatus for Explosive Gas Atmosphere
(xxii) IEC – 529 Degree of protection provided by Enclosures.
(xxiii) OISD-STD-105 Work Permit System
(xxiv) OISD-STD-118 Layout of Oil and Gas Installation
(xxv) OISD-STD-120 Inspection of Compressors
(xxvi) OISD-STD-128 Inspection of Pressure Vessels.
(xxvii) OISD-STD-130 Inspection of Pipes, Valves and Fittings.

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Annexure-I
(Clause 2.0)

FACILITIES INDICATED BY SOILD LINES ARE IN THE SCOPE OF THIS STANDARD

SP - SEPARATION / PROCESSING PLANT
CS - COMPRESSOR STATION
GGS - GAS GATHERING STATION
IPS - INTERMEDIATE PIGGING STATION
ICS - INTERMEDIATE COMPRESSOR STATION
RGP - LNG STORAGE AND REGASIFYING PLANT
SV - SECTIONALISING/MAINLINE VALVE STATION
CGS - CITY GATE STATION
TS - GAS RECEIPT / TERMINAL STATION
MRS - METERING AND REGULATING STATION

WELL WITHOUT SEPARATOR,
WELL WITH SEPARATOR,
MRS - METERING STATION
DETERMINATION OF LOCATION CLASS

C-1 Location Class along the pipeline route shall be determined as follows:

A zone, 400 m wide, shall be considered along the pipeline route with the pipeline in the centre-line of this zone. Then the entire route of the pipeline shall be divided into random lengths of 1600 m such that the individual lengths will include the maximum number of buildings [1] intended for human occupancy. The number of such dwellings which are intended of human occupancy within each 1600 m zone shall be counted.

C-2 Areas shall be classified based on guidelines as given below:

a) **Location Class 1** - A Location Class 1 is any 1600 m section that has 10 or fewer dwellings intended for human occupancy. This Location Class is intended to reflect areas such as wastelands, deserts, mountains, grazing lands, farm lands and other sparsely populated areas.

b) **Location Class 2** - A Location Class 2 is any 1600 m section that has more than 10 but less than 46 dwellings intended for human occupancy. Location Class 2 is intended to reflect areas where degree of population is between Location Class 1 and Location Class 3 such as fringe areas around cities and towns, industrial areas, ranch or country estates, etc.

c) **Location Class 3** - A Location Class 3 is any 1600 m section that has 46 or more dwellings intended for human occupancy except when a Class 4 Location prevails and is intended to reflect areas such as suburban housing developments, shopping centers, residential areas, industrial areas, and other populated areas not meeting Location Class 4 requirements.

d) **Location Class 4** - A Location Class 4 include areas where multi-storey buildings are prevalent, and where traffic is heavy or dense and where there may be numerous other utilities underground. Multi-storey means four or more floors above ground, including the ground floor and irrespective of depth of basement or number of floors of basement.

C-3 In addition to the criteria contained in C-2 a) to d), while classifying areas, additional consideration must be given to possibilities of concentration of people along the pipeline route such as locations with schools, hospitals, recreational areas of an organized character, places of assembly, places of worship, etc. If one or more of such areas of high concentration of people are present in Location Class 1 or 2, the area shall be classified as a Location Class 3. Concentration of people referred to in this Para are not intended to include groups of fewer than 20 people per instance or location but are intended to cover people in an outside area as well as in a building.
If the facility is used infrequently, the above requirement need not be applied.

C-4 Notwithstanding the above, while determining class location of an area due consideration shall be given to the possibility of future development of the area during the design life of the pipeline. If it appears likely that future development may cause a change in the location class, this shall be taken into consideration while determining its class location.

C-5: When cluster of building intended for human occupancy indicates that a basic 1600 m should be identified as a location class 2 or 3, the location class 2 or location class 3 may be terminated at 200 m from the nearest building in the cluster.

C-6 For pipeline shorter than 1600 m in length, a Location Class that is typical of the Location Class that would be required for 1600 m of pipeline traversing through the area shall be assigned.

C-7 Location Class 2 or 3 shall be terminated at least 200 m from the end dwelling i.e. dwelling located at the boundary of the Location Class 2 or 3 as the case may be.

Notes:

1 For this purpose each dwelling unit in a building with multiple dwelling units shall be counted separately.
REVISED ANNEXURE- III OF THE STANDARD

ANNEXURE- III

(Clause 5.3.4)

MINIMUM INTER DISTANCES FOR VARIOUS STATION FACILITIES

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<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Small Compressor / Pump House</td>
<td>-</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>16</td>
<td>30</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>Main Compressor House</td>
<td>15</td>
<td>-</td>
<td>15</td>
<td>15</td>
<td>30</td>
<td>30</td>
<td>15</td>
<td>15</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>Gas Handling System (PB /GC)</td>
<td>15</td>
<td>15</td>
<td>-</td>
<td>5</td>
<td>16</td>
<td>30</td>
<td>15</td>
<td>15</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>Equipment Room</td>
<td>15</td>
<td>15</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>30</td>
<td>15</td>
<td>15</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>Control Room / Office building</td>
<td>16</td>
<td>30</td>
<td>16</td>
<td>-</td>
<td>-</td>
<td>30</td>
<td>15</td>
<td>15</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Fire Pump House / Fire water storage tanks</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>-</td>
<td>-</td>
<td>30</td>
<td>12</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Water Spray Deluge Valve</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>-</td>
<td>-</td>
<td>15</td>
<td>-</td>
<td>16</td>
</tr>
<tr>
<td>8</td>
<td>Cold Blow Down</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>30</td>
<td>15</td>
<td>-</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>9</td>
<td>Compound wall</td>
<td>15</td>
<td>30</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>12</td>
<td>-</td>
<td>5</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>Elect Substation,</td>
<td>16</td>
<td>30</td>
<td>16</td>
<td>16</td>
<td>-</td>
<td>-</td>
<td>16</td>
<td>30</td>
<td>5</td>
<td>-</td>
</tr>
</tbody>
</table>

x- Any distance suitable for constructional and operation convenience.
1. All distances are in metres. All distances shall be measured between the nearest points on the perimeter of each facility
2. Hot elevated flare shall be located 90 mtr away and ground flare shall be located 150 mrt away
3. 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.

PB - Pig receiver / Launcher Barrel, GC- Gas Coolers / Meters / filters
TYPICAL COMPRESSOR STATION SCHEMATIC
PART -II

CITY GAS DISTRIBUTION NETWORKS
1.0 INTRODUCTION

The use of piped natural gas (PNG) for domestic, commercial and industrial purpose in cities is gaining increased importance as an alternative fuel. PNG is being used internationally with proven success.

PNG is a mixture of hydrocarbon gases and vapours consisting of principally Methane in gaseous form. The PNG network consists of receiving natural gas from suppliers at City Gate Stations (CGS), Steel Mains, Pressure Regulating Installations (PRI), Poly Ethylene (PE) Mains and Supply System to end users. A typical system of piped natural gas distribution is given at Annexure-I.

Safety in PNG distribution is important in view of the highly inflammable nature of the gas and densely populated areas in which the network is installed.

This standard aims to ensure safe design, construction, operation & maintenance of PNG distribution to various customers viz. Domestic, Commercial and Industrial so as to provide a level of safety and protection of life and property.

This standard has been prepared for supply of Piped Natural Gas to domestic, commercial and industrial users

2.0 SCOPE

This standard lays down the minimum safety requirements for PNG Distribution in cities/towns. It covers the equipment, pipelines, accessories etc. installed between Up-Stream Inlet Isolation Valve of City Gate Station (CGS) and;

a. Consumer Meter (CM) for Commercial & Industrial Consumers

b. First isolation valve down stream of Consumer Meter for Domestic Consumers.

c. Piping and facilities upto the burner of gas Oven and /or any Gas Appliances for domestic consumer.

The facilities up-stream of CGS Inlet Valve are covered under Part-1 of this standard.

d. CNG Dispensing facilities are covered on OISD-STD-179

3.0 DEFINITIONS

a. **Authorised Person**: A person trained and assigned to carry out a specific job by the owner or PNG Distribution Company.

b. **Active Regulator**: Regulator in PRI that normally controls the outlet pressure

c. **City Gate Station (CGS)**: An installation where PNG operator receives the natural gas from the supplier. The first stage pressure regulation and odorization of natural gas takes
place in CGS. A typical schematic layout of facilities/ equipment installed at CGS is given at Annexure-II

d. **Competent Person**: A person recognized by the concerned Statutory Authority for the purpose in respect of which the competency is required.

e. **Consumer Meter** (CM): A meter that measures gas delivered to a customer for consumption on the customer’s premises.

f. **Creep Relief Valve**: A relief valve having maximum 1 % flow capacity and is installed to prevent over pressurization of the downstream system.

g. **Emergency Shut Off Valve**: A quick action shut off valve, which operates from full open to full closed condition in less than one complete turn.

h. **Electro Fusion Joint**: A joint made in thermo plastic piping by heating the parts sufficiently to permit fusion of the materials using electrical coil or otherwise when the parts are pressed together.

i. **Hazard**: A substance or circumstance which may cause injury or damage due to being explosive, flammable, poisonous, corrosive, oxidizing, or otherwise harmful.

j. **Insulation Joint**: A fitting having high electric resistance, which can be fitted in a pipeline to insulate one section of pipe from another electrically.

k. **Mains**: A pipe, other than an installation or service pipe, used for conveying gas in a distribution system.

l. **Maximum Incidental Pressure (MIP)**: Max. Pressure, which a system is designed to experience under fault condition and is less than or equal to the design pressure.

m. **Monitor/ Active (Regulator)**: An arrangement of two regulating devices in series whose pressure settings are stepped so as to allow one (Active) normally to control the outlet pressure and the other (Monitor) to assume control in the event of failure of the active device to the open position.

n. **PNG Distribution System**: A natural gas distribution system & facilities in which the piped natural gas (PNG) is distributed to residential, commercial & industrial customers.

o. **Pressure Regulating Installation (PRI)**: PRI is an installation in the PNG network where second stage pressure regulation of natural gas takes place after CGS. A typical schematic layout of facilities/ equipment installed at PRI is given at Annexure-III.

p. **Shall**: Indicates mandatory requirement.

q. **Should**: Indicates recommendation or that which is advised but not mandatory.

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r. **Service Line:** A pipe connecting a gas main up to and including a meter control valve. A service line may supply more than one meter in a particular building or in two adjacent buildings.

s. **Service Regulator:** Regulator installed on a gas service line to control the pressure of the gas delivered to customer.

### 4.0 STATUTORY REGULATIONS

It is necessary to comply with statutory regulations such as State Pollution Board, Factories Act, Indian Explosives Act, IE Rules, Municipal Authorities etc as applicable and requisite approvals shall be obtained from the relevant competent authorities for the PNG distribution system.

### 5.0 LAYOUT & FACILITIES

#### 5.1 PRESSURE REGULATING STATIONS (CGS & PRI)

5.1.1 The facilities at the pressure regulating station shall be located in a manner to facilitate operation and ease of maintenance & inspection. The typical schematic layout of facilities/equipment installed at CGS and PRI are given at Annexure II & III respectively. Additionally, the facilities at CGS and PRI shall conform to the following:

a. For CGS, the minimum separation distance between the nearest equipment and the boundary wall shall be 6 meters.

b. The PRI shall be inside an enclosure with sufficient ventilation. For above ground PRI, the separation distance between enclosure and the boundary wall of nearest building/structure shall not be less than 2 meters.

c. There shall be minimum two safety devices and at least one shall be a slam-shut valve operating on over-pressure for installations operating at inlet pressure more than 4.0 barg.

d. The environmental effect and associated hazards of fire and explosion due to the release of large volumes of gas to atmosphere shall be considered in case a relief valve is installed as a pressure control device. Creep relief valve can be used to prevent over pressurization of the downstream system.

e. In case, a monitor regulator is used, it shall be the first acting device in the pressure safety system.

f. PNG shall be supplied after adequate filtration to prevent erosion and damage to equipment/instruments. The steel mains shall not be pig-able.

g. Minimum 3 numbers gas leak detectors shall be installed at the strategic locations in the CGS to cover entire facility.

h. CGS shall be installed outside the city limit.

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5.1.2 VENT LINE

The relief valve vent line shall be terminated at a minimum height of 3 meters above the equipment for over ground installations and 3 meters above the ground level for underground installations.

Vent line shall extend to location where the discharge of gas shall not create a hazard to the compressor station or the surrounding area.

5.1.3 ISOLATION OF CGS
Quick acting isolation valves shall be provided at CGS for emergency isolation purpose.

5.2 PIPING AND VALVES

5.2.1 STEEL PIPING

a. All rigid piping, tubing, fittings and other piping components shall conform to the requirements clause 5.2 of part-1 of this standard. Pipe having D/t ratio greater than 96 shall not be used.

b. The steel piping shall be designed for maximum operating pressure of 19.0 barg. at temperature ranging between (-) 29 Deg. C to (+) 65 Deg. C.

c. For underground steel piping network, suitable corrosion protection like cathodic protection, wrapping/ coating etc shall be applied. Provisions of clause 9.0 of Part -1 of this standard shall be applicable.

d. The above ground mains shall be painted yellow for identification.

e. The cast iron pipes shall not be used in the PNG network as a carrier of natural gas.

5.2.2 POLY ETHYLENE (PE) PIPING

The PE piping, tubing, fitting and other components shall conform to requirement of ASME B 31.8 or equivalent as approved by statutory authority. The PE piping shall be designed for maximum operating pressure of 4.0 barg. at temperature ranging between (-) 29 Deg. C to (+) 65 Deg. C. PE piping shall not be used in water / rail crossing. The value of pipe thickness ‘t’ shall not be less than the following table

<table>
<thead>
<tr>
<th>Nominal outside dia, mm</th>
<th>Minimum wall thickness, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dn</td>
<td>SDR 17.6</td>
</tr>
<tr>
<td>16</td>
<td>2.3</td>
</tr>
<tr>
<td>20</td>
<td>2.3</td>
</tr>
<tr>
<td>25</td>
<td>2.3</td>
</tr>
<tr>
<td>32</td>
<td>2.3</td>
</tr>
<tr>
<td>40</td>
<td>2.3</td>
</tr>
<tr>
<td>50</td>
<td>2.9</td>
</tr>
<tr>
<td>63</td>
<td>3.6</td>
</tr>
</tbody>
</table>

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5.2.3 STRATEGIC VALVES

Such valves shall be installed to facilitate maintenance of system and to allow for speedy isolation in the event of damage. The location of the strategic valves shall be decided based on the risk associated with maintaining the gas supply and to facilitate maintenance, repair, modification, testing and commissioning etc. In no case, distance between two strategic valves shall exceed:

a. 3 KM for steel pipelines.
b. 1KM for PE Pipelines of diameter 63 mm and above.

For PE Pipelines less than 63 mm diameter, the distance between strategic valves shall be based upon risk analysis.

Such valves of appropriate materials shall also be provided on each riser, upstream of each meter and at both ends of river & railway crossing.

5.3 CONSUMER INSTALLATIONS

5.3.1 Gas received through PE Pipeline undergoes further pressure regulation at domestic/commercial/ Industrial consumer end. The pressure regulator shall be capable of shutting down the downstream gas supply in case of low or high pressure in the system. These installations include isolation valve, pressure regulator and meter etc. The isolation valve down stream of consumer meter shall be easily accessible. Meters duly certified by competent authority shall be used.

The pressure ranges for different consumers should be as under:

(a) Domestic Consumer : 19mbar - 28 mbar
(b) Industrial / Commercial Consumer: As per consumer requirement.

5.3.2 Recommended specification for domestic customers for above ground GI pipes before and after consumer meter to isolation valves, copper pipes used inside residence, rubber hoses connecting the Gas stove and domestic gas burner is enclosed at Annexure – IV.
5.4 ROUTE OF PNG PIPELINE

5.4.1 The PNG pipeline route should avoid;

a. Areas congested with other underground utilities like power, water, telephone etc.

b. Close proximity to unstable structures or where construction could lead to damage to pipeline.

c. Close proximity to highly populated buildings such as schools, public places etc.

d. Ground areas of running sand, gravel or flood risk, water bodies.

e. Heavily traffic-loaded routes where the road has not been constructed to suitable standards.

f. Areas of known or suspected aggressive soil conditions.

g. Landfill sites.

h. Steel piping should avoid;

i. Close proximity to existing CP systems, particularly ground-bed locations.

ii. High stray direct current, typically near DC traction systems.

iii. Long runs parallel to high voltage overhead conductors.

5.5 PIPELINE MARKERS

Route markers shall be placed on the entire pipeline at a distance not exceeding 50 meter and also at bends in the city.

Additional sign/markers shall be installed to indicate the presence of a pipeline at road, highway, railroad, stream crossings and locations where there is a probability of damage or interference. Further, warning signs shall be displayed on the service line to consumer premises.

A marker shall be marked in easily readable local language with at least the following:

a) Name of PNG distribution company

b) Contact telephone number(s) in emergency.

c) Location code

d) Warning- “High Pressure Gas Line” and “Other Utilities to take permission from PNG Distribution Company before digging” etc.

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5.6 PROXIMITY TO PROPERTIES

The minimum distance between steel pipelines, having operating pressure of 4 barg or more and the normally occupied buildings shall be 2 meters.

5.7 PNG ODOURISATION

a. Natural gas supplied through PNG distribution shall have a distinct odour, strong enough to detect its presence. In case ethyl mercaptan is used as odorant, the concentration range shall be 7 to 12.5 PPM.

b. The odourisation and filtration system shall be located in a separate working area, but within the same fencing. There should be a clear safety distance of 1.5 M around the odourisation and filtration system to facilitate easy maintenance and personnel movement.

c. Risk Assessment of odourant installation site shall be carried out. The storage of odorant should be minimum enough to prevent a major risk. The unloading of odorant should be automated.

d. Precautions for handling odorant shall be prominently displayed.

e. Odourant absorber like activated carbon saw dust, dry sand and odorant neutralizer like sodium hypochlorite for spillage handling of odorant shall be provided.

e. Provision shall be made for eye wash, emergency shower near odorant handling and injection systems, in case ethyl mercaptan is used as odorant. Use of personal protective equipment like face shield, mask, rubber hand gloves, gumboot, safety goggles etc. for handling of odorant spillage shall be ensured.

5.8 FIRE PROTECTION FACILITIES

Each installation shall be equipped with the following facilities for fire protection.

5.8.1 CITY GATE STATION (CGS)

a. The entire gas handling equipment/ facilities installed in CGS shall be covered with water sprinklers.

b. The firewater storage shall be calculated based on following cooling rates for minimum 4 hours.

- Scrappers/Filters: 10 lpm/ sq. m of surface.
- Other areas : 3 lpm/ sq. m of surface

c. Adequate fire fighting access, means of escape in case of fire and segregation of facilities should be provided so that the adjacent facilities are not endangered during a fire.
d. Fire water storage and pump house shall be located at a safe place from the gas handling equipment / facilities. However, such separation distance shall not be less than 15 mtr in any case.

e. Additionally, following fire extinguishers shall be provided at the city gate station:
   
   i. Four numbers 10 kg DCP
   
   ii. Two numbers 22.5 kg DCP

   iii. One number 10 kg Foam

   iv. Two numbers 4.5 kg CO₂

5.8.2 MCC / ELECTRIC INSTALLATION

Following fire extinguishers shall be provided:

   a. One no. 10 kg DCP

   b. One no. 4.5 kg CO₂

   c. Sand Buckets

5.9 All electrical equipment/ installations shall conform to OISD Standards 110, 113, 149 and 173 as applicable.

6.0 LAYING OF PIPELINE

Safety provisions under OISD-GDN-192 (Safety Practices during Construction) shall be complied. PE pipe shall not be installed above ground provided it is encased in metal pipe protected against atmospheric corrosion or other appropriate RCC protection.

6.1 Following shall also be complied;

   a. Road signs, warning lamps and barrier systems shall be provided on highway or other work locations which are accessed by pedestrians or vehicles.

   b. Underground utilities shall not be disturbed or altered without the prior consent and approval of the owner or authority concerned.

   c. Electricity cables shall be treated as "Live", unless the owner certifies them as "Dead". The dead cable shall also be checked for any residual voltage.

   d. Where it is necessary to cross or run close to any other utility, a minimum of 250 mm clearance shall be maintained. In case the clearance is less, appropriate protection
measures shall be taken. The relative position of PNG pipeline with respect to other underground utilities shall be as given below:

![Diagram of utility layout]

e. Where open cut techniques are used, a warning tape of Yellow colour shall be laid above the pipe, the difference in elevation of the pipe and warning tape shall be minimum of 200 mm.
f. As built drawing and pipe book shall be maintained.
g. Trench width shall be at least 300 MM. The bed of the trench shall be free of sharp objects, stones etc. The trench should be padded with soft soil / sand to minimum of 100 mm below the pipe.
h. A layer of brick/concrete shall be laid or Impact resistant tape shall be laid over the on the pipeline covering its entire length.
i. At identified locations pipelines shall be provided with impact protection from excavating machinery as indicated in the fig 1(a) where ‘h’ shall not be less than 500 MM. & 1(b) where ‘h’ shall not be less than 250 mm.

![Figure 1 (a) Concrete Slab]

![Figure 1 (b) Slab with support for Impact protection of pipelines]
### 6.2 DEPTH OF COVER

Minimum depths of cover for buried pipelines shall be as per the table given below:

<table>
<thead>
<tr>
<th>Location</th>
<th>Min. Cover in meter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial, Commercial and Residential Areas</td>
<td>1.0</td>
</tr>
<tr>
<td>Stream, Canal and other minor water crossings (below bed level)</td>
<td>1.5</td>
</tr>
<tr>
<td>Drainage ditches at roadways and railroads</td>
<td>1.0</td>
</tr>
<tr>
<td>Rocky Areas</td>
<td>1.0</td>
</tr>
<tr>
<td>Road Crossings</td>
<td>1.2</td>
</tr>
<tr>
<td>Railroad Crossings</td>
<td>1.7</td>
</tr>
<tr>
<td>Inside the building / society premises</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**NOTE:**

(i) Wherever the minimum depth of cover as above is not possible, a risk analysis shall be carried out to determine the additional protection requirements.

(ii) The depth of cover shall be measured from the top of the pipe coating to the top of the undisturbed surface of soil or the top of graded working strip, whichever is lower.

(iii) The cover shall be measured from the top of road or top of rail, as the case may be;

(iv) For river/watercourses that are prone to scour and erosion, adequate safe cover shall be provided below the predicted scour profile expected during the life time of the pipeline;

### 6.3 JOINT REQUIREMENT FOR PE PIPE

(a) Pipe or tubing shall not be threaded.

(b) Joint procedure (mechanical, adhesive or heat fusion) qualification shall be done and proven by test.

(c) Flanges or special joints shall be used provided they are properly qualified.

(d) Coiled pipe, not exceeding 32 mm outside diameter, may be used for external risers and laterals. For larger diameter (and not exceeding 63 mm), only straight length shall be used. However, these pipes shall only be used for a maximum pressure of 100 mbar.

(e) An external PE risers and laterals system, not exceeding 63mm outside diameter, should be joined using wall mounted crimped or compression fittings.

(f) All external PE pipe work should be completely sleeved with half an hour fire
resistant glass reinforced plastic and secured at a minimum of 2 m intervals with wall mounted retaining clips.

6.4 LAYING OF PE PIPE
During installation of PE piping, care shall be taken to prevent damage to piping and components. Gouge, cuts, scratches, kinks / buckle or other form of damage shall be removed by cutting out and replacing the damage portion as a cylinder.

6.5 BACK FILLING
Back filling shall be performed in a manner to provide firm support around the pipe. Material used for back filling shall be free from rock, pieces of pavement, stones or any other material which can damage the pipeline.

6.6 Provision shall be made for locating the buried PE pipe by installation of electrical conductive trace wire or plastic coated metallic tape or any alternate proven locating method.

6.7 SERVICE LINE
The following shall be complied:

a. A service line shall not be laid under the foundations of any building.

b. Service lines shall not be laid in unventilated enclosures.

c. All Poly Ethylene (PE) pipe and fittings shall be laid underground and shall not be exposed. The service lines, where coming above ground, shall be only made of GI/Carbon Steel piping, with adequate anti corrosive coating.

d. Wherever the riser is to be laid through confined spaces like basements, only welded risers shall be used. Riser shall be installed with a minimum gap of 25 mm to wall and supported at every 2 m. Ventilators shall be provided in confined space.

e. Interface joint shall be provided over ground. In case interface joint is provided underground, it shall be protected against corrosion etc.

7.0 TESTING & COMMISSIONING

7.1 Following shall be complied before commencing the testing & commissioning activities:

a. Issue of Work Permit as per OISD-STD 105.

b. Availability of fire fighting equipment

c. Availability of communication facilities

d. Availability of inspected & calibrated testing equipment / instruments

e. Warning Signs
f. Cordonning of the test area

g. Emergency contact nos. of various agencies as per Emergency Response Plan

7.2 TESTING OF INSTALLATIONS

7.2.1 Pressure Regulating Installations shall be subjected to hydrostatic or pneumatic strength test as given below:

<table>
<thead>
<tr>
<th>Design Pr. (DP) (bar)</th>
<th>Strength Test Pr. (bar)</th>
<th>Duration Hydro.(H)/ Pneu. (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 0.1</td>
<td>0.3</td>
<td>P 30 min</td>
</tr>
<tr>
<td>From 0.1 to 1.0</td>
<td>2.0</td>
<td>P 30 min</td>
</tr>
<tr>
<td>From 1.0 to 2.0</td>
<td>3.0</td>
<td>H (4hrs)</td>
</tr>
<tr>
<td>From 2.0 to 7.0</td>
<td></td>
<td>H 4hrs</td>
</tr>
<tr>
<td>From 7.0 to 100.0</td>
<td>1.5 DP</td>
<td>H 4 hrs</td>
</tr>
</tbody>
</table>

Duration of test shall be after stabilization of pressure and shall be acceptable when no pressure loss is detected over the required period.
Tightness test shall be carried at operating pressure for a duration not less than 30 minutes.

7.2.2 HYDROSTATIC TESTING

a. Steel Pipelines and mains shall be tested hydrostatically to a pressure not less than 1.5 times the Maximum Operating Pressure. Suitable relief valve set at 5% over the test pressure, shall be fitted to avoid over pressurization.

b. The duration of hydrostatic test for steel pipeline shall not be less than 24 hrs or as specified by respective code to which the pipeline is designed and accepted by statutory authority.

7.2.3 PNEUMATIC TESTING

a. Pneumatic testing of PE PIPELINE shall comply with the following:

i. For services operating at pressure not exceeding 75 mbar, an air/ inert gas test at a minimum of 100 mbar shall be applied.

ii. For Services operating at pressure in excess of 75 mbar the test pressure shall be 1.5 times the maximum operating pressure.

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iii. The pipeline operated above 2 bars shall be tested at 1.5 times the max. operating pressure.

iv. Where a service supplies a multi-storey building, the risers and laterals shall be tested at a pressure of 350 mbar or 1.5 times the maximum operating pressure whichever is higher.

b. TEST DURATION

The duration of pneumatic testing of service line and internal installation shall not be less than 30 minutes.

7.3 COMMISSIONING OF FACILITIES

All fire protection and detection facilities shall be in place before commissioning.

All facilities i.e. CGS, PRI, Pipelines etc. shall be purged and commissioned as per approved procedure after due checks and certification by the authorised personnel.

8.0 OPERATION & MAINTENANCE

8.1 Operating procedures, with suitable operational controls based on formal hazard identification & risk assessment, shall include following safety aspects:-

a. Adherence to work permit system in line with OISD-STD-105

b. Management of change in line with OISD-GDN-178,

c. Selection of electrical equipment as per hazard area classification & maintenance in line with established O & M practices/ statutes,

d. Provision of Personal Protective Equipment (PPE),

e. Regular Preventive Maintenance

f. Availability of Documented Isolation Philosophy etc. shall be in place.

8.2 Following shall be complied:

a. Adequate training shall be imparted to the operators, service engineers etc. and records thereof shall be maintained.

b. Operating personnel shall possess adequate knowledge and experience to ensure functioning of the PNG distribution system in a safe and efficient manner.

c. Do’s and Don’ts shall be displayed at scraper/ filter, pressure regulator area and odourizing facility.

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d. System of periodic inspection and maintenance of PNG facilities shall be established as an integral part of operations.

e. Action in the event of emergency shall be clearly established and understood by all concerned and displayed prominently.

f. Important operational activities shall be logged and records of such activities shall be maintained.

g. All PNG operations shall be carried out under the supervision of authorised person(s).

h. Limits of operating parameters including level, pressure and any other condition as set for sound and safe operations shall not be exceeded. In case any abnormal operating conditions are encountered, the causes shall be investigated and corrective actions taken.

i. The operating staff shall maintain vigilance for detection and control of any leakage.

j. Explosimeter, duly calibrated, shall be available at CGS to monitor the leakage at flanges and instrument tapings.

k. A well-designed system of periodic inspection for all facilities of PNG shall be formulated to maintain it in safe operable condition all the time.

l. Safety audit of the PNG distribution system shall be undertaken & certificate of fitness, declaring integrity with respect to equipment, facilities, operations & safety procedures, shall be accordingly issued.

m. The safety inspections / audit of PNG systems shall be carried out as given below:

<table>
<thead>
<tr>
<th>Type</th>
<th>Freq.</th>
<th>Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Inspection</td>
<td>Daily</td>
<td>Operating personnel</td>
</tr>
<tr>
<td></td>
<td>Once a month</td>
<td>Engineering in-charge of PNG mktg. Company</td>
</tr>
<tr>
<td>Safety Audit</td>
<td>Once a year</td>
<td>Authorised Person(s) / Agency</td>
</tr>
<tr>
<td>Electrical Audit</td>
<td>Once a year</td>
<td>Licensed Electrical Agency</td>
</tr>
</tbody>
</table>

n. All recommendations of the safety audit/ inspections shall be complied in a time bound manner and records maintained thereof.
o. Disassembly or removal of the facilities and components of equipment whilst any part of the system is under pressure is hazardous and shall not be undertaken unless the system is de-pressurised, gas freed and certified.

p. The system of permit to work shall be established for non-routine works in line with OISD-STD-105 and such works shall be undertaken with full knowledge and approval by authorised person.

q. Equipment appurtenances, protection devices associated with the PNG system as incorporated in the design shall be tested, maintained, repaired and replaced as recommended by the manufacturer.

r. Preventive maintenance schedules shall be drawn for all equipment in accordance with manufacturer’s recommendations and established mandatory / recommendatory standards. Records of all preventive maintenance undertaken shall be maintained and updated from time-to-time.

s. Calibration of meters/ gauges etc. shall be carried out, documented and records kept.

t. The Functional Test of Active/ Monitor Regulator, Slam Shut Valve and Pressure Relief Valve for their proper operation shall be carried out once in a year.

u. “No Mobile phone”, “No smoking sign”, “No lighter / matches” shall be displayed at CGS operational area.

v. Do’s and Don’ts, safety precautions, emergency telephone nos. shall be displayed at the consumer point.

8.3 The following safety precautions shall be ensured during emergency repairs/ breakdown maintenance of pipelines:

a. Warning/ cordonning off work area.

b. All naked flames, sources of ignition and mobile phones shall not be allowed in the immediate work area.

c. Gas level should be monitored during the repair work with gas detectors.

d. Adequate fire fighting equipment shall be deployed during such repair.

e. Close Coordination among utility companies shall be carried out to avoid damages to the utilities.

8.4 MODIFICATIONS TO LIVE PIPELINES

All modifications i.e. additions/ alternations shall be carried out in accordance with applicable code of practice/ approved procedure. Provisions of OISD-GDN-178 (Guidelines on Management of Change) shall be complied.

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8.4.1 PRESSURE CONNECTIONS

a. Metallic Pipelines:
   Connection should be made to live metallic pipeline by direct drilling and tapping using proprietary fittings and “no gas to atmosphere” drilling equipment (hot tapping). Hot tapping procedures for steel pipelines At annexure V.

b. PE Mains:
   Only fused connections shall be made to PE mains using compatible polymeric material and as per applicable code.
   Subsequent to any alteration/ modification, the complete system shall meet the existing testing & commissioning requirements of the system as per clause 7.0 and shall be tested & certified prior to taking in service.
   Procedure for online “Electro Fusion “ jointing for PE pipelines is enclosed at Annexure-VI.

9.0 EMERGENCY PLAN AND PROCEDURE

a. Provision shall be made for emergency isolation valve outside factory premises to cut off gas supply in case of fire/ emergency in plant.

b. The Operating Company having control over the PNG distribution shall draw an operational emergency plan keeping in view the following:
   i. Loss of or interruption to the gas supplies due to leaks or failure of pipeline.
   ii. Major failure of equipment/ fittings
   iii. Accidents or other emergencies, which can affect the PNG supplies.
   iv. Civil emergencies
   v. Any other risk arising from the existence or operation of the PNG system.
   The above emergency plan shall be disseminated amongst all personnel involved and ensured that they understand their roles and responsibilities in the event of an emergency.

c. The in-charge of the PNG distribution shall maintain close liaison with Fire Service, Police, District Authorities and the Gas Supplying Organization.

d. Provision of round the clock emergency control room equipped with effective communication system shall be made. Emergency Contact telephone numbers of emergency response team members, emergency services, mutual aid industries, district authorities, enforcing agencies, contractors/ vendors, fire brigade, civic agencies etc shall be available.

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e. The control room shall be equipped with Emergency vehicle having communication system, first aid fire extinguishers, leak detection and repair tools & tackles etc. All necessary maps and plans & P&ID’s, Material Safety Data Sheet (MSDS), etc. shall be available.

f. Operating Company shall participate in local Disaster Management Drill.

g. Utility Co-ordination:

Effective co-ordination amongst utilities is required to reduce the damages to utilities and consequent loss of life/ properties etc. In order to reduce damages to gas pipeline, following measures shall be ensured by utility companies:-

i. A person should be designated by company for utility co-ordination.

ii. A utility co-ordination team should be formed consisting of representatives from all utility companies as well as Municipal Corporation.

iii. Formats should be designed for taking clearance from PNG distribution company prior to taking up any excavation / digging activity within the city limits by other utilities.

iv. Prompt reporting of gas leak/ damages shall be done.

v. Use of designated utility corridor provided by local administration shall be made.

10.0 TRAINING

10.1 The objective of training is to provide good understanding of all the facets of PNG distribution activities including operations, procedures, maintenance and hazards and the risks associated with its handling. Training shall ensure that the jobs are performed in accordance with the laid down procedures and practices.

Training shall be imparted to the staff attached with the PNG distribution at the time of induction, which is to be followed up by periodic refresher courses. The training programme shall inter alia cover following aspects:

a. Hazardous characteristics of PNG.

b. Familiarization with operational procedures & practices.

c. Commissioning of new facilities and equipment.

d. Hands on experience on operation of equipment.

e. Routine checks and maintenance activities of the facilities.

f. Knowledge of emergency and manual shut down systems.
g. Immediate and effective isolation of any PNG leak.

h. Safety regulations and accident prevention.

i. Fire fighting facilities, its upkeep and operation.

j. Housekeeping

k. First aid.

l. Emergency plan/drills

10.2 Proper records for the training and refresher courses shall be maintained.

10.3 Training for employees & contractors of other utility companies should be done to make them aware about hazards associated with leak/ damages and required actions.

11.0 RECORDS

The PNG distribution company shall maintain following records/documents:

a. Design/ specification documents
b. Pipeline alignment sheets for MP steel pipeline
c. Pipe Book / Installation Records
d. Vendor and subcontractor assessments and records
e. Surveillance inspection and maintenance reports
f. Material certification including dimension, metallurgy, DT and NDT, strength, tightness, performance and functional report
g. Welding records
h. PQR, WPS & Welder qualification records
i. Stage inspection reports
j. Test reports
k. Strength, tightness and leak test reports
l. Commissioning reports
m. Non-conformance/ deviation reports
n. Calibration records of Inspection, Measuring & Metering and Test equipment
o. Audit compliance reports
p. Statutory clearances
q. Approved drawings/documents
r. International practices
s. HAZOP/ Risk assessment studies/ compliance to recommendations
t. All operation & maintenance manuals
u. Interlock testing document/by pass records etc.
12.0 REFERENCES

a. ASME-B31.8 - Gas Transmission and Distribution Piping Systems

b. IGE/TD/1 – Steel Pipelines for High pressure Gas Transmission

c. IGE/TD/3 - Steel and Pipelines for Gas Distribution

d. IGE/TD/4 - Gas Services

e. IGE/TD/13 Pressure Regulating Installations for transmission and Distribution Systems

f. IGE/SR/16 - Storage of Odorant and Use of Odorant Systems

g. OISD-STD-105 – Work Permit System

h. OISD-STD-113 – Classification of Areas for Electrical Installations at Hydrocarbon Processing and Handling Facilities

i. OISD-STD-117 - Fire Protection Facilities for Petroleum Depots and Terminals and Pipelines Installations

j. OISD-STD-138 - Inspection of cross country pipelines – Onshore

k. OISD-STD-173 - Fire Protection System for Electrical Installations

l. OISD-GDN-178 – Guidelines on Management of Change

m. OISD-STD-179 – Safety Requirements on compression, storage, handling & refueling of natural gas for use in automotive sector.

n. OISD-GDN-192 – Safety Practices During Construction

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Typical Piped Natural Gas (PNG) Distribution System

INLET FROM SUPPLIER

City Gate Station (CGS)

PRI Combined

PE/ Steel Mains

PRI Industrial

PE/ Steel Mains

PRI Residential/ Commercial

PE/ Steel Mains

Compressed Natural Gas Dispensing Station

Steel Mains

Meter

PE/ Steel/ Copper Service

Appliances (Domestic, Comm. & Industrial)

Meter

PE/ Steel Service

Industrial Appliances

Dom./ Comm. Appliances

NOTE: Compressed Natural Gas Dispensing Station is not covered under the scope of this standard
TYPICAL LAYOUT OF A PRESSURE REGULATING INSTALLATION (PRI)
ANNEXURE - IV

1. **Recommended specification of GI pipes used for domestic gas piping above ground up to the isolation valve after the meter**

   Pipes shall be conforming to IS: 1239 (Part-1) – 1990. The manufacturer shall have a valid license to use ISI Monogram for manufacturing of pipes in accordance with the requirements of IS: 1239 (Part-I) – 1990.

<table>
<thead>
<tr>
<th>NOMINAL BORE</th>
<th>15 mm</th>
<th>25 mm</th>
<th>50 mm</th>
<th>80 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRADE</td>
<td>HEAVY ('C' CLASS)</td>
<td>HEAVY ('C' CLASS)</td>
<td>HEAVY ('C' CLASS)</td>
<td>HEAVY ('C' CLASS)</td>
</tr>
<tr>
<td>O.D. mm max.</td>
<td>21.8</td>
<td>34.2</td>
<td>60.8</td>
<td>89.5</td>
</tr>
<tr>
<td>Min.</td>
<td>21.0</td>
<td>33.3</td>
<td>59.7</td>
<td>88.0</td>
</tr>
<tr>
<td>THICKNESS mm</td>
<td>3.2</td>
<td>4.0</td>
<td>4.5</td>
<td>4.8</td>
</tr>
<tr>
<td>NOMINAL WEIGHT Kg / mtr</td>
<td>1.44</td>
<td>2.93</td>
<td>6.19</td>
<td>9.90</td>
</tr>
</tbody>
</table>

**Note:**

Maximum tolerance on thickness (-)10%, Tolerance on weight for single tube ± 10% and for quantities per load of 10 tonnes, ± 7.5%.

- Pipes shall be designed to withstand a test pressure of 5 MPa (50 Kgf / cm²), maintained for at least 3 second without showing any kind of defects.
- Eddy Current test may be done in place of hydrostatic test as per the procedure given in Annex - C of IS: 1239 (Part-1) - 1990.
- All Galvanised Tubes shall be Zinc coated by hot dip galvanising in accordance with IS: 4736-1986 & its relevant parts.
- Minimum mass of zinc coating determined as per IS: 6745-1972 shall be 400 gms / m².
- The zinc coating on external and internal surfaces shall be adherent, smooth and free from such imperfections as flux, ash & dross inclusions, bare patches, black spots, pimples, lumpiness, runs, rust stains, bulky white deposits and blisters.
- Rejection and acceptance for these defects shall be as per Appendix-A of IS: 2629-1985.
The galvanised coating when determined on a 100 mm long test piece in accordance with IS: 2633 - 1986 shall withstand 4, one-minute dips.

The adherence of zinc coating on tubes above 50 mm nominal bore, shall be determined by the pivoted hammer test given in IS : 2629 - 1985.

Each pipe shall be legibly and durably marked at intervals of not more than one metre with the following information (i) Manufacturer’s name or trade mark, (ii) Class of Pipe – HEAVY, (iii) Indian Standard mark – ISI, (iv) Batch No. of Production, if any.

2. **Recommended specification of copper pipes used for domestic gas piping inside the residence up to the isolation valve after the meter**

For a copper service in domestic natural gas installations, materials supplied shall be in accordance with BS EN 1057:1996, it has replaced the copper tube standard BS 2871 Part 1. BS EN 1057 ensures the quality of the copper product by specifying the pipe in terms of its chemical composition, mechanical properties (tensile strength, hardness, elongation etc.), dimension and tolerance, surface quality, freedom from defects and suitability for pipe bending.

Copper pipe work shall be jointed by soldering or brazing, using mechanical compression or capillary type fittings. Fittings for use in joining copper tube shall be as per BS EN 1254 Parts 1 and 2. Fittings for capillary soldering and brazing are specified in Part 1 and compression fittings are specified in Part 2.

Soft soldering utilises filler metals with melting points at temperatures up to 450°C. Filler metals shall be as per BS EN 29453:1994 - Soft solder alloys - Chemical compositions and forms. Solders for use with copper tube and fittings generally melt within the temperature range 180°C to 250°C. Compression fittings shall be comply with BS 864 Part 2 or BS 2051 Part 1.

For capillary fittings:

- Soft solder shall not be used for pressure in excess of 75 mbar
- If the operating pressure is to exceed 75 mbar then a solder with a melting point of not less than 600 degrees C shall be provided the pipe diameter does not exceed 35 mm. This equally applies to brass fittings.

Height limit for copper risers: Although there is no specific guidance regarding maximum height of copper risers, IGE/UP/2 only allows the use of steel for risers above heights of 15 meter. Thus, unless local information is available to the contrary, 15-meter maximum height shall be considered safe due to weight and mechanical strength of material.
General guidance in BS 6891 also states that copper pipe work is not acceptable inside a protected shaft. Requirements for ventilation and fire stopping shall apply to ducts conveying copper pipe work. For an external copper riser system, protection against lightning conductors shall be considered.

Last but not least, a copper gas line shall never be used as a ground for an electrical system.

3. **Recommended specification of rubber hose used for connecting the Gas Stove after the isolation valve to the Gas Stove.**

   Rubber hose shall be conforming to IS: 9573 Type IV. The hose shall consist of lining, reinforcement and cover.

   The Hose should not be exposed to internal or external temperature exceeding the recommended limits, as high heat conditions can cause an adverse effect on the hose by degrading the Elastomer and thereby reducing fitting retention.

   The hose size must be capable of handling the required flow volume. Using the smaller than required diameter of hose for a given volume of flow would, result in excessive fluid turbulence, pressure drop, heat generation and tube damage.

   The hose should not be bend or flex beyond the specified parameter (refer, Table 1 Dimensions and Bend radii for Rubber Hoses, IS: 9573), as this would put excessive stress on the reinforcement and severely reduce the ability of the hose to withstand pressure.

   Hoses in service should be checked every year, for leakage, kinking, corrosion, abrasion or any other signs of wear and damage. Any hose worn or damaged must be removed from service and replaced immediately.

4. **Recommended specification of the domestic gas burner.**

   The gas stové shall be manufactured and checked in accordance to IS: 4246, IS: 11480 and IS: 5116. The following tests are conducted, (i) strength testing, (ii) thermal efficiency, (iii) combustion, (iv) gas soundness test, (v) floor wall & ceiling temperature measurement (vi) gas consumption test.
The jet nozzle of the gas burner shall be designed for a standard length of 11mm, with a tolerance of ± 0.2mm. The bore at the bottom of the hose is of 2.38 mm diameter (tolerance +0.1, -0.15). The hole on the top of jet is of diameter 1.25 mm or 1.10 mm (tolerance +0.02, -0.01) based on the capacity. (Refer fig. 1 & 2)
Annexure - V

Details of the online procedures for Steel pipelines where hydro testing is not recommended. “Hot tapping”

Procedure for Hot tapping on pipelines in-service shall comply to IS: 15679 : 2006. Hot tapping is the technique of attaching a mechanical or welded branch fitting to piping or equipment in service, and creating an opening in that pipeline by drilling or cutting a portion of the piping within the attached fitting.

Hot tapping shall be performed when it is not feasible, or impractical to take the piping out of service, or to purge or clean it by conventional methods. A hot tap connection can often be safely made without interfering with the process operation.

Prior to conducting hot tapping, a written plan shall be prepared which includes the following,
- Connection design
- Hot tap procedure
- Detailed written welding procedure
- Health, safety, fire protection, emergency response, and other appropriate procedures & instructions.

Additional information when developing a written plan may be obtained from Section IX of the ASME Boiler and Pressure Vessel Code for qualification of welders and the fundamental ASME Code welding procedure to be employed.

**Note:** Section IX does not cover the condition encountered while welding on in service piping containing flammable and combustible liquids. Refer to API Recommended Practice 1107 for qualification of welders and the welding procedures to be employed when welding on in-service flammable and combustible liquid piping.

The tightness of bolts, packing, packing nuts and any by-pass line shall be checked to avoid any possible leakage. The test pressure should be atleast equal to the operating pressure of the line or vessel to be tapped. But it shall not exceed the present internal pressure by more than approximately 10%, in order to avoid possible internal collapse of the pipe or vessel wall.
Details of the online procedures for PE pipelines where hydro testing / pneumatic testing is not recommended. “EF Jointing”

MDPE pipeline is constructed by joining together lengths of PE pipe. The PE pipes can be joined by a variety of joining techniques like electrofusion couplings, butt fusion and mechanical jointing. However, the most preferable method shall be electrofusion jointing. Smaller service pipes or spur lines can be taken off the live PE main by tapping tees to the top of the pipes using the EF jointing method.

PE fittings used for EF jointing shall be made as per ISO 8085, Part 3 “Polyethylene fittings for use with polyethylene pipes for the supply of gaseous fuels – Electrofusion fittings”

The Electrofusion jointing shall be carried out as per ISO DTR 10839 “Recommended practice for laying of PE pipes”. Electrofusion type of jointing shall be applied to pipe / fittings of same Outside Diameter and Wall Thickness. The surface of the pipe shall be scrapped to ensure that it is free from burrs and oxide layer at the pipe ends to be welded. Pipe ends shall be free from grease or other dirt & the degreasing shall be done by Isopropyl Alcohol.

The End faces of pipe to be welded shall be at right angle to pipe axis. Gap between pipe-pipe or pipe-fittings or fittings-fittings shall not be more than 0.3 mm for all sizes after planing.

The Electrofusion jointing shall be carried out using standard EF jointing machines. During the Electrofusion welding process, the frequency & voltage of generator supplying power shall not outside the prescribed range of the EF machines. The use of Top-loading clamp is a must during the entire heating cooling cycle. The heating & cooling time for each joint shall be fed into the EF machine either by bar code readers or manually.