1.0 GUIDELINES

1.1 GENERAL

1.1.1 All pipeline networks shall establish, document, implement and maintain an Integrity Management System (IMS) of pipelines as prescribed in Petroleum and Natural Gas Regulatory Board (PNGRB) Regulations. All activities covered therein shall be carried out strictly in conformity with the provisions and intervals mentioned in the board approved IMS of respective networks.

1.1.2 All the units / network headquarters shall establish, document, implement and maintain an Integrated Quality Management System (IQMS) for pipelines, compressor / booster stations encompassing Quality Management System, Environment Management System and Occupational Health and Safety Assessment Series. All the units / stations / pipeline systems shall ensure certification / recertification as per latest relevant version from reputed certifying agency. IQMS shall be implemented to all the new systems viz. compressor / booster stations and pipeline and its associated installations within minimum possible time after their commissioning but not later than one year from start of operation. To ensure uniformity and consistency across installations of similar nature, effort shall be made to keep similar frequencies for monitoring & maintenance activities in the IQMS unless some specific requirement exists.

1.1.3 All maintenance bases shall prepare component based SOPs / SMPs to address all components and aspects of operation & maintenance of plants (Compressor stations, pumping stations & terminals), pipelines and its associated installations which are part of IMS. SOPs and SMPs are categorized under Type-A and Type-B.

Type–A are common general SOPs and SMPs which shall be applicable to all sites (with / without site specific reference / modulation) and shall be issued with the approval of ED (O&M)-CO.

Type-B are site specific SOPs and SMPs which shall be applicable to specific sites only and shall be issued with the approval of OIC / CGM after vetting by the RIMG of the respective network for uniformity across GAIL.

i) The SOPs & SMPs shall be prepared by a team of maintenance / operation group after due consideration of manual, OEM recommendations, experience & if required advice from Subject Matter Expert (SME).

ii) Apart from operation / maintenance aspects, the SOPs / SMPs shall take care of the safety aspect of environment, man, and machine.

iii) The SOPs / SMPs shall be made available in soft form in GAIL Intranet.

iv) SOPs / SMPs shall be adhered to during Operation and Maintenance activities.

1.1.4 “List of all critical equipment / components / instruments / spares shall be declared by all the Departments / Stations, along with its OEM / OEM approved vendors with the approval of respective OIC / CGM. The list shall be reviewed by OIC / CGM every
year for any revision based on experience gained and / or any modification in system during the preceding years and shall be part of IQMS.

Any equipment / component / instrument / spares shall be considered critical if it is custom made, have long lead times from ordering to delivery, outage of the same directly disrupts the intended objective of the station (i.e., throughput, production etc.), direct impact on safety, environment and its frequency of failure. Such an equipment / component / instrument / spares meeting the above criterion shall be considered critical even when standby equipment is provided since availability of standby equipment also has to be ensured.”

1.1.5 All the critical equipment of compressor Station / Booster station shall be maintained in such a way that they can be operated instantly at any given point of time including standby equipment.

1.1.6 All the interlocks of Machine / equipment shall always be kept in healthy condition and should not be bypassed but for extremely exceptional conditions which need to be duly certified and authorized by the Operations-in-Charge of the plant. Such exception shall be brought to the notice of OIC / CGM and efforts taken for expeditious restoration of system to conditions that do not require such by-passing. However, if any interlock is not restored within 7 working days then approval of OIC / CGM shall be taken with proper justification.

1.1.7 All machines, big or small, shall be covered under preventive / predictive / condition monitoring maintenance programme and all such machines to be mapped in SAP. The preventive / predictive / condition monitoring technique shall be selected depending upon criticality of the machine and shall be incorporated in the maintenance manual. The frequency of maintenance shall be based on past experience, vendor recommendations and national / international codes & standards.

1.1.8 All preventive maintenance activities shall be carried out in accordance with good engineering practices, vendor instructions & checklists / datasheets, as applicable, at prescribed frequency / interval. However, specialised maintenance activities shall preferably be carried out under OEM supervision / through OEM where in-house expertise is not available e. g. rotary & static equipment, critical systems, UPS, VSD, Circuit breakers, Battery chargers etc.

1.1.9 Predictive / Condition Based Maintenance: Since rotating equipment is more prone to wear and tear it is imperative to adopt equipment specific predictive / condition based monitoring programme. If running of such turbo-machinery beyond recommended Time between Overhaul is necessitated, the same shall be done in consultation with the OEM.

On line / off line predictive maintenance shall be part of the maintenance programme which shall include but not limited to following techniques.

1.1.9.1 Boroscopic Inspection of Turbines: Boroscopic inspection shall be part of predictive maintenance practices of gas turbines / other rotary machines where ports / provisions for such inspection exist and shall be carried out at least once in six month or at the best possible interval in case machine is run continuously beyond six
months. Records shall be maintained and analysed periodically to assess the deterioration of turbine internals with time and for any other condition that requires attention.

1.1.9.2 **Lube Oil Analysis:** Oil samples from equipment shall be collected at least once in a year from major rotating equipment and sent to reputed laboratories for analysis of various properties as well as for detection of presence of various metals. Based on such analyses, corrective action may be decided.

1.1.9.3 **Vibration Analysis:** Online / off line vibration monitoring shall be part of maintenance programme. Online vibration monitoring shall be adopted for critical / major equipment like gas turbines, compressors, major pumps etc. For non-critical / other rotating equipment off-line vibration monitoring may be carried out at regular intervals. Remedial measures required to maintain the health of the equipment shall be taken immediately based upon such analyses / diagnoses.

1.1.10 **INSTRUMENTATION AND CALIBRATION:**

1.1.10.1 A consolidated list of instruments including test software, if any, shall be established, segregated into ‘Instruments’ and ‘Masters’. History sheets of the master / instruments shall be maintained.

1.1.10.2 All Test & measuring instruments shall be calibrated traceable to national / international standards.

1.1.10.3 All product quality control instruments shall be calibrated with standard test and measuring instruments to generate required confidence on manufactured product quality.

1.1.10.4 All field and master instruments as identified above shall have a unique identification number (tag number).

1.1.10.5 The identification and status of calibration of test equipment’s covered under list of master & instruments shall be indicated on the instrument in the form of stickers / tag indicating the instrument name, tag number, calibration date, calibration due date etc.

1.1.10.6 Upkeep of master instruments shall be ensured with regard to safety, accuracy and repeatability. Master instruments shall be calibrated traceable to National / International standards through an unbroken chain.

1.1.10.7 Deviations from approved Calibration and Maintenance periodicities and procedure shall be only with the approval of OIC / CGM concerned.

1.1.11 **STATUTORY PERMISSIONS:** OIC / CGM / In-charge of station / pipeline network shall ensure that all required clearances / permissions for operating the pipelines / facilities are in place. Clearances / permissions obtained during the construction phase shall be taken over from the construction / project group and their continued validity ensured. Details like date of inspection, next renewal date, capacity, license etc. shall be displayed nearby respective equipment in the field, wherever applicable. A list of all required licenses / permits / clearances shall be maintained with the office of the OIC / CGM / Station-in-Charge with details of
validity, file references, contact details of authorities concerned etc. to enable advance action for renewals if required and maintenance of validity of such documents.

1.1.12 Maintenance workshop / meet for experience sharing will be arranged at least once in a year to disseminate the maintenance experience, innovative initiatives, adoption of latest technologies, etc. The same shall be compiled and shared widely amongst employees through e-platforms such as intranet, email etc.

1.1.13 Data pertaining to inspections carried out during commissioning stage such as machine test run, vibration, pipeline ILI & EGP, CP etc. shall be handed over to O&M.

1.1.14 DELETED

1.1.15 In addition to technical audit by internal audit group, Corporate O&M shall constitute and notify cross location teams and audit plan to ensure compliance of maintenance policy provisions. OIC / CGM’s of respective units / stations shall ensure time bound compliance of the recommendations of such audits.

1.1.16 Each station / network headquarters shall develop a checklist of most common deficiencies pointed out by various auditors for a proactive internal assessment and rectification with an objective to achieve zero audit point status.

1.1.17 All the entries in SAP shall be ensured while carrying out the maintenance activities i.e. maintenance planning to generating order / PR to completion of job, OIC / CGM / network in charge / Department Head should ensure compliance every month.

1.1.18 General Housekeeping of plant / station shall be maintained under excellent condition keeping the safety aspects in mind.

1.1.19 As a general practice painting of plant machinery / piping / structures / building / offices shall be carried out once in three years. However, if condition of painting is found satisfactory, the periodicity may be increased after reviewing the condition of painting. For corrosive environment, this frequency may be increased with the approval of respective OIC / CGM.

1.1.20 All the important structures like foundation of motors, turbines, generators, building etc. shall be checked every year visually and shall be checked once in five years or after every extension, alteration, repairs, addition or machinery, plants etc. through competent agency to ensure their structural integrity.

1.1.21 All the drainage of plants and buildings shall be cleaned before start of monsoon every year.

1.1.22 Pipeline Integrity Management System Framework and associated manuals & guidance documents issued under the approval of ED (O&M)-CO, shall be referred in pipeline integrity management in general and specific areas of coverage in particular.

1.1.23 The provisions contained in this guideline shall be considered as minimum requirement. Any additional activity / assessment for maintaining integrity or system improvement may be carried out as per site requirement.
1.1.24 Each region / network shall review the data implemented in the central GIS and Centralized Pipeline Integrity Management System (CPIMS) applications, at least once every year for keeping them up-to-date.

1.1.25 Data for Integrity assessment: Data integrity is of utmost importance. All data to be furnished for integrity assessments shall be validated under a maker checker concept.

1.2 SAFETY

1.2.1 GAIL fosters highest level of safety in all its activities. All the maintenance procedures shall invariably incorporate specific safety precautions to be followed during various activities. “Health, Safety and Environment Management System Manual” should also be referred while carrying out the maintenance activities.

1.2.2 All pipeline regional offices / Pipeline Headquarters shall designate a Risk officer. All the modifications shall be carried out following management of change procedure.

1.2.3 Subsequent to commissioning of pipelines & Plants, QRA and HAZOP shall be carried out at regular intervals as per stipulations of prevailing statutes such as OISD, PNGRB regulations etc.

1.2.4 No maintenance job shall be executed without obtaining the applicable safety permit and ensuring proper safety. At remote locations / terminals where safety permit system cannot be applied such as stations without Safety Department or where distinction can not be drawn between operation and maintenance department, specific safety check list notified in this regard, shall be referred to at the beginning of each of the activity at operational pipeline installation / facility by the engineer who is undertaking / supervising the maintenance job.

1.2.5 In addition, hot work, work at height, vessel entry etc., shall be undertaken after complying with required safety measure suggested by Fire & Safety department and under the supervision of Fire & safety department representative where available for completion of the required jobs safely.

1.2.6 Safety devices: LEL / UV / Thermal / Infrared / smoke detectors shall be checked for their operation at least half yearly through simulating their operation and healthiness shall be ensured by taking corrective actions based on simulation results.

1.2.7 Monthly status of all installed safety devices – relief valves, rupture devices, switches, LEL / UV / Thermal / Infrared / smoke detectors, interlocks, fire extinguishing agent release system shall be updated and a consolidated report shall be prepared at each station and an exception report shall be sent to Corporate O&M with reasons for exception and action plan for restoration.

1.2.8 Electrical earthing system shall be constructed and maintained in accordance with IS: 3043 / OISD137 / OISD147 at all the installations of GAIL to ensure safety to plant machinery and personnel. Testing of earth pit shall be carried out at least twice in a year (once in dry season) and appropriate action shall be taken to maintain the pit resistance within the specified values as per relevant codes / standards.
1.2.9 Periodical Safety Audits of each and every facility shall be conducted without exception. Frequency of such audits shall be as notified by Corporate HSE. Audit observations / recommendations shall be implemented and exceptions, if any, shall be intimated to Corporate O&M for further deliberation and advice.

1.2.10 **Pressure Safety Valves:** Pressure Relieving Devices are installed on process equipment, pressure vessels, piping, and tanks to relieve excess pressure resulting from operational upsets and other causes. Malfunctioning of these devices could lead to devastating and disastrous conditions. Inspection, Maintenance and Calibration of these devices therefore assume critical proportions. Isolation valves of PSVs shall be kept open under normal operating condition.

1.2.10.1 Guidelines for frequency for calibration / checking of Pressure Relief / TRV / Safety Devices are given as under:

<table>
<thead>
<tr>
<th>Application</th>
<th>Frequency</th>
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<tbody>
<tr>
<td><strong>Pipelines</strong></td>
<td></td>
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<tr>
<td><em>NG and LPG pipelines &amp; appurtenances</em></td>
<td>At least once every year</td>
</tr>
<tr>
<td><strong>Compressor / Booster stations</strong></td>
<td></td>
</tr>
<tr>
<td>(a) Equipment / Pressure Vessels Not covered under SMPV rules</td>
<td></td>
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<tr>
<td><em>Corrosive Service</em></td>
<td>Not later than 2 years</td>
</tr>
<tr>
<td><em>Non-Corrosive Service</em></td>
<td>Not later than 4 years</td>
</tr>
<tr>
<td>(b) Equipment / Pressure Vessels covered under SMPV rules</td>
<td>At least once every year or according to SMPV rules</td>
</tr>
</tbody>
</table>

1.2.10.2 **Calibration Methodology:**

Further, following shall be ensured while carrying out the calibration:

A) **For outsourcing the calibration of PSVs, the contractor shall fulfil the following minimum criteria:**

- Agency / authorized representative must be certified by CCOE for testing and calibration of PSV for Equipment / Pressure Vessels covered under SMPV rules.
- Test bench shall be hydro-tested as per frequency defined in SMPV rules.
- Third party certification / inspection / calibration of test benches and accessories like pipe, flexible hose, pressure gauges etc. shall be submitted by the contractor.
- Contractor must fulfil the experience and other criteria as per C&P procedure of GAIL.
- Persons involved in testing must wear proper PPE & toughened glass shield during calibration.

B) **For in-house calibration following minimum shall be ensured:**

- Test bench shall be hydro tested as per frequency defined in SMPV rules.
• Third party certification / inspection / calibration of test benches and accessories like pipe, flexible hose, and pressure gauges shall be maintained.

• Persons involved in testing must wear proper PPE & toughened glass shield during calibration.

• Process / Operation department shall witness the calibration and sign the calibration report jointly.

1.2.11 Routine and diligent use of Safety Appliances, Non-Sparking Tools in Hydrocarbon areas, etc. shall be adopted while carrying out maintenance jobs.

1.2.12 Testing and Calibration of all the safety devices (such as critical pressure / temperature indicating devices, lifting and hoisting devices, tools and tackles, Electrical Overhead Cranes, etc.) shall be carried out regularly without exception as per statutory requirements.

1.2.13 All the tools and tackles used for maintenance activities by respective department shall be maintained for safe use & inspected at least once in six months to ensure their integrity. This shall be made part of IQMS system also.

1.2.14 All efforts shall be made to keep environment green and clean during maintenance. Waste / hazardous material generated during maintenance activities shall be disposed-off at designated places only.

1.2.15 In case of LPG pipeline, Critical control parameters i.e., storage vessel level, pressure, temperature, flow, quantity, ROV and MOV status shall be shared / made available & monitored in the control rooms of GAIL and connected OMCs.

In case of emergency the pipeline ROV shall close earlier than Storage vessel ROV. An interlock / circuitry shall be incorporated in the design.

The following indications shall be incorporated in the control rooms of both supplier and consumer company. (a) Close indication of LPG storage ROV. (b) Pr. Switch High High of LPG storage (c) Level Switch High High of LPG storage (d) Pr Switch High High of LPG receiving pipeline system (e) Pr. Switch High High of main LPG pipeline (f) Any fire/emergency in supplier / receiver installation
1.3 OPERATIONS

1.3.1 A Comprehensive Operation Manual for pipeline / Compressor / Booster station covering written procedures for conducting operations and for emergency response shall be prepared with due approval of OIC / CGM concerned / In-charge of pipeline network within the Integrated Quality Management System (IQMS) of the concerned network / facility. The manual shall be scrupulously adhered to and shall be reviewed and updated every year.

1.3.2 The Operation manual shall include but not limited to following procedures to ensure safety during operations and maintenance:

(a) NORMAL CONDITIONS:

1.3.2.1 Standard Operating Procedures (SOPs) for all plant operation activities.

1.3.2.2 Monitoring, sample testing and controlling of quality of Natural Gas / LPG for pipeline transmission such as moisture / hydrocarbon dew point, total sulphur, H₂S etc.

1.3.2.3 Maintaining records related to construction & operations such as statutory / other permissions, P&ID, maps, operating history, incident reports etc.

1.3.2.4 Start-up and shutdown of pipeline / Compressor / Booster stations in a manner designed to assure operation within the limits prescribed for operation.

1.3.2.5 Procedure for isolating and purging of compressor / Booster stations or sections of pipelines, as applicable before handing over for maintenance and after taking over for service.

1.3.2.6 Periodically reviewing the effectiveness and adequacy of the procedures followed for normal operation and amendment of the procedures for continual improvement.

1.3.2.7 Periodic inspection and testing of pressure limiting equipment, sectionalising / critical / safety valves and devises to determine that they are in safe operating condition.

1.3.2.8 Control Room Management / Shift Management procedures for smooth operation of pipeline / Compressor / Booster stations and implementation as applicable.

(b) ABNORMAL CONDITION:

Procedures, when operating design limits have been exceeded, such as Responding to and correcting the cause of:

1.3.2.9 Unintended shutdowns such as closure of valves etc.

1.3.2.10 Increase or decrease in process parameters (such as pressure or flow rate or temperature etc.) outside normal operating limits.

1.3.2.11 Loss of communications.

1.3.2.12 Actuation of any safety device due to abnormal condition / situation.
1.3.2.13 Any other anticipated malfunction of a component, deviation from normal operation, or personnel error, which may result in a hazard to persons or property.

1.3.2.14 Handling and reporting for any abnormal operation / condition.

1.3.2.15 Emergency response as per Emergency Response and Disaster Management Plan.

1.3.2.16 Total power loss.

1.3.3 The control rooms of Compressor / Booster Stations, National / Regional Gas Management Centre and major terminals shall be manned round the clock with manpower of adequate level, qualification and experience.

1.3.4 All the Regional Pipeline Headquarters, Compressors Stations and Booster Stations shall be equipped with SCADA facility for remote monitoring and control of operational parameters and critical operations including quick response to failures / emergencies.

1.3.5 Pipeline operation activities shall be performed by operation department of respective Compressors Stations, Booster Stations & RGMC operation personnel under its jurisdiction.

1.3.6 **ALARM MANAGEMENT:** An alarm management system shall be established to review and analyse all the alarm / abnormal operating conditions / events. The alarm management shall include but not limited to the following:

1.3.6.1 SCADA / DCS / HMI shall be equipped for indicating, storing and trending of alarms

1.3.6.2 All the alarms shall be segregated into following major categories:
   a. Critical alarms that can affect the safety and operation of plant / pipeline
   b. Non-critical alarm which may not impact the operation and safety

1.3.6.3 A Review of safety-related critical alarm using a process that ensures alarms are accurate and need the corrective action shall be forwarded to department concerned for immediate corrective action. The faulty signals shall be rectified within 7 days of occurrence by the department concerned.

1.3.6.4 Safety related alarm set-point values and alarm descriptions shall be verified and corrected at least once every year.

1.3.6.5 Alarm management plan shall be reviewed at least once every year to determine the effectiveness of the plan.

1.3.6.6 The type and frequency of alarm instances shall be reviewed periodically and necessary action shall be taken to avoid escalation of alarm / event to breakdown / trip.

1.3.6.7 An exception report shall be generated on daily basis by each RGMC / MCR / Control Room on all the faulty field signals and critical alarms of each pipeline network / station with date and time of occurrence. The report shall be sent to HOD concerned with a copy to respective OIC / CGM and NGMC.
1.3.6.8 In exceptional case, an alarm may be disabled by GAILTEL-T/M for a maximum period of 30 days (for Pipelines) on the request of WIC / OIC / CGM of respective work centre.

1.3.6.9 Weekly report of critical alarms and faulty signals older than 07 days shall be sent by the RGMC / MCR to respective OIC / CGM with a copy to NGMC, Head of GAIL TEL and O&M departments at CO (O&M) Office and respective EDs.

1.3.6.10 The critical alarms and faulty signals older than 30 days shall be reported by Corporate O&M to Director (Projects).

1.3.7 PRESSURE CONTROL SYSTEM IN THE BRANCH PIPELINES IN CITIES & TOWN:

1.3.7.1 Suitable Pressure Regulating System (PRS) shall be installed in all the branch / spur pipelines.

1.3.7.2 PRS shall be set for safe maximum pressure in the downstream pipeline sections, also considering the customers flow requirements.

1.3.8 REMOTE OPERATION & AUTO CLOSURE FACILITY OF SECTIONALIZING VALVE (SVS):

1.3.8.1 All SVs / IPs / Tap off valves in pipelines shall be equipped with actuators. However, this is not applicable for tap-off valves falling within Industrial corridor.

1.3.8.2 All the SVs / IPs within city location / high risk locations / vulnerable location shall be remote operated and always kept in remote.

1.3.8.3 At least alternate SVs / IPs in trunk pipelines shall be remote operated.

1.3.8.4 All remote operated SV’s shall remain in Auto mode. Based on risk analysis study, if required, the manually operated SVs / IPs / Tap-Off shall be converted for remote operation through SCADA.

1.3.8.5 Remote operation checking shall be done through SCADA at least once in 6 months.

1.3.8.6 In addition to above, all the SV’s within city location / high risk / vulnerable locations shall also have auto closure facility, operating from combination of at least two hard wired pressure switches / transmitters feedbacks in series, one for upstream pressure and another for downstream pressure of SV. Pressure set point may be fixed based on operating pressure range duly following Management of Change (MOC) procedure given at Clause 9.0 of this document. The system shall be checked for functionality at least once in 6 months.

1.3.9 Energy Efficiency Monitoring and Control:

1.3.9.1 Operation department shall identify the major equipment and system for performance monitoring.

1.3.9.2 The performance of major equipment and system shall be monitored for energy / specific energy efficiency and compared with designed data / benchmark at least once
in quarter followed by suitable action to keep the performance within targets and made part of IQMS system.

1.4 MONITORING & MAINTENANCE OF PIPELINES, TERMINALS & ASSOCIATED FACILITIES

1.4.1 A comprehensive Maintenance Manual covering guidelines, programme and practices to manage integrity of pipelines under their control as per board approved IMS as minimum and prevailing standards (ASME B31.8 / B31.4 / ASME B31.8S, OISD 226 / 214 / 233, PNGRB regulations etc.) shall be prepared with due approval of OIC / CGM concerned / In-charge of pipeline network within the Integrated Quality Management System of the network / facility concerned.

1.4.2 An Integrity Assessment, Monitoring and Mitigation plan comprising identification of threats and evaluation of their impact, preferred integrity assessment methods and frequencies shall be part of such Maintenance Manual which shall also take into consideration periodic assessment and an evaluation process to check effectiveness of the programme. The plan shall be updated periodically to incorporate any change in the integrity threats. The plan shall be in compliance to PNGRB regulations for Pipeline Integrity Management of NG / LPG pipelines.

1.4.3 The documents such as ERDMP and Integrity Management System for Natural Gas / LPG pipelines shall be prepared as per requirement of PNGRB regulation within one year of commissioning of any pipeline followed by TPIA certification. The compliance audits as per requirement of PNGRB regulations (T4S) shall also be completed within one year of commissioning any pipeline and associated system. The compliance document shall be submitted through Corporate RA / HSE department to PNRGB along with time bound mitigation plan for non-conformities / observations of auditor / TPIAs.

1.4.4 A composite preventive maintenance schedule for all the pipeline segments covering the Integrity Management Plan and the other preventive maintenance activities shall be defined in the above maintenance manual which shall be scrupulously adhered to. Any deviation shall be only with the approval of OIC / CGM concerned with due justification for deviation and catch-up / alternate plan.

1.4.5 On commencement of each financial year, all the OIC / CGMs shall prepare their Maintenance Plan / Work plan covering important jobs along with major milestones and completion targets. The same shall be presented during O&M meets along with its progress / status.

1.4.6 With regard to foreign pipeline / utility crossings of GAIL pipelines / OFC, existing ‘Guideline / Policy for Pipeline / OFC crossings – GAIL / Policy/Pipeline/O&M/01 and revisions if any issued by Corporate O&M may be referred.

1.4.7 Maintenance & Inspection activities such as cleaning pigging, intelligent Pigging, CPL / DCVG survey etc. may be performed as stipulated in the latest edition of ASME B 31.8 / OISD 226 / PNGRB regulations for NG pipelines and ASME B31.4 / OISD 214 / PNGRB regulations and other related OISD standards to improve the
efficiency and integrity of pipelines. The frequencies of some major activities shall be as mentioned in the following clauses.

1.4.8 CLEANING PIGGING:

(a) NG Pipelines: Cleaning Pigging shall be carried out for all piggable pipelines at least once in a quarter for wet gas and once in a year for dry gas. This frequency of cleaning pigging may be revised with the approval of OIC / CGM not below the rank of GM, based on quantity of debris / condensate collected. The revised frequency in any case shall not be more than a year for wet gas and three years for dry gas.

(b) LPG Pipelines: Cleaning Pigging shall be carried out for all piggable pipelines at least once in a quarter. This frequency of cleaning pigging may be revised with the approval of OIC / CGM, based on quantity of debris / condensate collected. The revised frequency in any case shall not be more than once a year.

(c) Collected pigging residue shall be analysed and records of the same shall be maintained for future reference (refer Guidance document on Pig Residue Sample Collection, Testing and Reporting for details). Consideration shall be given for action, based on trend analysis of pig residue.

(d) Cleaning pigging shall be done using foam, gauge, brush & magnet pig runs during each cleaning pigging cycle. In case pigging is done quarterly or more frequently, one pig run of brush / magnetic pig and any other cleaning pig may be alternated during each run. Additional pig runs may be considered as per condition of pigs received, debris collected and other site conditions.

(e) The pipeline may be considered clean if the maximum amount of debris collected in the last / Magnet pig run, is less than 100 Kg / Condensate less than 50 liter (for pipeline section 18” dia. & above and 70 Km length & above) and 25 Kg / condensate less than 10 liter for other pipelines.

(f) Notwithstanding the above, if the hydraulic condition in a pipeline section cannot support pigging (owing to very low flow / pressure or pipeline not in operation), pigging of such pipelines shall be taken up immediately after the same attains requisite conditions for pigging. Such lines till the time they achieve piggability shall be considered as unpiggable and all actions applicable for unpiggable lines shall apply.

1.4.9 INTELLIGENT PIGGING (IN-LINE INSPECTION):

1.4.9.1 In-Line Inspection of pipelines shall be done using High Resolution MFL tool with Inertial Mapping Unit (IMU) before commissioning / handing over to O&M. Further high resolution Electronic Geometry Pigging (EGP) shall also be done before commissioning, after hydro-test.
1.4.9.2 In-Line Inspection (ILI) with Inertial Mapping Unit (IMU) shall be carried out at least once in 10 years for Dry gas and once in 5 years for wet gas / sour gas and LPG pipelines. First time ILI shall be carried out using high resolution MFL tool. Subsequent type of ILI tools and next ILI schedule (not later than the above stipulated intervals), shall be decided by the Pipeline Head Quarters, based on the Fitness for Purpose / Service report of previous ILI.

1.4.10 Methodology for Unpiggable Pipelines:

1.4.10.1 Effort shall be made to convert the existing underground unpiggable pipelines to piggable pipelines depending upon feasibility. ILI shall be carried out immediately after conversion but not later than the interval stipulated in 1.4.9.2

1.4.10.2 In case conversion is not possible, the integrity Assessment of unpiggable pipelines shall be done using Direct Assessment (DA) as per relevant NACE standards or any other technology acceptable to statutory / regulatory bodies. The integrity assessment as above shall be conducted at the frequency specified in the IMS document of respective pipeline region / network but not later than 10 years. The assessment interval shall be decided by the Pipeline Head Quarters based on operating conditions / past assessment / life of pipeline but the same shall not be more than the stipulated interval of once in 10 years. Further, specific inspection activities recommended in OISD-233 shall be carried out at the intervals mentioned therein.

1.4.10.3 Further, whenever any pipeline is exposed for inspection, coating repair, crossings etc. non-destructive testing such as UT, peel off test etc. (refer Guidance document on Field Verification Procedure for details) shall be conducted and record shall be maintained.

1.4.11 PIPELINE REPAIR METHODOLOGY:

1.4.11.1 All anomalies discovered during integrity assessment / inspection such as intelligent pigging, bell-hole inspection, DCVG, CIPL etc. or reported otherwise shall be evaluated and classified under the following three categories based on severity of defect (refer Guidance Document on Pipeline Anomaly Management for details):

   a) Immediate repair condition – Indication shows that defect is at failure point.

   b) Scheduled Repair condition– Indication shows that defect is significant but not at failure point.

   c) Monitored conditions– Indication shows that defect will not fail before next scheduled inspection.

1.4.11.2 Root cause analysis shall be carried out and action may be initiated to arrest the root cause of the defects.

1.4.11.3 A schedule for repair shall be prepared for all defects to be attended / monitored and mitigation action shall be undertaken accordingly, in a time-bound manner to eliminate an unsafe condition detrimental to the integrity of a pipeline or to ensure
that the condition is prevented from posing a threat to the integrity of the pipeline until the next reassessment. This schedule shall be updated after completion of each integrity assessment and mitigation action.

1.4.11.4 Recommendations of external consultant / Integrity experts may be obtained for suitable repair action, if required.

1.4.12 PIPELINE REPAIR CRITERIA:

1.4.12.1 Immediate Repair Conditions:

i. Pipeline failure (Leak and Rupture).

ii. A dent with depth greater than 2% of nominal pipeline diameter on girth and seam welds or dent of any depth with cracks.

iii. A plain dent with depth exceeding 6% of nominal pipeline diameter.

iv. Metal loss anomalies with depth greater than 70% of wall thickness.

v. Metal loss anomalies with ERF greater than or equal to 1.00 (Estimated Repair Factor = Maximum Allowable Operating Pressure / Safe operating pressure calculated as per ASME 31G).

vi. Any indication of adverse impact on the pipeline that may cause immediate or near term leaks or ruptures based on their known or perceived effects on the strength of pipeline which include dents with gouges, welding defects etc.

vii. In case of liquid (LPG) pipeline, a dent located on top of the pipeline (above the 4 and 8 o’clock positions) with a depth greater than 2% of pipeline diameter [greater than 0.250 in. in depth for a pipeline diameter less than nominal pipe size (NPS) 12].

viii. In case of liquid (LPG) pipeline, any dent that contains indications of stress risers (e.g. gouges, grooves, scratches), or corrosion. Alternately, an industry-recognized engineering evaluation may be used to determine a response schedule.

1.4.12.2 In case, indication is of ‘Immediate category’ the operating pressure shall be immediately lowered to safe limit or the affected section shall be isolated as the situation demands. The defect location shall be treated as “Vulnerable Location” and monitored accordingly, till permanent repair action is taken.

1.4.12.3 Scheduled repair Condition:

i. Metal loss anomalies with depth between 40% to 70% of wall thickness.

ii. Metal loss anomalies with ERF greater than or equal to 0.95 but less than 1.00 (Estimated Repair Factor = Maximum Allowable Operating Pressure / Safe operating pressure calculated as per ASME 31G).

The defect location shall be declared as “Vulnerable Location” and monitored accordingly, till permanent repair action is taken. Repair action shall be scheduled based on severity of defect but shall not exceed more than 2 years from the date of ILI inspection.
1.4.12.4 Monitored Conditions:

Monitored indications are least severe and typically will not require examination and evaluation until the next scheduled integrity assessment interval stipulated by the integrity management plan, provided that they are not expected to grow to critical dimensions prior to the next scheduled assessment.

1.4.12.5 Temporary Repair method:

a) In case of burst no temporary repair is allowed.

b) For Pin hole / leaks and thickness loss as per clause 1.4.12.1:
   - System Pressure to be reduced to safe operating pressure till the completion of temporary repair.
   - External Mechanical Clamp (Bolted) to be used as temporary measures.
   - Circumferential and axial welding of the clamp shall be completed at the earliest available opportunity or within three months whichever is earlier (Refer ASME 31.8) to convert it to permanent repair. In this case no further action is required for permanent measure.

c) For other immediate repair conditions:
   - Pressure may be reduced to safe operating pressure.
   - Declaring the location as vulnerable and action for repair as per the guidelines shall be taken till permanent measure has been taken.

1.4.12.6 Permanent Repair Method:

1.4.12.6.1 Permanent measures for repair shall be completed at least one year prior to the recommended date / year as per the FFS / RRR report on ILI.

1.4.12.6.2 Replacement of defective pipeline section is the most preferred option to repair the defects permanently. Considering un-interrupted supply to the consumers, where shut down of the pipeline may not be feasible for longer duration; following repair methodology may be adopted as per the international codes & standard. However, if any one pipe length has more than 2 defects of immediate or scheduled condition closer than 1.5 m and / or if any one pipe length has a cluster of defects of more than 20% metal loss with one or more among them falling under immediate or scheduled repair category, then repair shall be carried out by replacement of full pipe length.

a) For leaks:
   - Pressurized full encirclement welded split sleeve shall be installed. Sleeve shall be designed in strength at least equal to the design strength of the pipe being repaired and shall not be less than 300 mm in length.
b) For dents, external damages and External corrosion:

- Pressurized full encirclement welded split sleeve shall be installed. Sleeve shall be designed in strength at least equal to the design strength of the pipe being repaired and shall not be less than 300 mm in length.
- Composite sleeve which is applied with an adhesive with proven and reliable engineering tests & analysis may also be installed. However for dents & external damage, the pipeline surface shall be smoothened and the missing wall shall be filled with incompressible filler, check for cracks / other defects shall be carried out through NDT, before installing the composite sleeve. If required the pipeline pressure may be reduced / depressurized while executing the job.

c) For Internal Corrosion:

- Pressurized full encirclement welded split sleeve shall be installed. Sleeve shall be designed in strength at least equal to the design strength of the pipe being repaired and shall not be less than 300 mm in length.

1.4.12.6.3 In case the pipeline is under shutdown or where shutdown is feasible then the defects shall preferably be repaired by replacement method.

1.4.13 ROU SURVEILLANCE & INSPECTION

1.4.13.1 Helicopter / Aerial Surveillance: Helicopter / Aerial surveillance of the identified major pipeline networks shall be carried out as per notified frequency. However efficacy and feasibility of latest pipeline surveillance technologies shall be reviewed from time to time and may be adopted in lieu of or in conjunction with Helicopter patrolling after management approval.

1.4.13.2 Foot Patrolling: All gas & liquid hydrocarbon pipelines shall be patrolled to detect any encroachment / unauthorized construction activity / soil erosion / wash out etc. GAIL pipeline shall be mapped in GIS & pipeline foot patrolling shall be done using portable gas detector with GPS based line tracking facility. The ground patrolling of Natural Gas and LPG pipelines shall be carried out as per following frequency.

a) NG Pipelines:

i) Monthly patrolling for Location class 3 & 4 and quarterly patrolling for location class 1 & 2 by a hired Pipeline Patrol Agency / GAIL official (This includes any other surveillance like helicopter patrolling also).
ii) Yearly foot patrolling / Line Walk by GAIL officials after monsoon.

b) LPG Pipelines

i) Weekly Patrolling by a hired Pipeline Patrol Agency / GAIL official (This includes any other surveillance like helicopter patrolling also).
ii) Yearly foot patrolling by GAIL officials after monsoon.

c) *NG and LPG Pipelines in urban / suburban Area*

i) Daily foot patrolling for section of pipeline which falls within the limits of Urban Agglomeration (UAs) / Towns having a population of 1 Lakh or more by a hired Pipeline Patrol Agency / GAIL official. Notwithstanding the foregoing, the locations where patrolling is being done at a lesser frequency, the existing practice / frequencies may be continued based on the experience so far.

ii) Ground patrolling at a frequency more than daily patrolling (for e.g., twice a day etc.) may be required in areas of very high population density or vulnerable locations. In such cases, the frequency shall be decided as per assessment by OIC / CGM of the respective pipeline network.

iii) Yearly foot patrolling by GAIL officials.

d) Pipeline sections not falling within city / suburban areas which may require increased ground patrolling than the recommended frequency shall be patrolled at such increased frequency as per assessment by OIC / CGM of the respective pipeline network.

1.4.13.3 Aerial photography and satellite imagery are increasingly being employed for variety of planning and analytical work. There are a number of resources from where historical imageries of area of interest can be obtained, many of them in public domain. It has been demonstrated that the pipeline corridor can be analysed using such platform. As a proactive measure, the imageries of pipeline corridor under each Pipeline Maintenance Base and RIMG shall be examined to detect potential earth cover erosion (such as in river meandering cases) and potential for development of residential / commercial buildings & structure on or near the pipeline. This activity may be conducted at least once a year.

1.4.14 **RECTIFICATION OF PIPELINE EXPOSURES:**

Based on various patrolling reports / other information, mitigation action for pipeline exposure shall be taken as follows:

1.4.14.1 **Temporary/ medium term Rectification :**

The exposed pipeline shall be provided with requisite earth cover, in combination with other measures such as providing support by gabion / sand / cement geo textile bags, anchor piles etc. as per site requirements. In case of pipeline exposure in river / nala etc. bank protection, stud etc. may also be done as per site requirements to prevent recurrence of soil erosion.

1.4.14.2 **Permanent measure :**
All such measures required for long term protection of pipeline such as lowering the pipeline, constructing concrete culverts, concrete encapsulation etc. based on standard engineering practice & experience, shall be taken.

For the exposure in the River / Nala crossing, lowering the pipeline either by open-cut or through HDD to a depth of minimum 2.5 m below scour depth may be considered. The length of pipeline section to be lowered should be decided considering the hydrological data of the river and length shall cover maximum span of the river plus extra length (depending on site conditions) on either side. Additionally, bank protection, stud etc. may also be required to prevent recurrence of soil erosion at such locations.

1.4.15 DEALING WITH ENCROACHMENTS:

1.4.15.1 After notice of any encroachment in GAIL ROU, respective maintenance base shall take-up with the encroacher to remove the encroachment through interaction or serving notice, failing which, follow-up action shall be done with respective authorities, followed by legal action, if required. Legal action, once decided shall be taken through Competent Authority by filing an application in the court as stipulated in the PM&P Act.

1.4.15.2 Competent Authority may be appointed, if not available already in respective area, by approaching the administrative authority concerned.

1.4.15.3 The encroacher shall be served notice informing about possible consequences due to third party activities in GAIL’s RoU and informing local authorities on regular basis.

1.4.15.4 Regular monitoring of progress made towards removal of encroachments shall be done at regional level.

1.4.16 CATHODIC PROTECTION AND COATING INTEGRITY : Pipe to Soil Potential (PSP), Close Interval Potential Survey (CIPS), Direct Current Voltage Gradient (DCVG) / CAT survey and other Cathodic protection / Coating integrity surveys shall be carried out as stipulated in prevailing OISD Standard (OISD 226 / OISD 214 / OISD 233) / PNGRB regulations. (Refer Guidance Documents on Monitoring & Maintenance of Cathodic Protection (CP) System for details). However, following may be adhered to as minimum requirement for CP monitoring:

1.4.16.1 Monitoring of CP data of all TRUs / CPPSM Units shall be online. The online parameters shall be cross verified with field data on monthly basis to check the efficacy of system.

1.4.16.2 The CP units not connected to online system shall be converted to on line monitoring. Till such time these CP units data monitoring shall be done at least on fortnightly basis.
1.4.16.3 Current Density for CP shall be calculated at least on monthly basis and compared with the design current density of the pipeline. In case of significant variation, reason shall be investigated and corrective action shall be taken.

1.4.16.4 The PSP reading (ON potential) at the Test Lead Points for entire pipeline shall be taken at least 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 polarised potential of at least (-) 0.85 volts with respect to copper / copper sulphate half-cell. In areas, where sulphides, anaerobic / aerobic bacteria, elevated temperatures, acid environments, and dissimilar metals are present, 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 cell.

1.4.16.5 Instant pipe to soil “OFF” potential readings at test lead points of entire pipeline shall be taken at least once every three Quarter. The PSP survey results shall be plotted graphically to identify and locate cathodic holidays. In case of unpiggable pipelines, the same shall be carried out once every 6 months as stipulated in OISD-233.

1.4.16.6 Current measurement at the test stations shall be carried out at least once in a year where current measurement facility exists.

1.4.16.7 Monitoring of Anode Ground Bed shall be carried out at least half yearly.

1.4.16.8 Monitoring of Polarisation Coupon shall be done at least quarterly, wherever installed.

1.4.16.9 CIPS, CAT, DCVG / CAT with “A” frame survey shall be carried out at least once in five years. Coating Peel off test shall also be conducted during coating repair to check the coating integrity.

1.4.16.10 All the cased crossing locations shall be inspected for any shorting between casing and carrier pipe at least once in year. However, if shorting is suspected based on quarterly PSP monitoring, further investigation shall be conducted, immediately.

1.4.16.11 Power availability to the CP station shall be monitored on percentage availability basis through online system.

1.4.16.12 All protective devices (Insulating Joints / Insulating Flanges, polarization cells, surge diverters, Zinc grounding cells, interference bonds etc.) shall be inspected at least once in a quarter.
Any anomalous condition observed during the inspection / survey shall be promptly corrected by appropriate mitigation measures.

1.4.17 CORROSION MONITORING:

1.4.17.1 Internal corrosion of pipelines shall be monitored by following monitoring techniques:

a) Corrosion coupons – Half yearly.
b) ER (Electric resistance) / ECN (electrochemical noise) / LPR (Linear polarisation) probe – Quarterly.
c) Analysis of Pipeline liquid, if available / collected – At least half yearly.
d) Pig debris analysis – as per pigging schedule.
e) ILI run comparison – as per ILI schedule.
f) Corrosion modelling based on gas / LPG quality & operating characteristics. (during ICDA of unpiggable pipelines).
g) Any other available technique.

In pipelines handling gas with corrosive components beyond acceptable limits, as many number of techniques as possible in combination with a more rigorous monitoring frequency shall be adopted.

1.4.17.2 External ER Probe shall be monitored quarterly to measure the external corrosion rate.

1.4.17.3 Based on trend of corrosion rate observed, appropriate mitigation action such as control of source gas / LPG quality, effective cleaning pigging, corrosion inhibitor dozing, enhancing effectiveness of coating & CP system etc., shall be taken.

1.4.18 CRITERIA FOR AC / DC INTERFERENCE SURVEY:

1.4.18.1 Initial AC and DC Interference Survey shall be carried out at the time of pipeline commissioning and thereafter at an interval of every five years. The survey must necessarily be conducted on observance of any actual AC / DC interference on the pipeline or a potential interference source such as a new power line / third party pipeline in the vicinity of GAIL pipeline.

1.4.18.2 A positive swing of PSP of more than 50 mV shall be considered as DC interference. A 15 V induced AC voltage on the pipeline or AC Current density more than 30 A/m² measured on an AC corrosion coupon with 1 cm² holiday during steady state condition shall be considered as AC Interference. However, on case to case basis, higher criteria of AC current density above 30 A/m² but not more than 75 A/m² may also be considered acceptable considering sound grounding design.

1.4.18.3 AC transmission lines shall be verified and list to be updated every year. AC interference survey shall be carried out with computer modeling & simulation once
for entire pipeline and thereafter for the section where new transmission lines are noticed during yearly verification.

1.4.18.4 **AC / DC Interference Survey** shall be conducted on the identified pipeline section with suspected interference, including modelling / simulation in case of AC or HVDC interference. Mitigation measures shall be designed, implemented and validated on a case to case basis for its type and extent (refer Guidance document on AC Interference Survey & Mitigation for further details).

1.4.19 **All the periodical survey / monitoring shall be mapped and data uploaded in Intranet based application on Corporate O&M portal / SAP PM Module.**

1.4.20 **The aboveground / underground pipeline, equipment, vessels etc. which are part of a pipeline system in a Despatch Terminal, Receiving Terminal, Compressor Station, Pump Station, Intermediate Pigging Station, SV, Tap-off etc., shall be inspected in accordance with Guidance Document Ref: CIMG-GD-4-2016-0007 Facility Integrity Management System and repair action if any required shall be taken.**

1.4.21 **Thickness measurement survey of above ground pipeline, piping and vessels such as scrubbers, knock-out drums, etc., shall be done at least once in a year with particular attention to potential corrosion areas such as 5 - 7 o’ clock position on piping, vessel bottoms / drains etc. The measured thickness of piping / vessels shall be assessed for continuation in service.**

1.4.22 **IDENTIFICATION AND MONITORING OF VULNERABLE LOCATIONS:**
Vulnerable location identification and review shall be done by the OIC / CGM concerned of pipeline networks considering all aspects of safety, security and integrity. The vulnerable location list shall be reviewed every year for any modification required. Inspection of the identified vulnerable location shall be done at least on monthly basis.

1.4.23 **CONSTRUCTION WORK IN THE VICINITY OF GAIL PIPELINE:**

1.4.23.1 Efforts shall be made to appraise the local authorities including the district officials concerned, on the threats involved and to avert major construction activities in the vicinity of GAIL pipeline.

1.4.23.2 If such activities cannot be avoided, the constructing agencies may be persuaded through local authorities to adhere to precautions, terms and conditions as notified by Corporate O&M from time to time by entering into an agreement, to safeguard GAIL pipeline / installations during such construction work.

1.4.23.3 In case Construction agencies approach GAIL for clearance on instruction of local authorities or of their own, then also, they may be persuaded to adhere to precautions, terms and conditions as notified by Corporate O&M from time to time by entering into an agreement, to safeguard GAIL pipeline / installations during such construction work.
1.4.23.4 If construction agencies desire changes in Proforma agreement, same may be dealt, on merit as per clause 10.2 (amendment / deviation).

1.4.23.5 In case construction agencies are not willing to enter into agreement or ask for major changes in the Proforma agreement, the local authorities may be intimated on the threats involved during construction activities in the vicinity of GAIL ROU with list of precautions / terms and conditions to be followed during construction. No separate clearance in this case may be given to construction agencies.

1.4.23.6 Introduction of cased crossing especially by split casing method should be avoided, since cased crossings introduce additional vulnerabilities to pipeline integrity. The following principles shall be adopted in permitting extension or new transport corridors across GAIL pipelines:

a. In case of existing cased crossing, extension of casing by split casing may be permitted, after taking due precautions such as
   (i) Laying PCC underneath the casing to prevent settlement.
   (ii) Casing insulators at an interval of maximum 500 mm.

b. In case of new crossing, calculation in accordance with API RP 1102 to confirm safety of pipeline without casing and such crossings satisfying the calculations, may be permitted without casings. Where the crossings fail to satisfy the calculations, the concerned agency may be asked to provide appropriately designed RCC culverts or portals for the extent of casing.

Further, where pipelines come underneath carriageway of transport corridors, the preferred option will be to shift the pipeline out of the carriage way extent. If the same is not feasible, engineering assessment on case to case basis shall be required.

1.4.24 MARKERS IN PIPELINE:

The following types of marker shall be provided along the pipeline:

1.4.24.1 Warning Marker: Pipeline Warning markers shall be installed at each & every kilometer. Apart from this, additional warning markers shall also be installed at each side of highways (NH/SH), major district roads (MDR), all metalled roads, railway crossings, water body crossings any other major crossings and at entrance to stations.

For Urban Agglomeration (UAs) / Towns having a population of 1 Lakh or more, the warning marker shall be installed at least at every 50 meters and if required additional markers shall also be installed where there is a probability of damage or interference.

Warning markers essentially consist of two plates on which following information is to be written in the Hindi / Regional Language & English, with GAIL’s LOGO & with a Caution
“Underground High pressure ___________ (pipeline name) Gas / LPG pipeline: Before excavation or in emergency, please contact GAIL (INDIA) LIMITED, Contact no.: -----------------, Toll Free No__________”

1.4.24.2 **Directional Marker:** Directional Markers shall be provided at each Turning point and 150 m upstream and downstream of Turning points.

1.4.24.3 **Aerial Marker / Kilometer Marker:** Aerial / Kilometer Markers shall be provided at a spacing of 1 Km along the pipeline route. The Aerial / Kilometer Markers having the warning details can also be treated as Warning Marker.

1.4.24.4 **ROU Marker / Boundary Marker:** ROU Marker / Boundary marker shall be provided at maximum spacing of 400 m along the pipeline route. However, pipeline markers shall be installed preferably at every 25 m but not exceeding 50 m within the limits of Urban Agglomeration (UAs) / Towns having a population of one Lakh or more.

1.4.25 **INTEGRITY ASSESSMENT OF PIPELINES THAT HAVE COMPLETED DESIGN LIFE (25 YEARS):**

i) After completion of design life of pipeline and every five years thereafter, residual life analysis / Fitness For Service (FFS) analysis shall be carried out.

ii) Annual Risk assessment shall continue to be carried out.

iii) ILI shall be carried out immediately after completion of design life. Subsequent frequency shall be decided based on the findings but not later than eight (8) years interval. However, if ILI has been carried out within the previous five (5) years, then the same shall also be considered and subsequent ILI shall be carried out based on the findings of the last ILI but not later than eight (8) years.

iv) Instant OFF PSP monitoring along with ON PSP at TLP shall be carried out every six months.

v) Coating surveys such as CAT / DCVG survey shall be carried out within one year of completion of design life and thereafter at least every five years.

vi) Soil resistivity survey shall be carried out within one year after completion of design life and subsequently at least once in every 10 years.

vii) DA (ECDA, ICDA & SCCDA) shall be carried out within one year of completion of design life in case of unpiggable pipelines. Subsequently same shall be carried out based on finding or at least once in eight years whichever is less.

1.4.26 **STATUTORY PERMISSIONS:** The list of statutory clearances / permissions taken over from project shall include the followings:

i) State Pollution Control Board & Ministry of Environment & Forest (MOEF)

ii) Petroleum and Explosive Safety Organization (PESO)

iii) State & Central Electricity authority Permissions & subsequent periodical inspection as per prevailing Electricity Act
iv) Batteries (Management and Handling) rules 2001
v) Storage license from CCOE / District Collector in case of Diesel or any Hydro carbon storages
vi) Permissions / agreements executed for railways / road (NH & SH) / canal crossing / OFC / any other Crossing

1.4.27 METERING & CALIBRATION:

Following Clauses are applicable to installations owned & operated by GAIL:

1.4.27.1 Custody Transfer Equipment

The custody transfer metering system shall be as per relevant AGA standard. The flow computers and meters shall be of the type approved for custody transfer metering. In case of difference with regard to any specific contract clause (with customers), the contract clause shall prevail. However, efforts shall be made to amend the contractual provision to reflect the code requirements at the earliest.

1.4.27.2 Verification / Calibration measures required for primary metering devices:

(i) Installation of the primary metering devices shall be strictly as per AGA requirements. For Existing installations, where modifications to meet the code requirements are not feasible, upgrading to alternate type of primary meter (e.g. Orifice to Turbine to Ultrasonic Meter) may be considered.

(ii) Sizing of meters shall be done with due consideration to actual minimum / maximum flow. Flow readings shall be recorded regularly and shall be reviewed at least once in a quarter for ensuring the flow within specified range. In case it is noted during such quarterly review that the flow is beyond \(Q_{\text{min}} / Q_{\text{max}}\) for more than 50% of the period, suitable action to be taken by site for replacing with suitable size meter to meet the normal operating range.

Wherever the metered flow is below \(Q_{\text{min}}\) of the flow-meter, calculation shall be done as per guidelines issued by Corporate Marketing Department which are as under:

The reading recorded by the seller’s meter will be taken as final for all purposes except when the error / variation is established to be more than the threshold specified in the Agreement. If the error / variation exceeds the threshold specified in the Agreement, final value shall be arrived as per detailed procedure defined in the agreement.

To ensure that the flow does not exceed \(Q_{\text{max}}\) corrective action such as taking standby stream into line / increasing pressure / replacing existing meter with suitable size to meet the normal operating range etc. shall be taken.

(iii) Inspection / validation of orifice plate shall be done at least once in two years through third party agency or by way of replacement with certified orifice plate. Inspection of upstream / downstream meter tubes shall be carried out in-
(iv) Turbine meters / RPD meters shall be proved at least once in two years from GAIL’s facility or a reputed calibration agency certified by national/ international accreditation bodies. Servicing of Turbine meters shall also be carried out along with proving. The K-factor & linearity curve shall be fed correctly in the flow computers immediately after calibration.

(v) Proving of the USM shall be done once in five years or as per contract with customer whichever is earlier. Ultrasonic meter, if selected, shall be of type certified for custody transfer application. Quarterly cross-checking of SOS (speed of sound) shall be carried out as per standard software of AGA-10. The same shall be verified with the flow computer / USM reading and records maintained. Quarterly performance checking of USM such as gain, signal to noise ratio, velocity profile shall be done and records maintained. Internals of USM shall be physically inspected and to be cleaned carefully at least once in two years for dry gas and once in a year for wet gas application.

(vi) Custody transfer mass flow meters, sensor and transmitter shall be calibrated at least once in a year from a reputed calibration agency certified by national / international accreditation bodies. Certificate of calibration of mass flow meter shall clearly mention tag no., sensor and transmitter serial number, k-factor, old and new mass factor, calculation of percentage error, linearity and repeatability. The new mass factor shall be fed in the mass flow meter immediately after calibration. The custody mass flow meters shall also be duly sealed and certified from weights and measures department.

(vii) During installation of mass flow meter transmitter configuration shall be checked / verified and secured jointly (OMCs or Supplier or Both as applicable). Orientation of installation of mass flow sensor should be such that it remains filled with LPG liquid in stagnant conditions. The pipes adjoining the two ends of sensor unit should be rigidly fixed / clamped with pipe support structure suitable enough to hold and isolate the sensor from pipeline forces / stress.

(viii) Proper care shall be taken during removal, transportation & reinstallation of turbine / ultrasonic / mass flow meters during calibration.

(ix) Configuration data and fixed parameters of the flow computers like base pressure, base temperature, K-factors, Linearization curve parameters, Orifice dia., pipe dia., Z-base, Alarm, Event Logs etc. shall be downloaded / recorded at the time of joint calibration and record shall be maintained for review at later date.

(x) For custody transfer meters, efforts should be made to select orifice meter plate so that the diameter ratio (beta ratio) is between 0.2 to 0.6 and orifice
bore size is greater than 0.45 inch. However, in case the same cannot be adhered to owing to pressure drop, pipe size restrictions, etc. the beta ratio may be maintained between 0.2 to 0.75 with the approval of OIC / CGM.

(xi) In case of Turbine & RPD meters only HF pulse transmitters should be used for flow measurement.

1.4.27.3 Calibration Of Masters:

(i) Periodic checking / calibration of Custody Transfer equipment shall be carried out with reference to the Masters available with the terminal / Maintenance bases.

(ii) Dead weight testers shall be calibrated at least once in three years from laboratory accredited to ISO / IEC 17025 and test certificates shall be readily available for reference.

(iii) Any electronic masters like multi-meters, portable calibrators, different voltage and current sources etc. shall be calibrated at least once in a year from laboratory accredited to ISO / IEC 17025 and the test certificates shall be readily available for reference.

(iv) All the masters used for calibration shall have traceability to National / International standards.

(v) Master meters in the meter-provers shall be calibrated once in 03 years with calibration lab or in-situ with travel standard or equivalent method. Performance of Master Meters to be checked regularly and to be replaced if stability of meter is out of limits. History of each master meter to be maintained.

(vi) On receipt of calibration certificates of master instruments, same shall be reviewed and in case of deviation from the specified accuracy then corrective action for repair / replacement shall be taken. Appropriate record shall be maintained accordingly.

1.4.27.4 Energy Measurement & Gas Analysis:

(i) Major Metering terminals (more than 1.0 MMSCMD) shall be equipped with on line Gas chromatograph approved for custody transfer application.

(ii) For consumers with DCQ less than 1 MMSCMD, one common online / Lab GC shall be used for cluster of consumers where same gas composition is being supplied.

(iii) For isolated fields, with a few customers having gas supply less than 25000 SCMD and supplier Gas Chromatograph data is available, supplier data may be used for energy measurement.

(iv) Sampling / analysis frequency of the on-line GCs for natural gas shall be at least once in an hour and the calibration frequency of the online G.C. shall be
at least once per day. For major metering terminals, gas composition data input in the flow computers shall be online for Gas compressibility factor computation as per AGA-8 detailed method. For small and medium metering terminals where common online GC is available, gas composition data shall be updated remotely in flow computer(s) once every 4 hours for Gas compressibility factor computation as per AGA-8 detailed method. In case remote connectivity is not available for these flow computers, gas composition shall be updated manually on fortnightly basis.

In case of online GCs for LPG, Sampling / analysis frequency shall be at least once in an hour and the calibration frequency of the online G.C. shall be at least quarterly.

(v) For metering terminals where Lab GC is being used, the sampling and analysis shall be done from a representative point once in a day and fortnightly average shall be updated in the respective flow computers.

However, for customers drawing gas up to 5000 SCM per day, frequency of gas analysis data entering in flow computers can be reduced with approval of OIC / CGM.

(vi) The standard gas used for the on line GC shall have stability period of minimum three years and the composition of the standard shall be as close to the composition of sample gas as possible. Care shall be taken that the standard gas is used within its certified stability period only. The supplier’s laboratory for standard gas for online Gas Chromatograph shall be accredited in accordance with ISO / IEC 17025 for Testing and Calibration of Natural Gas. The mole % composition of standard gas shall be close to the sample gas and should be within the range specified in ASTM D 1945.

(vii) Standard gas / Helium procurement for a network shall be planned in one lot in such a way that measurement anomalies / discrepancies between the GCs installed in a same network is not attributable to different lots of such gases.

(viii) Comparison of the different GCs in a same pipeline network shall be carried out regularly.

(ix) **DELETED**

(x) Total Energy for the day shall be measured by any of the two following methods:
   a) 24 hours average CV from GC multiplied by corresponding day’s total corrected Volume.
   b) Energy calculated directly by FC based on gas composition value.

(xi) Standard used for heating value calculation shall be as per the Gas Sales / Supply Contract entered with the customer.

(xii) **DELETED**
(xiii) Online Moisture analyser shall be installed at each WET gas sources supplying more than 0.1 MMSCMD & at Dry Gas sources of 1 MMSCMD & above and Online H₂S analysers shall be installed at sources (cluster of sources at gas receipt terminals) of 1 MMSCMD & above or at sources having history of H₂S/Sulphur.

(xiv) Wherever online analyzers are not available, the analysis for Moisture, H₂S, total Sulphur, CO₂, O₂, HC dew point and Water dew point shall be carried out at least once in a month.

(xv) **DELETED**

(xvi) For LPG pipelines, all the Dispatch terminals shall have online measurement of composition, H₂S, moisture, total Sulphur as per IS 4576. In addition to this analysis of caustic should also be done at least on monthly basis. Other tests required as per IS 4576 should also be conducted once in a month.

(xvii) In case the quality of gas / LPG crosses the limit prescribed in the access code of PNGRB or IS 4576, immediate warning / notice shall be issued to supplier. If quality is not improved, suitable action shall be taken in consultation with Corporate O&M, Marketing & Zonal marketing office.

1.4.27.5 **Secondary Custody Transfer Instruments:**

(i) The Pressure Transmitters, Differential Pressure Transmitters & Temperature Transmitters installed for custody transfer application shall be suitable for custody transfer application with requisite accuracies / repeatability / functionalities (such as SMART type). In case of new terminals, HART protocol to be used for interfacing pressure, differential pressure & temperature transmitters for custody transfer metering systems where gas drawl is more than 1 MMSCMD.

(ii) Joint Checking / calibration of the PT, DPT, TT & Multivariable transmitters shall be carried out with the customer at least once every three months except for those customers whose DCQ is less than or equal to 5000 SCMD. For customers having DCQ equal to or less than 5000 SCMD, frequency shall be at least once in six months. Reference of masters used shall be recorded.

(iii) The custody transfer RTD elements shall be checked either in-house from masters or reputed outside agencies at least once in a year.

(iv) In case of pressure calibration using dead weight tester, local gravity (g) correction shall be ensured.

(v) Frequency / Pulse loop in case of RPD / turbine / USM meters, to be checked / simulated for entire flow range.

a) Quarterly preferably along with joint calibration for Major consumers > 1 MMSCMD

b) Yearly for Consumers < 1 MMSCMD
(vi) The custody transfer RTD elements shall be of 4 wire type, Class-A or better (like 1/5 DIN), in case of new metering systems / upgradation. For terminals more than 1 MMSCMD the RTD to be upgraded to minimum Band 3 (1/3 DIN).

1.4.27.6 Integrity of Metering Terminals:

(i) In order to ensure against unauthorized access / operation of custody transfer equipment and systems, the same shall be duly secured with electronic and physical access protection.

(ii) Electronic and / or physical access protection shall be strictly applied to at least the following:

   a) Primary meters
   b) Secondary Instruments & Flow Computers
   c) Vent / Drain connections (before custody transfer meter)
   d) By-pass piping connection

1.4.27.7 Unmanned terminals shall be visited by GAIL officials / designated staff from the respective maintenance bases at least once every fortnight and it should be properly logged.

1.4.27.8 Data Integrity: Flow computers shall be password protected with requisite control on password security and its use restricted to limited and designated persons only. The flow computers shall have audit trail for configuration data integrity. Various components used in the custody transfer metering to be sealed to avoid the unauthorized access.

1.4.27.9 Audits:

(i) Corporate O&M shall constitute and notify an Annual Audit Plan indicating the list of auditors for carrying out audit of different metering terminals at least once in a year. The OIC / CGM / In-charge of network shall ensure time bound compliance of the recommendations of such audits.

(ii) In addition to above, OIC / CGM / In-charge of network shall constitute & notify a regional team comprising of members from other terminal locations to carryout metering audit of different metering terminals in the respective region on yearly basis. Additionally third party metering audit through reputed international / national agency to be carried out once in 05 years.

(iii) A regional level internal committee shall be associated with site instrument personnel on half yearly basis during the joint calibration of the supplier measurement facility to check the complete measurement system, wherever gas supply is equal to or more than 0.5 MMSCMD.

1.4.27.10 Reconciliation:
(i) Daily reconciliation of gas balancing in volume terms shall be done region wise / pipeline segment wise by respective site / region.

(ii) Pan India reconciliation shall be done on monthly basis in energy as well as volumes terms for entire GAIL and posted in SAP to achieve the company targets / benchmarks.

(iii) Any deviation more than MOU target shall be analysed for root cause and corrective action thereafter.

(iv) Adequate reconciliation metering system shall be installed to achieve the region wise / pipeline wise reconciliation in accordance with 1.4.27.14.

(v) Calibration of reconciliation metering system between two regions / segments shall be done jointly by representative of these segments / regions on quarterly basis. However, where primary meters are utilised for reconciliation purpose, the calibration shall be done as per custody transfer meters schedule.

(vi) Terminal-in-Charge shall ensure calculation of the flow rate, compressibility factor, heating value, SOS of the gas (in case of USM) manually using the standard software and accordingly cross checking of values in the flow computers, USM and GC. This shall be done on quarterly basis and records maintained.

(vii) The Power back-up shall be checked on monthly basis. In case of any power disruptions, the flow computers shall be checked immediately for the fixed data as it can revert to default values.

(viii) Contract service personnel (if any) should preferably be rotated among different terminals in the region, so that they are not stationed at a particular terminal for a long time.

(ix) Atmospheric pressure shall be updated in flow computers on quarterly basis. The quarterly average of atmospheric pressure shall be obtained either from;

   a) The regional / nearest metrological office of Government of India. The records of these authenticated data shall be maintained by all regions / locations with date of updation in flow computer, or
   b) Local Digital Barometer.

(x) Changes in configuration data of flow computer shall be maintained in log book.

(xi) Audit trail / event log shall not be deleted from flow computers in any circumstances. In case, existing flow computer does not have facility of audit trail, same shall be upgraded / replaced for such facility.

(xii) The flow rate, pressure, temperature, gas composition and base data shall be compared in the parallel and series streams regularly and stream change over shall be carried out at least once in a quarter.

(xiii) **DELETED**
1.4.27.11 **Guidelines for Installing Custody Transfer Meters:**

**(A) New Installations:** As a standard practice, the below mentioned guidelines shall be followed for new installation of GAIL.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Meter Type</th>
</tr>
</thead>
</table>
| Quantity of Gas Flow up to 25000 SCMD | For Dry Gas: RPD / Turbine / USM meter based skid (refer note 1 below)  
For Wet Gas: Orifice meter based skid (refer note 1 below) |
| Quantity of Gas Flow > 25000 SCMD & < 0.25 MMSCMD | For Dry Gas: Turbine Meter 1+1 stream with field mounted flow computer  
For Wet Gas: Orifice Meter 1+1 stream with field mounted flow computer |
| Quantity of Gas Flow > 0.25 MMSCMD & < 1.0 MMSCMD | For Dry Gas: Turbine Meter 1+1 stream with control room mounted flow computer  
For Wet Gas: Orifice Meter 1+1 stream with control room mounted flow computer  
For Dry Gas, in case meter size is > 6” – USM Meter with control room facilities |
| Quantity of Gas Flow > 1.0 MMSCMD | Ultrasonic Meter 1+1 stream with full-fledged metering facility, GC, control room mounted flow computer, FCV etc. for both dry and wet gas |
| LPG Pipeline (Mass terms) | Coriolis Mass Flow Meter (1+1) sensor and transmitter with display of flow, density, and cumulative flow in control room. |

**Note:**

1. Skid consists of 02 filter streams, 02 PRS streams with or without Active Monitor configuration, single stream metering with local flow computer / EVC, with or without inter stream redundancy.

2. For LMC customers with initial flow less than 25000 SCMD but projected flow within next 05 years exceeds 25000 SCMD, in addition to metering system requirement for 25000 SCMD as per table above, provision for additional streams to be provided to cater to such projected high flow requirement as per above table (in case where flow capacity is higher than the installed skid for 25000 SCMD). However, for CGD customers, the methodology proposed by PD will be applicable.

Double decker configuration of metering streams may be considered but the same to comply with OISD / PNGRB regulations.

**(B) Existing Installations:** The above guideline shall also be followed in case of upgradation / modification of existing installation due to terminal upgradation activities.
/ customer requirement in future. Efforts shall be made to upgrade the metering facility in line with new metering installation during the review as per clause No. 4.7.

1.4.27.12 Guidelines for Installing Check Meters:

As a standard practice, the following guidelines shall be followed for new and existing installation of GAIL.

(a) For New Installations:
At any new custody transfer receipt / intake point of GAIL, depending on the quantum of gas flow being handled / transported, the expected term / period of gas flow through that installation and specific location of such receipt / intake points following guidelines may be followed for installation of check meters:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Check meter required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity of Gas flow &gt; 1 MMSCMD and more than one customer on the supply side</td>
<td>Yes</td>
</tr>
<tr>
<td>Only single customer where back to back calculation is possible (Any quantity of Gas flow)</td>
<td>No</td>
</tr>
<tr>
<td>Quantity of Gas flow &lt; 1 MMSCMD and &gt; 0.1 MMSCMD and term of supply is more than 3 years</td>
<td>Yes</td>
</tr>
<tr>
<td>Quantity of Gas flow &lt; 1 MMSCMD and no certainty of continuous supply of gas</td>
<td>No</td>
</tr>
<tr>
<td>Quantity of Gas flow &lt; 1 MMSCMD and Isolated fields with few customers and where back to back calculation is possible</td>
<td>No</td>
</tr>
<tr>
<td>Quantity of Gas flow &lt; 1 MMSCMD and &gt; 0.1 MMSCMD and Isolated fields with more customers / complicated lines and where back to back calculation is not possible</td>
<td>Yes</td>
</tr>
<tr>
<td>Quantity of Gas flow &lt; 0.1 MMSCMD</td>
<td>No</td>
</tr>
</tbody>
</table>

(b) For Existing Installations:

(i) In existing locations where check meters are installed but they do not conform to standard guidelines, as a best endeavour the standard guidelines shall be followed, which are to be based on the type of check meter.

(ii) Modifications required to meet the code requirements or installation of check meter where none is available as required by the guidelines given herein, may be undertaken at the earliest available opportunity based on criticality.

1.4.27.13 Proving / Calibration of Check Meter:

(i) Proving of the USM shall be done once in five years. Cross checking of SOS (speed of sound) for USM shall be carried out on quarterly basis as per standard
software of AGA-10 and verification shall be done with flow computer / USM reading and records maintained.

(ii) Turbine meters shall be proved once in two years from GAIL’s facility or from a reputed calibration agency certified by national/international certifying bodies.

(iii) Inspection / validation of orifice plate shall be done at least once in two years through third party agency or by way of replacement with certified orifice plate. Inspection of upstream / downstream meter tubes shall be carried out in-house or through external third party agency at least once in two years & records maintained.

(iv) Verification / Calibration of secondary check meter instruments shall be as per that of custody transfer meter instruments.

(v) Check mass flow meters, sensor and transmitter shall be calibrated at least once in a year and other non-custody transfer mass flow meter at least once in four years from a reputed calibration agency certified by national / international accreditation bodies.

(vi) For non-custody transfer metering the applicable beta ratio shall be 0.2 to 0.75

1.4.27.14 Accuracy / Uncertainty Level:

The check meter / reconciliation meters should be of similar accuracy / uncertainty as that of custody transfer meter. These meters may be installed in single run, double run or multi run configuration depending on the quantum of gas received but standby meter run is not required. In case of single run, bypass arrangement to be provided with double block & bleed valve arrangement.

1.4.27.15 Generally, various AGA standards applicable to metering systems undergo revision from time to time wherein new provisions are incorporated or existing provisions revised. In such case, it would not be necessary to incorporate those changes in existing metering system unless they are mandatory. However, it needs to be ensured that all metering systems that would be installed after issuance of the revised standard comply with the revised standard.

1.4.27.16 Steam Metering:

i. Sizing of orifice and entire metering system shall be as per AGA-3 or ISO-5167. Flow profiler is required to be designed as per API 14.3.

ii. Calibration frequency of secondary instrumentation should be quarterly in case of custody transfer metering.
iii. DM water loss vis-à-vis steam generation at rated capacity may be a max of 4% of Feed Water upto main steam stop valve.

1.4.28 ELECTRICAL SYSTEM:

1.4.28.1 Criteria for Electrical Power Requirement and Battery Bank back-up hours:
Electrical Power & Battery banks at various pipeline installations shall be provided as indicated below:

<table>
<thead>
<tr>
<th>Type of installation</th>
<th>Primary Power Sources (Grid / DEG / GEG / Solar / TEG / CCVT)</th>
<th>Battery Bank back-up during design</th>
<th>Battery Bank back-up during Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>For unmanned (Not manned by GAIL Personnel) remotely located pipeline installations*</td>
<td>Any one of the above</td>
<td>72 hrs.</td>
<td>48 hrs.</td>
</tr>
<tr>
<td></td>
<td>Any two of the above</td>
<td>36 hrs.</td>
<td>24 hrs.</td>
</tr>
<tr>
<td>Installations manned by GAIL personnel OR Receiving power from customer power plant</td>
<td>Any two of the above. If reliable power is received from customer power plant, one additional standby source.</td>
<td>12 hrs.</td>
<td>8 hrs.</td>
</tr>
<tr>
<td>In case of Installations having UPS OR other installations having requirement for specific field mounted equipments **</td>
<td>Any two of the above OR as per design basis</td>
<td>As per design</td>
<td>70% of the designed capacity</td>
</tr>
</tbody>
</table>

*If located in city / urban area, 50% of the above indicated capacity shall be required.

**Requirement for design basis has to be assessed on case to case basis, however minimum back up capacity of 4 hours shall be maintained.

The capacity test and boost charging of all battery banks shall be carried out every year to ensure the desired back up hours.

1.4.28.2 Condition monitoring of the Switchyard equipments like Current Transformers (66 KV & above), Power Transformers, Lightning Arresters shall be performed at an interval of 3 years or as recommended by OEM whichever is earlier, to check the Tan Delta, Polarization Index (PI), Insulation / Electrical Resistance etc. and further steps of maintenance /replacement to be taken based on historical trending to avoid any catastrophic failure of equipment. Operational performance of Switchyard Isolators shall be ensured with all interlocks. Above exercise shall be taken during planned
shutdown, ensuring all safety measures for electrical isolation of the equipment to be inspected.

1.4.28.3 Condition monitoring of all other critical rotating equipment like HT alternators, HT Motors, Transformers may be carried out at an interval of at least 5 years or as recommended by OEM, whichever is earlier and based on this, action for major overhauling should be taken. Other than the above, Run-Hour based major overhauling of Rotating Electrical equipment shall be also performed as per OEM recommendation.

1.4.28.4 Other than the regular preventive maintenance of HT / LT Circuit breakers, their major overhauling shall be carried out during shutdowns from its OEM / Experienced service provider / In-house expertise at an interval of 5 years or as recommended by OEM whichever is earlier Or as whenever required based on the condition assessment. It’s Contact Resistance with Close / Trip / Close-Open time of Circuit Breakers (for 6.6KV and above) to be recorded at regular intervals and further required maintenance actions should be taken.

1.4.28.5 Protection relays shall be tested / calibrated yearly to ensure their proper functioning. Also, it should be ensured that their settings are restored as per relay co-ordination chart before taking into operation.

1.4.28.6 Protection / Operational Interlocks of the HT / LT panels, DEG set, Switchyard equipment shall be checked during the shutdown of the plant or during the available opportunity and all steps should be taken to ensure the healthiness of their functioning. Bus-Bar tightening of all HT / LT switch gear panels to be carried out during the shutdown.

1.4.28.7 Transformer (TR) oil in service shall be tested as per IS: 1866 every year and Dissolved Gas Analysis (DGA) at every two years, to know the deteriorations and contaminations in Oil. New TR oil may be added as make up only and not to exceed 10 % of the in-service quantity, otherwise whole oil to be replaced with new one. Insulation resistance and Polarization Index of HV Cables connected with Electrical Equipment to be recorded every year for historical trending.

1.4.28.8 General Illumination level of the unit to be recorded half yearly and to be maintained as per OISD / BIS requirement.

1.4.29 Handling of Off-spec gas in pipelines:

Only Natural gas conforming to specifications given in PNGRB Access Code regulation (Schedule – II) shall be handled in the pipeline system unless in specific cases suitable enhanced integrity measures such as injection of Corrosion Inhibitors, Corrosion Monitoring and cleaning pigging at reduced intervals than those specified in these guidelines are taken. Further, replacement of existing carbon steel pipelines servicing such off-spec gas after an initial integrity assessment shall be carried out
with alternate materials such as MDPE or Carbon Steel pipelines with short economic life as may be permitted by PNGRB.

1.5 MONITORING / MAINTENANCE OF COMPRESSOR / BOOSTER STATIONS

1.5.1 A comprehensive maintenance manual covering guidelines, procedures and practices shall be prepared by respective headquarters of compressor / booster station within the ambit of IQMS. Respective compressor stations / booster stations, based on these guidelines establish an annual composite preventive maintenance schedule covering all the critical as well as non critical equipment with the approval of In-charge of Compressor station / Booster Station. In case of any deviation in actual execution of maintenance actions as per the schedule, same shall be only with the approval of respective In-charge of Compressor station / Booster Station with due justification and catch-up / alternate plan.

1.5.2 On commencement of each financial year, all the OIC / CGMs shall prepare their Maintenance Plan / Work plan covering important jobs along with its major milestones and completion target. The same shall be presented during O&M meets along with its progress/ status.

1.5.3 MAJOR MAINTENANCE / OVERHAULING:

1.5.3.1 Major maintenance / overhauling of notified / declared critical equipment shall be carried out at OEM / OEM authorized workshop or at site, if feasible, under the supervision of OEM representative.

1.5.3.2 Machine running shall be staggered in such a manner that major maintenance / overhauling of more than one machine does not occur at the same time.

1.5.3.3 All the sites should incorporate the periodical (at least once in a quarter) performance / efficiency monitoring of major equipment in IQMS with threshold limit for corrective action. Analysis of such performance indicators shall be utilized to build job lists that need to be attended at the earliest opportunity / shutdown maintenance, with due care to requisition required materials and services thereof in time.

1.5.4 Statutory Permissions: The applicable statutory compliance for compressor station may include the followings:

1. Factory License
2. Consent Order Under Air Act
3. Consent Order Under Water Act
4. Water Cess Report
5. Environmental Audit Report
6. Environmental Statement (Form No. V)
7. Certificate of Structural Stability
8. Hydro-Test of Pressure Vessels
9. CEA Compliance
10. Weights & Measures
11. Pipeline PESO approval
12. Any other as required by State / Central Government body

The details like date of inspection, next renewal date, capacity, license etc. shall be displayed nearby respective equipment in the field, wherever applicable.

1.6 **MONITORING / MAINTENANCE OF NON-CONVENTIONAL POWER GENERATION**

1.6.1 GAIL has installed Solar and Wind power units to produce renewable energy. The electricity is being sold / wheeled to GAIL’s other unit. Though Operation and Maintenance of such projects has been assigned to designated “operator(s)”, a comprehensive maintenance manual covering guidelines, procedures and practices shall be prepared by respective regions under which such project exists, to ensure the healthiness of system.

1.6.2 The manual shall specify the quality objective so that higher performance and reliability can be achieved (compared to other projects in similar geographical location, similar nature).

1.6.3 To achieve the objectives specified in the maintenance manual, OIC / CGM shall designate a person / team to monitor “non-conventional” power project performance.

1.6.4 List of critical equipment, Preventive maintenance schedule, stock of critical spares manpower resource shall be prepared by “Operator” in consultation with respective O&M base which shall be part of the maintenance Manual. Designated team / person shall ensure:

   a) Maintenance plan
   b) Testing and calibration of energy meter
   c) Procuring & inventory control of stores & spares
   d) Fire fighting and emergency handling
   e) Plant safety and security

1.6.5 Designated team / person shall monitor performance on following aspects as per schedule defined in IQMS manual:

   a) Machine availability (monthly, quarterly, and annual)
   b) Capacity Utilization Factor (machine wise, project wise)
   c) Power factor
   d) Transmission loss
1.7 SECURITY AND RISK MANAGEMENT OF OPERATIONAL TECHNOLOGY SYSTEMS:

Effective governance and management of the Operational Technology (OT) environment at GAIL is essential to maximize the value that can be delivered to GAIL and its stakeholders. Given the strategic importance of OT systems and GAIL’s endeavour to ‘Think Digital, Be Digital’, a structured approach to develop and maintain the OT operating environment, this requires the management commitment and guidance for establishing streamlined and robust OT processes, practices and structures to ensure effective OT management by way of:

- Achieving operational excellence through effective and efficient utilization of OT Systems
- Managing risks
- Complying with applicable laws, regulations and contractual agreements

OT Systems in GAIL consist of DCS / PLC system in process plants, compressor stations, Pipelines and all digital systems like Advance Software Applications for Pipeline Integrity Management System, Pipeline Intrusion Detection System, Smart meters, SCADA Systems etc. For the effective security from the emerging threats and existing vulnerabilities of the operational environment, the security of the Operational Technology (OT) Systems requires critical care. Thus following are to be adopted:

1. Remote access of OT Systems for maintenance or incident management should be done via secured mechanism.
2. Asset listing of OT Inventory should be done (that includes details like Asset name, Patch upgrade records, Licence, Critical/Non-Critical, identification of trusted devices, maintenance activity etc.)
3. Procedure shall be established for maintaining and upgrading of Architecture Drawings of OT Systems.
4. To increase the host security of OT Networks,
   a. Create separate account with lower privileges for user to perform day to day activities. Administrator privileges should be restricted to limited users only.
   b. Configuration and maintenance machines for OT Systems (i.e. Laptops) should not be connected to internet and kept under lock and key when not in use
   c. Disable all USB Ports and CD/DVD ROM access for OT Systems to restrict external media usage.
2.0 ENVIRONMENT

2.1 All the sites shall prepare the environment protection plan which inter alia includes the implementation of ISO 14001 for environmental management under IMS, measurement of water consumption, action plan to achieve sustainability aspirations 2020 targets etc.

2.2 In addition to above, environmental protection action plan includes but not limited to following:
   - Rain water harvesting system shall be created at installations such as Compressor Stations, Booster Stations etc. based on feasibility. All the new major installation shall be provided with the rain water harvesting system.
   - Venting of natural gas / intermediate product shall be done through flaring and direct venting to atmosphere shall be avoided as far as possible.
   - Liquid hydrocarbon inventory shall be evacuated from storages, to the maximum extent possible, during plant shutdowns and statutory inspection etc.
   - Water management system shall be implemented for all the sites for treatment of waste water, proper accounting of total water, recycling and reuse of water.
   - Procedure for management and disposal of solid hazardous and non-hazardous waste including e-waste.
   - Afforestation plan such as development of green belt, protection of native plant species etc.
   - Measurement and control for fugitive emission

2.3 Site shall ensure the compliance of all statutory act / permission, renewal and reporting as per regulation / act such as:
   - Consent to Air and water act.
   - Monitoring and control of ambient air and stack exhaust quality as per environment act and reporting.
   - Monitoring and control of water quality as per water act and reporting.
   - Regular submission of reports to MOEF as per consent/permission.

2.4 To improve the energy efficiencies in process and operations, all major installation such as compressor stations / booster stations shall endeavour to implement latest applicable energy audit standards certification e.g. ISO 50001.

2.5 Advanced technologies conducive to minimise environmental impact shall be adopted along with utilisation of renewable energy resources.

2.6 Boundary Management such as Safety, Statutory and regulatory compliances with regard to plant / pipeline operations and maintenance (factory licence, environment act, audits, mock drill etc.) shall be ensured.
3.0 STAKEHOLDER MANAGEMENT

3.1 A written plan shall be prepared for stakeholder management, identifying all stakeholder groups such as employees, statutory authorities, land owners of pipeline ROU, general public etc.

3.2 The management plan shall explicitly spell about communication type, frequency, agenda etc. for each group of stake holders and personnel responsible for executing the same. The tools includes but not limited to following shall be used by all work centres for dissemination of the relevant information:

3.3 External communications:
The external stake holders shall be kept abreast of GAIL’s efforts on integrity management and its effectiveness, general awareness and contact information for communication etc. Type of information to be disseminated and target recipients with frequency of communication shall be clearly spelt out for following:

3.3.1 Communication / awareness of Public and Landowners of ROU: For Propagating information regarding presence of pipeline location, damage preventing actions, company contact information for reporting leakage and informing before carrying out any excavation etc.:

- Display of Phone numbers / implementation of one-call system.
- Distribution of pamphlets to villages for Do’s and Do not’s through which pipeline passes.
- Public awareness camps shall be organized at each district level and if possible at village / mandal level for risk awareness.
- Warning / Safety boards at vulnerable locations and wall writing at prominent places in village / town through which pipeline passes.
- Notices in print media, FM radio in cities, television etc.
- Use of GAIL website.
- Conducting Nukkad Nataks.
- Meeting with group of peoples, landowners etc.
- GAIL Sahyogi Scheme.

3.3.2 Communication / awareness of Statutory authorities and district administration:

- Meeting with civic/ district / Statutory Authorities (DM, SP, DSP etc.) on regular basis.
- Meeting with Sarpanch, Panchayats at village level.
- Communication with district authorities regarding GAIL efforts for safety and security of pipelines and various threats to pipeline such as encroachments etc.
- Reporting of incidents to OISD, CCOE, PNGRB as per ERDMP etc.
- Communication of all statutory compliances to appropriate authority as per stipulations.

3.3.3 Communication / awareness of Customer / Supplier:
• Meetings with Customer / supplier individually and / or collectively.
• Communication regarding GAIL efforts for safety and security of pipelines / Installations and various issues regarding quality of product, pipeline / Installations integrity etc.

3.4 Internal Communications:

3.4.1 Communication with other department:

• Communication with other department regarding integrity efforts by GAIL through email, intranet, internet etc.
• Disseminating the information about Integrity management program, its objectives to all relevant personnel (employees, contract persons etc.) involved in Operation and Maintenance.
• Communication of Achievements etc.

3.4.2 Communication with Employees:

• Monthly meeting with employees, collective of work centres with respective OIC / CGM.

3.4.3 Communication within hierarchy:

• FIR, system alarm or other system abnormality information flow within organization.
• Reporting to the management.
• Daily morning meeting at plant / Station level for daily / catch-up plan.
• Weekly Meeting of HODs and OIC / CGMs.
4.0 TECHNOLOGY

4.1 Technology upgradation is imperative to improve the efficiencies in operation and maintenance. Technological obsolescence of any equipment may affect the reliability and availability of machine. The same may be due to various reasons such as non-availability of vendor support for spares and services, availability of better equipment with advent of new technology etc. Action for phasing out such systems may be taken well in advance. For systems with multiple similar machines, replacement should be planned in a phased manner so that spares available from replaced machines can be utilized for retained machines for optimum utilization.

4.2 Technology Cell formulated within Corporate Central Integrity Management Group (CIMG) will interact with vendors, sites etc. from time to time for any new Technologies and with regard to its applicability for GAIL’s operations and maintenance which can improve the efficiencies and quality. Based on merit of technology, the same shall be presented for management approval.

4.3 The technology seminars, presentations etc. shall also be arranged by CIMG to disseminate the information with regard to new technologies.

4.4 These activities shall be coordinated by RIMG at site level in coordination with CIMG.

4.5 All the modification, Technology up-gradation, implementation of SLICE etc. shall be routed through CIMG before approval and implementation.

4.6 Technical / Non-Technical Audits by Internal Audit / Vigilance / CTE etc. are one of the main sources of areas of systematic improvements. In order to achieve the desired systematic improvement, corporate O&M shall study the Reports / Observations / Recommendations of Internal Audit / Vigilance / CTE time to time and suggest recommendations which can be implemented on Pan India basis.

4.7 With regard to combating obsolescence resulting in improved reliability & availability of machines / systems, the guidelines given below may be followed:

4.7.1 All systems like Monitoring and Control systems, Electrical, Mechanical, instrumentation, metering skids etc. shall be reviewed for technical obsolescence at least after 10 years of its installation and every two year thereafter.

4.7.2 Regular interaction / co-ordination shall be maintained with respective vendors to get advance information for availability of support and services.

4.7.3 As and when new technology or better / efficient equipment become available, the same may be reviewed for replacement of older systems based on suitability and techno-economic advantages irrespective of frequency mentioned above.

4.7.4 System PC like desktop, monitor, Printer and other IT accessories which are essential part of any DCS PLC to be replaced as per IT policy. DCS / Plant system Software may be upgraded as per advancement of technology to reap maximum benefit from technological advancement.
4.7.5 Technological obsolescence of the supporting monitoring / control systems / tools like Distributed Control System (DCS) / VFDs / UPS / Switch Gears / Battery chargers & protective relays / Vibration Monitoring Systems / Fire and Gas detection systems / measuring instruments etc. which may affect the proper monitoring of the machine should also be reviewed as per the frequency mentioned above.

4.7.6 Adoption of new technologies in areas of pipeline construction, pipeline O&M, compressor / booster stations, process plants and other areas where the applicability & benefits of a new technology identified is to be ascertained by way of Proof of Concept (POC) the same may be executed in line with METHODOLOGY FOR ADOPTION OF NEW TECHNOLOGIES hosted in Intranet.
5.0 EDUCATION

5.1 To develop adequate level of competence to perform the job in respective work areas, training need shall be identified for each O&M personnel for up-gradation of knowledge / skill in all facets such as technical, behavioural etc. and may be imparted refresher trainings from time to time.

5.2 For development of core competence, personnel working in relevant fields shall be imparted refresher training and / or nationally / internationally recognised certification courses in the area of CP, coating, ILI, risk assessment etc. through GTI. Target for these specialised training / certification courses may be set at the beginning of every year by CO-O&M based on performance / evaluation.

5.3 The Planning Monitoring and Control Cell (PMCC) of Corporate O&M and respective sites shall organise the knowledge sharing sessions. CO-O&M / BIS from time to time will present papers on new technology, practices, regulatory / code requirement and organise in-house or external Subject Matter Experts lectures. Target for number of Knowledge sharing session may be set at the beginning of every year.

5.4 Seminars on Suggestion, Learning, Initiative, Case Studies, Extraordinary-effort (SLICE) etc. by sites and new technologies adopted may be organised every year based on previous years experiences.

5.5 Inter Organisation Meets for Sharing of Experience shall be organised on various elements of SOMES (TEA) on yearly basis.
6.0 REQUIREMENTS DURING PROJECT PLANNING AND EXECUTION STAGE

6.1 PRE-COMMISSIONING AND COMMISSIONING OF A NEW PIPELINE SYSTEM:

6.1.1 Pipelines shall be designed and constructed in accordance with the requirements of PNGRB regulations and OISD standards, as a minimum.

6.1.2 A nodal officer shall be designated by the OIC / CGM of respective site / Corporate O&M department at least one month before the scheduled commissioning date of a New Pipeline System, Compressor / Booster stations etc. to ensure smooth take-over of system.

6.1.3 The nodal officer shall be associated with the project department and assist the local OIC / CGM. He shall be responsible for smooth take over from the Project Group with all systems checked for their integrity, functionalities and documentation.

6.1.4 PESO approval for commissioning, OISD pre-commissioning audit, T4S audit shall be completed by Projects Department before handing over to O&M. Clearance for commissioning of pipelines which does not fall under the purview of PESO shall be obtained from a third party agency such as Project Management Consultant / Third Party Agency having experience in the field of pipeline construction but other than those already involved in project management or inspection during construction.

6.1.5 Handing-over and taking-over (HOTO) between Projects and O&M group shall be completed within six months of commissioning at respective ED level. The handing over / taking over shall include all the statutory permissions, design and commissioning documents and reports.

6.1.6 Before handing-over of any new pipeline system, compressor / booster stations etc., Projects Department shall ensure commissioning of all the major system such as SCADA / DCS, remote operation of valves, permanent cathodic Protection system, etc.

6.1.7 Before commissioning of new custody meter facilities a committee of instrument engineers from O&M and Projects shall be constituted by OIC / CGM for commissioning of metering facility. Base data shall be recorded for future reference.

6.1.8 Hydro test of new pipelines shall be targeted at a test pressure corresponding to 95% of SMYS at the lowest point of the section but not less than 1.25 or 1.5 times MAOP as per class location at any point.

6.1.9 Pipeline Drying is a critical operation having a significant impact on the pipeline during service life from internal corrosion point of view. Vacuum Drying and Drying using Super Dry Air are two most commonly employed techniques. As against Super Dry Air technique which involves number of pigging runs (foam pigs of different
densities) which is generally expected to provide a higher degree of cleanliness, in case Vacuum Drying is adopted as drying technique, the same shall be preceded by swabbing to remove liquid water from pipeline and also, upon commissioning, to be immediately followed by several pig runs (foam & brush pig).

6.1.10 The sectionalizing valve station 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.

6.1.11 All pipeline installations like SV / IP / Terminals / RR / Tap off / O&M bases etc. shall be easily accessible through road and well maintained, irrespective of the ownership to comply all the relevant legislation, laws, standards, codes for smooth operation, protection & safety of facilities. In cases where, approach roads have not been laid and only kuccha road is available, new approach road shall be built and maintained.

6.1.12 The concerned pipeline construction group shall ensure that ROU of the pipeline conforms to the constructed pipeline alignment including any rerouting / realignment that may have taken place during the course of construction. A post construction validation survey shall be carried out to confirm the correctness of ROU details and further that the particulars of ROU acquisition is duly endorsed in the land owner records of the concerned revenue department.

6.1.13 All valves to be installed in the mainline shall have a fully welded Body design.


6.1.15 CASED CROSSING

i. Cased crossings should be avoided as far as possible in all ongoing /future Pipeline projects and Pipelines to be laid (may be through HDD) at a minimum specified depth. In this regard, Railways have recently issued the “Addendum & Corrigendum Slip No. 5 dated 10.04.2017 for Guidelines on Pipeline Crossing”, which may be further referred.

ii. Filling of bentonite in cased crossings should be discontinued as the hardening of Bentonite results in transfer of load directly to carrier pipe defeating the very purpose of providing the casing for mechanical protection of the carrier pipe. Also it makes it very difficult for any rectification in case of shorting.

iii. In case pipeline cased crossings are located in water logged areas, annular space may be filled with the non-conductive, non-setting, non-corrosive, non-hygroscopic materials like petroleum wax/jelly to avoid ingress of moisture.

6.1.16 Survey for pipeline route selection, cadastral and geotechnical surveys shall be carried out on GIS platform in accordance with the requirements of Pipeline Geographic Information System implemented in GAIL.
6.1.17 All the material test certificates and inspection release notes in respect of materials procured and incorporated in a project, shall be progressively handed over (without waiting for final HOTO) to concerned O&M at site and if O&M resources not available at site, then to Corporate O&M.

6.1.18 **Hot Tapping:**
Taking connection for spur-lines or other connectivities by hot tapping the pipeline should be avoided. In case, it is unavoidable and if the hot-tap location falls outside GAIL stations, the same may be allowed subject to the condition that a plot of land covering the hot-tap connection location is acquired and an intermediate station built with necessary perimeter walls etc. along with provision of access road from the nearest all weather metalled road. In all such cases, a valve shall be provided after the tap-off to isolate the spurline or LMC. It shall further be ensured that if the tap-off size is 1/3rd or larger, of the pipeline size, then barred Tee shall be specified for the split tee, so as not to affect pigging activities.

6.1.19 **Requirements in case of LMC:**
All the requirements mentioned herein above shall apply. However in case of LMCs falling within industrial estates, industrial parks etc. the requirements at sl no 6.1.18 for hot tapping, sl no 1.3.8.1 for actuated valves and sl no 6.6 for piggability may not be applicable.

6.2 For all the future pipeline projects, OFC shall be laid invariably parallel to new pipelines.

6.3 **DELETED**

6.4 **Flow Metering System**

6.4.1 The custody transfer metering and check metering system shall be designed as per clause 1.4.27.11 and 1.4.27.12

6.4.2 In case of new metering system for quantity of gas flow greater than 1.0 MMSCMD & CGD customers, provision to be kept for 3rd stream meter of 20% flow capacity.

6.4.3 The custody transfer RTD elements shall be of 4 wire type, Class-A or better (like 1/5 DIN), in case of new metering systems / upgradation.

6.5 Suitable pressure reduction system (PRS) shall be considered during design and installed in all the branch / spur pipelines.

6.6 All new pipelines should be piggable irrespective of length and size of pipeline. In any case, pipelines traversing public space carrying wet gas shall invariably be provided with full bore valves and bends of minimum 3D radius with pig barrels at either ends or with provisions for connecting temporary scraper barrels.

In-Line Inspection of new pipelines shall be done using high resolution MFL tool with Inertial Mapping Unit (IMU) before commissioning / Handing over to O&M Department. Further high resolution Electronic Geometry Pigging (EGP) shall be done before commissioning, after hydro-test.
6.7 All the SVs / IPs within city location / vulnerable / high risk location shall be remote operated through SCADA.

6.8 At least alternate SVs / IPs in trunk pipelines shall be remote operated.

6.9 In addition to remote operating facility through SCADA, all manual / remote SVs / IPs shall be equipped with auto closure facility, operating from combination of at least two hard wired pressure switches / transmitters feedbacks in series, one for upstream pressure and another of downstream pressure of SV.

6.10 PIPELINE SPECIFICATION AND CLASS LOCATION OF NEW PIPELINE:

6.10.1 Corrosion Allowance for line pipe, fittings and mainline valves shall be calculated based on the corrosion modeling (For ascertaining the potential corrosion mechanisms and for calculating appropriate corrosion allowance). Notwithstanding the modeling, a minimum corrosion allowance of 1.0 mm shall be incorporated in the pipeline wall thickness design in case of sweet & dry gas as per PNGRB Access Code specifications. If any variation in gas quality is expected at initial or subsequent stages of operation, calculated corrosion allowance based on corrosion rate prediction or 2.0 mm whichever is higher shall be considered as corrosion allowance.

6.10.2 For the wet / sour gas pipeline application, pipe material & thickness may be selected considering these factors.

6.10.3 **DELETED**

6.10.4 Online Moisture analyser to be installed at each WET gas sources supplying more than 0.1 MMSCMD & at Dry Gas sources of 1 MMSCMD & above.

6.10.5 Online H₂S analyser to be installed at sources (cluster of sources at gas receipt terminals) of 1 MMSCMD & above.

6.10.6 Corrosion monitoring system shall invariably be incorporated in the pipeline system based on Internal Corrosion Predictive Modelling (ICPM) which shall incorporate a combination of probes and coupons. Underground vaults shall be constructed, if the monitoring location falls in ROU, to monitor corrosion rate and maintain the probes / coupons.

6.11 MARKERS IN PIPELINE:

The following types of marker shall be provided along the new pipelines:

6.11.1 **Warning Marker**: Pipeline Warning markers shall be installed at each & every kilometer. Apart from this, additional warning markers shall also be installed at each side of highways (NH/SH), major district roads (MDR), all metalled roads, railway crossings, water body crossings any other major crossings and at entrance to stations.
For Urban Agglomeration (UAs) / Towns having a population of 1 Lakh or more, the warning marker shall be installed at least at every 50 meters and if required additional markers shall also be installed where there is a probability of damage or interference.

Warning markers essentially consist of two plates on which following information is to be written in the Hindi / Regional Language & English, with GAIL’s LOGO & with a Caution.

“Underground High pressure ____________(pipeline name) GAS/LPG pipeline: Before excavation or in emergency, please contact GAIL (INDIA) LIMITED, Contact no.: ------------------, Toll Free No__________”

6.11.2 **Directional Marker:** Directional Marker shall be provided at each Turning point and 150 m upstream and downstream of Turning points.

6.11.3 **Aerial Marker / Kilometer Marker:** Aerial / Kilometer Markers shall be provided at a spacing of 1 Km along the pipeline route. The Aerial / Kilometer Markers having the warning details can also be treated as Warning Marker.

6.11.4 **ROU Marker / Boundary Marker:** ROU Marker / Boundary marker shall be provided at maximum spacing of 400 m along the pipeline route. However, pipeline route markers shall be installed at least at every 25 m in Urban Agglomeration (UAs) / Towns having a population of one Lakh or more.
7.0 SPARES PHILOSOPHY

7.1 Spares are critical for proper upkeep of equipment and machinery. However in order to keep the inventory and maintenance costs to a minimum, procurement of spares shall be optimized to meet the requirement without build-up of inventory to unwanted levels.

7.2 The spares availability vis-à-vis requirement shall be reviewed by each Maintenance Base / plant at least every year followed by procurement action for short fall quantities to ensure the timely availability of spares. As a minimum requirement the following shall be followed:

- Review of spares requirement by the month of January.
- Consolidation and finalization of spares requirement by regional headquarter by the month of February.
- Administrative approval and financial concurrence by mid of the month of March.
- Placement of Indent to C&P department by the end of the month of March.
- Procurement for critical / insurance item immediately after its consumption for replenishment as required.

7.3 Inventory in GAIL can be classified in to following categories depending upon its usage, procurement procedure, criticality etc.:

- Insurance Spares
- Spare for running maintenance
- Spares for Overhauling / Major Maintenance
- Consumables

7.4 All procurement shall be carried out by considering the followings:

- Consumption rate of the item
- Existing stock
- Spare parts ordered / in transit
- Processing time and lead time for procurement

7.5 The use of critical spares / components should normally be avoided beyond their recommended service life, however, if condition of spare is found to be satisfactory for reuse till next inspection / maintenance, same may be reused based on assessment of the condition of spare / component, in consultation with OEM, if required.

7.6 Non-moving and disposable inventory shall be reviewed every year followed by suitable action as per C&P guidelines.

7.7 INSURANCE SPARES:

7.7.1 Declaration of critical components / spares shall be governed by applicable accounting standards and company policy / procedures notified from time to time.
List of all such insurance items / spares shall be maintained by each site, which shall be updated every year. On consumption of these spares, necessary steps shall be taken to replenish the stock and accord requisite accounting treatment.

7.7.2 Purchase of Insurance items is done after comparing the cost of loss of production in the absence of the item, considering the production / throughput loss. The cost of production loss in such cases will be multiplied by the probability of failure of the stand by machine. When there are identical machines in the plant / system with standby machines, Insurance items are purchased for group of machines (including similar machines spread across various sites).

7.7.3 Following quantum of line pipes shall be kept as insurance spares properly stacked in a pipe yard in a strategic location with respect to the pipeline segment / network the same is meant to service, as decided by the OIC / CGM / In-charge of the network:

(a) Line pipes of all sizes: 0.25% of total pipeline laid length of each wall thickness, size and grade used or higher thickness and / or grade of same size.

Note:

i) Equivalent Wall thickness for higher compatible grades of pipe may be arrived as per ASME 31.8.

ii) Minimum two lengths of pipe may be kept of maximum wall thickness or equivalent.

(b) Pre-tested line pipes of all sizes – 0.05% of total pipeline laid length separately stacked, for meeting any emergency requirement, with markings of pipe number and date of pre-testing with proper documentation.

(c) The Insurance Line Pipes shall be stacked with required preservation measures against corrosion.

(d) After every five year unused pretested pipes shall be transfers to normal pipe lot and kept separately and new 0.05% pipe length from normal pipe lot shall be tested at test pressures as per ASME B31.8 / B31.4 and kept ready for meeting the emergency requirement.

(e) In addition, insurance pipes shall be procured for one major and one minor river crossing through HDD for all applicable diameters with highest thickness and grade, to meet any exigency due to river washout/meandering etc. These pipes shall be stored at centralised location and have internal epoxy coating of minimum 75 micron and end cover for proper protection against internal corrosion.

Guidance document on Long Term Preservation of Coated Carbon Steel Line Pipes may be referred.

7.8 SPARES FOR RUNNING MAINTENANCE:
7.8.1 **Spares of Proprietary Nature:** Since the specification / source of procurement of these items is fixed / limited, they shall be procured for annual requirement considering available stock every year. However, in exceptional cases, if lead time of spares is 6 months or more, two years requirement may be procured.

7.8.2 Spares / consumables having critical application shall also be purchased from OEM, OEM of packaged equipment or OEM approved vendors to ensure the reliability of system though same may be available from other sources [e.g. Air filter required for feed gas intake system for Gas turbines].

7.8.3 However, for spares / consumables used for non critical application, efforts can be made to source the same from reputed vendors having proven track records and requisite experience in the same field [e.g. filters for gas turbine enclosure etc.]

7.8.4 **Other Spares:** Spares / components having multiple vendors shall be procured after assessing annual requirement and available quantity in stock every year through competitive bidding. However, if spares of different makes are not suitable due to their mounting/dimensional problem same shall be procured through OEM / OEM approved vendors.

7.9 **CONSUMABLE ITEMS:**

7.9.1 Consumable are normally required on regular basis for smooth operation and maintenance. Procurement of common items may be carried out centrally by designated department, at site.

7.9.2 Continuous review shall be adopted for procurement of consumables. Maximum, minimum, safety stock and reordering level shall be established for each item. Procurement then, shall be for Economic Order Quantity (EOQ) with due consideration for procurement lead time. Consumables having definite shelf life shall be consumed on ‘first-in-first-out’ principle.

7.10 **SPARES FOR OVERHAULING / MAJOR MAINTENANCE / ZERO HOUR REPAIRS:**

7.10.1 **Equipments Overhauled at OEM / Authorized Maintenance Centres (AMC):** For these equipments / machinery, no spares are required to be stocked for overhauling purposes. Spares required for overhauling should be purchased / ordered along with overhauling job from AMC / OEM. Specific strategy for any long lead item among such overhauls shall be decided on a case to basis by the OIC / CGM / In-charge of network.

7.10.2 **Equipments Overhauled at Site under Vendor Supervision:** The spares required for overhauling of these machines need not be stocked at site as overhauling become due at every 5/6 yrs interval. They should be procured sufficiently well in advance, keeping the lead time and processing time in consideration, so that they will be
available at site before commencement of overhauling. The list of unused spares after overhauling should be circulated to all sites having similar machines. However, for such machines, at least one set of critical components may be kept as insurance spare.

7.10.3 For critical equipment / components, exercise for developing substitute spares / suppliers is not recommended as any failure owing to the same may far outweigh the expected benefits. This shall also be applicable for refurbishment of critical spares / components.

7.10.4 However, for equipment / components not notified as critical, the spares / components can also be sourced / refurbished from reputed vendors having proven track record and requisite experience in the similar field. The process of selection / identification of such alternate source of supply / service needs to be rigorous with due regard to accrued benefit in cost and time without any compromise whatsoever on quality.

7.10.5 The review for indigenization of imported spare may be carried out on yearly basis by a committee for possibility to reduce the dependence on foreign vendors / components and plummeting the lead time and cost of replacement.

7.11 Any spares / consumable items drawn by user groups for emergency use etc. shall be properly documented, stored and maintained in such a way which allows for easy retrieval and proper records.
8.0 PLAN, MONITOR, CONTROL AND REPORT MANAGEMENT

8.1 Monitoring and reporting of Audit Recommendations:

Various technical and non-technical audits / inspections are being carried out by OISD, PNGRB, CTE, Internal Audit etc. throughout the year. The majority of these audit recommendations are corrective measures to be taken to improve safety and integrity of system. To ensure timely review and implementation of corrective measures, a systematic monitoring and reporting mechanism shall be put in place.

Such a system may include the following:

- Review of Audit report by ED / CGM / OIC concerned, within two weeks and Action plan for implementation within next one week along with circulation to all concerned for implementation and to respective Auditor for information.
- Progress review by ED concerned every month.
- Submission of monthly reports in first week of every month to Director (Projects).
- Meetings with ED’s on first Tuesday of every month (or the next working day if first Tuesday is a holiday) to review the progress.
- DGM-PMCC is designated as centralised coordinator to monitor implementation of corrective measures recommended by Auditors.

8.2 Time bound resolution of issues in O&M Department:

Time bound resolution of issues is one of the key aspects to achieve success in any endeavour. In order to achieve this, it is essential to bring the issues to the notice of appropriate levels of management in a systematic manner. Accordingly below mentioned process shall be followed to ensure time bound resolution of issues / constraints at site level to ensure safety & integrity of Pipelines & Assets.

- The Site In-Charges at the levels of CM or below shall put up reports to OIC / CGM by first week of the month. These Reports shall be in the form of Source-Operation-Maintenance (SOM). ED (O&M)-CO shall circulate the format for capturing all details among other groups for compliance. Eventually, the format shall be in synchronization with Component Based Operation & Maintenance Schedule.
- OIC / CGM, upon reviewing the report and taking appropriate action at his / her level to resolve the issues, shall put up report to ED concerned by second week of the month.
- ED Concerned, upon reviewing the report and taking appropriate action at his / her level to resolve the issues, shall put up the exception report to Director (Projects) in Monthly Performance Report (MPR).
• Director (Projects) will forward advice, if any, on the subject report to ED concerned, by last week of the month.

8.3 **Reporting and Reviewing:**

8.3.1 Respective CGM (O&M) and ED (O&M) shall visit site(s) on monthly basis for at least one site under their jurisdiction.

8.3.2 The Centralised Integrity Management Group shall monitor, guide and control the maintenance related activities on Pan India basis and submit the exception report related to integrity and maintenance activities on monthly basis.

8.3.3 Planning Monitoring and Control Cell (PMCC) at Corporate Office will centrally co-ordinate with regional PMCCs, Centralised Integrity Management Group (CIMG), Regional Integrity Management Groups (RIMGs) and other stake holders for Planning, Monitoring, Controlling and Management reporting.

8.3.4 Each site will submit the Fortnightly plan (on first and 15th day of every month) and quarterly plan (on first of January, April, July and October) incorporating critical maintenance activities to Corporate PMCC and compliance thereon in subsequent fortnight / quarter. The catch plan for slippages, if any, shall be incorporated in subsequent plans.

8.3.5 Each site shall submit monthly report to Corporate PMCC which shall at least include performance with respect to MOUs targets, Benchmarks, Compliance of various audit / Statutory recommendations, Compliance of schedule maintenance, encroachment status, washout status etc.
9.0 MANAGEMENT OF CHANGE

9.1 Management of change should be implemented to achieve higher efficiency, improve operability, safety, reliability, improvement of the plant machineries and equipment and to accommodate technical change. The management of changes may be arising due to various reasons like operational flexibility, energy conservation, capacity augmentation, improvement of product specification, yield improvement, compliance with statutory rules and regulations.

9.2 However, before implementing any major modification, same shall be reviewed by formulating a cross functional team. The cross functional team should review the modification in totality including safety hazards, quality issues, HAZOP etc. OISD 178 shall be referred for details. The approving authority for these changes shall not be below the level of OIC / CGM.

9.3 The Management of change shall also include the introduction to personnel, who is new to the process, through training on overview of the process and operating procedures. The training shall include emphasis on the specific safety and health hazards, emergency operations including shutdown, safe work practices applicable to employee’s job task.

10.0 AMENDMENT / DEVIATION

10.1 All the maintenance activities should be carried out in line with above guidelines; deviation, if any, shall be put up for approval of the Executive Director concerned, along with proper justification.

10.2 The changes in agreements, such as GAIL pipeline / OFC Crossing agreement and / or agreement with Developer / Builder in the vicinity of pipeline may be carried out with approval of the Executive Director concerned, based on recommendation of respective OIC / CGM, after vetting by corporate legal department. However, the changes which are not major in nature and that do not change intent of the agreement may be approved by OIC / CGM concerned.

11.0 Periodicity of review of Maintenance Policy and Guidelines

11.1 The Operation & Maintenance Policy and Guidelines shall be reviewed every year and changes, if any, shall be incorporated and notified.

11.2 Operation & Maintenance Policy and Guidelines shall be reviewed comprehensively after every three years by formulation of CGM level committee.

11.3 Guidelines amendment shall be put up for approval of Director (Projects) and Policy amendment for approval of CMD.
12.0 EXPLANATORY NOTES

12.1 Equipment / Station Availability: The availability of any equipment / station is the total time for which equipment is available for operation excluding planned and unplanned down time.

\[
\% \text{ Availability} = \left( \frac{\text{Total hours} - (\text{Planned} \& \text{Unplanned down Time})}{\text{Total Hours}} \right) \times 100
\]

12.2 Equipment Reliability: The quality of maintenance should be such that the unplanned downtime should remain as minimum as possible. The reliability of the system is total availability of system including planned maintenance time but excluding the unplanned down time.

\[
\% \text{ Reliability} = \left( \frac{\text{Total hours} - (\text{Unplanned Down time})}{\text{Total Hours}} \right) \times 100
\]

12.3 Pipeline Availability: The availability of any pipeline network is the total time for which pipeline is available for operation at rated flow excluding prorated partial / complete interruption of flow.

\[
\% \text{ Availability} = \left( \frac{(AD - BC)}{AD} \right) \times 100
\]

A = Average gas supply to all firm consumers in pipeline system
B = Average gas off take by consumers where supply is interrupted
C = Time duration in hrs of interruption
D = Total no of hours in fixed duration

12.4 Pipeline Protection Index: Pipeline protection index is indicative of CP protection for pipelines in a year.

\[
\% \text{ Pipeline Protection Index} (\text{PPI}) = \left( \frac{D}{365} \right) \times (\frac{K}{T}) \times 100
\]

D = Total Number of Days Protected in a year
K = Total pipeline length in Kilometer protected
T = Total Length of pipeline in Kilometer.

12.5 Energy Efficiency for Gas Transportation: This is the ratio of fuel /IC consumption in energy terms to gas compressed in energy terms:

a) % of fuel / Internal consumption for gas delivered = \[
\left( \frac{\text{Fuel For Compression} \times \text{IC}}{\text{Gas Compressed Energy}} \right) \times 100
\]
13.0 APPENDIX

13.1 APPENDIX-I: RESPONSIBILITY MATRIX
### Responsibility Matrix:

<table>
<thead>
<tr>
<th>SN</th>
<th>Activity</th>
<th>Designated Engineer/Officer</th>
<th>HOD/WIC</th>
<th>OIC / CGM</th>
<th>ED (O&amp;M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overall Implementation of Maintenance Policy &amp; Guidelines Provisions</td>
<td>M</td>
<td>R</td>
<td>P</td>
<td>C</td>
</tr>
<tr>
<td>2</td>
<td>Overall Implementation of Integrated Management System (IMS) of pipelines</td>
<td>M</td>
<td>R</td>
<td>P</td>
<td>C</td>
</tr>
<tr>
<td>3</td>
<td>Overall integrity of assets</td>
<td>M</td>
<td>R/P</td>
<td>C</td>
<td></td>
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<tr>
<td>4</td>
<td>Availability of Machines</td>
<td>M</td>
<td>R</td>
<td>P</td>
<td>C</td>
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<tr>
<td>5</td>
<td>Pipeline Availability</td>
<td>M</td>
<td>R/P</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Operating reliability</td>
<td>M</td>
<td>R/P</td>
<td>C</td>
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<tr>
<td>7</td>
<td>Pipeline Protection Index (PPI)</td>
<td>M</td>
<td>R</td>
<td>P/C</td>
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<tr>
<td>8</td>
<td>Permit system implementation</td>
<td>M</td>
<td>R/P</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Safety in operation and Maintenance*</td>
<td>M</td>
<td>R</td>
<td>P</td>
<td>C</td>
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<td>10</td>
<td>Availability of accredited ERDMP</td>
<td>M</td>
<td>R/P</td>
<td>C</td>
<td></td>
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<td>11</td>
<td>Hazop and QRA</td>
<td>M</td>
<td>R/P</td>
<td>C</td>
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<tr>
<td>12</td>
<td>Healthiness of safety devices Such as UV / LEL / Thermal / IR etc.</td>
<td>M/R</td>
<td>P/C</td>
<td>-</td>
<td></td>
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<tr>
<td>13</td>
<td>Healthiness of Earthing System</td>
<td>M</td>
<td>R</td>
<td>P/C</td>
<td>-</td>
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<td>14</td>
<td>Calibration of Pressure Safety Valve</td>
<td>M</td>
<td>R</td>
<td>P/C</td>
<td>-</td>
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<td>15</td>
<td>Testing and Calibration of Safety devices</td>
<td>M</td>
<td>R</td>
<td>P/C</td>
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<tr>
<td>16</td>
<td>Testing of Tools and tackles</td>
<td>M/R</td>
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<td>Review and adherence to SOPs / SWPs</td>
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<td>R</td>
<td>P/C</td>
<td>-</td>
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<tr>
<td>18</td>
<td>Monitoring of gas source parameter and other operating condition, alarms etc.</td>
<td>M/R</td>
<td>P</td>
<td>C</td>
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<td>Trip Failure and alarm analysis</td>
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<td>Manning of Control Room</td>
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<td>Certification &amp; Compliance of IQMS</td>
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<td>Declaration of Critical equipment / components along with details of Vendor and required quantity</td>
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<td>Review of Technological Obsolescence / upgradation</td>
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<td>Preparation, implementation &amp; periodic review of Comprehensive Maintenance</td>
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<td>Healthiness of CP system &amp; CP / CPL / DGVG Survey, Coating integrity survey</td>
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<td>Management of change</td>
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</table>

* For safety issues, all officers are accountable to their job and respective HODs are responsible. In addition, HOD (F&S) is also responsible.
Note:

1) Designated Engineer / Officer: The officer in respective department to whom the job is assigned.
2) HOD / WIC: Respective Head of Departments / WIC (in JLPL & VSPL) for their job responsibility to whom designated officer reports.
3) OIC: Respective OIC / CGM
4) ED (O&M): Respective ED (O&M) for their jurisdiction.
OPERATION AND MAINTENANCE GUIDELINES
FOR PIPELINES AND COMPRESSOR / BOOSTER STATIONS