

**NOTIFICATION**  
**THE PETROLEUM AND NATURAL GAS REGULATORY BOARD**

New Delhi, the 16<sup>th</sup> May 2013

F.No.INFRA/IMP/CGD/1/2013 - In exercise of the powers conferred by section 61 of the Petroleum and Natural Gas Regulatory Act, 2006 (19 of 2006), the Petroleum and Natural Gas Regulatory Board hereby makes the following regulations to evaluate risks, improve the safety of city gas distribution network and bring more effectiveness in operations to minimize the probability of CGD network failure, namely:-

**1. Short title and commencement.**

(1) These regulations may be called the Petroleum and Natural Gas Regulatory Board (Integrity Management System for City or Local Natural Gas Distribution Networks) Regulations, 2013.

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

**2. Definitions.**

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

(a) "Act" means the Petroleum and Natural Gas Regulatory Board Act, 2006;

(b) "city or local natural gas distribution network" (hereinafter referred to as CGD network) means pipeline network as defined in the Act;

(c) "city gate station (CGS)" means the station as defined in Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for City or Local Natural Gas Distribution Networks) Regulations, 2008;

(d) "risk" means the risk as defined under the Petroleum and Natural Gas Regulatory Board (Codes of Practices for Emergency Response and Disaster Management Plan (ERDMP)) Regulations, 2010;

(e) "risk analysis" means the risk analysis as defined under the

Petroleum and Natural Gas Regulatory Board (Codes of Practices for Emergency Response and Disaster Management Plan (ERDMP)) Regulations, 2010;

(f) “risk assessment” means the risk assessment as defined under the Petroleum and Natural Gas Regulatory Board (Codes of Practices for Emergency Response and Disaster Management Plan (ERDMP)) Regulations, 2010;

(g) “risk management” means the risk management as defined under the Petroleum and Natural Gas Regulatory Board (Codes of Practices for Emergency Response and Disaster Management Plan (ERDMP)) Regulations, 2010;

(h) “Shall” indicates that the provision in which it occurs is mandatory;

~~(g)(i) “Should” Indicates that the provision in which it occurs is recommendatory but not mandatory;~~

~~(h)~~

~~(i) “Shall” A mandatory term no dispensation is permitted without written approval from the board.~~<sup>[RBS1]</sup>

“Shall” A mandatory term no dispensation is permitted without written approval from the board

~~(j) “Should” A recommended term indicating a certain course of action is preferred but not mandatory~~

“Should” A recommended term indicating a certain course of action is preferred but not mandatory

“May”

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

### **3. Applicability.**

These regulations shall apply to all the entities laying, building, operating or expanding city or local natural gas distribution networks. .

### **4. Scope.**

These regulations shall cover all existing and new city gas distribution networks including sub-transmission pipelines, city gas station, distribution mains and piping facilities downstream of inlet isolation valve of city gate station (inclusive of primary, secondary and tertiary networks) including consumer meter for

commercial or industrial customer and up to final isolation valve including connecting hose to gas appliances for domestic consumer:

Provided that the materials and specifications followed shall be in accordance with Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for City or Local Natural Gas Distribution Networks) Regulations, 2008 as amended from time to time.

## 5. Objective.

### 5. Purpose Objective.

These Regulations outline the basic features and requirements for developing and implementing an effective and efficient integrity management plan for making them **reasonable and prudent operator** [RBS2] of city gas distribution networks to manage its integrity and to continue providing [RBS3] safe and reliable delivery of natural gas to its customers through -

- i) evaluating the risk associated with city gas distribution networks and effectively allocating resources for prevention, detection and mitigation activities;
- ii) improving the safety of city gas distribution networks so as to protect the personnel, property, public and environment;
- iii) bringing more streamlined and effective operations to minimize the probability of CGD network failure.

## **6. Integrity Management System.**

The development and implementation of integrity management system for the city gas distribution networks shall be as described in Schedule 1 to Schedule 10 of these regulations.

Entity operating and maintaining CGD networks shall have the qualified manpower as indicated in Appendix III.

## **7. Default and consequences.**

- (1) There shall be a system for ensuring compliance to the provisions of these regulations through implementation schedule as described in these regulations at Schedule 7 and Schedule 8 in conjunction to Appendix II.

(2) In case of any deviation or shortfall in achieving the implementation of integrity management system as specified in these regulations, the entities shall be liable to face the following consequences, namely:-

- (i) the entity is required to complete each activity within the specified time limit and if there is any deficiency in achieving in one or more of the activities, the entity shall submit a mitigation plan within the time limit for acceptance of the Board and make good all short comings within the time agreed by the Board and if the entity fails to complete activities within the specified time limit by the Board, relevant penal provisions of the Act shall apply;
- (ii) in case the entity fails to implement the integrity management system, the Board may issue a notice to such defaulting entity allowing it a reasonable time to implement the provisions of integrity management system and if the entity fails to comply within the specified time, the relevant provisions of the Act and regulations shall apply.

#### **8. Requirement under other statutes.**

It shall be necessary to identify and comply list of applicable ~~comply with all~~ [RBS4] statutory rules, regulations and Acts in force as applicable and requisite approvals shall be obtained from the relevant competent authorities for the CGD networks.

#### **9. Miscellaneous.**

- (1) In the event of any problem faced by an entity in implementing the provisions contained in these regulations, the entity may approach Board for necessary dispensation.
- (2) The Board may issue guidelines from time to time relating to Integrity Management System for City or Local Natural Gas distribution Networks.

## SCHEDULES (see regulation 6)

### **SCHEDULE 1** [RBS5]

#### **1.1. Objective**

The objective of Integrity Management System (IMS) is to ensure the integrity of CGD networks at all times to ensure public protection of environment, optimal ~~maximum~~ availability of CGD networks and also minimizing business risks associated with operations of gas network. The availability of the Integrity Management System will allow professionals and technicians in integrity tasks to ensure work plans and targets in the short, medium and long term horizon which in turn will improve their efficiency and satisfaction. ~~to attain them.~~

**1.2.** The IMS will enable the CGD operator to select an identified system for implementation such that the IMS will be uniform for all CGD entities within the country.

**1.3.** An effective Integrity Management System shall be -

- (a) ensuring the quality of CGD network integrity in all areas which have potential for adverse consequences;
- (b) promoting a more rigorous and systematic management of CGD network integrity and mitigate the risk;
- (c) Increasing the general confidence of the public in operation of CGD network;
- (d) optimizing the life of the CGD network with ~~the~~ inbuilt incident implementation of Integrity Management Plan (IMP) investigation and data collection ~~including~~ [a6] periodic review by the entity.

## SCHEDULE 2

### **Introduction to the Integrity Management System (IMS)**

- 2.1 CGD network comprises of important assets transporting flammable gas under pressure within the densely inhabited areas. As such, they expose people, communities and the environment to risks in case of failure. On the other hand, CGD network are themselves exposed to external damages caused by third parties and in many cases such external damages are the main cause for network failure. Further, the life-line of the masses in regard to domestic cooking of food and movement in vehicles are fully dependent on CGD network. In case of failure, normal life may be badly disrupted. It is, therefore, essential that a system is introduced which ensures maximum availability of the network with minimum disruption and damages.
- 2.2 An Integrity Management System for CGD networks provides a comprehensive and structured framework for assessment of CGD networks condition, likely threats, risks assessment and mitigation actions to ensure safe and incident free operation of CGD networks.

~~2.3 Such a comprehensive integrity management system essentially comprises of the following elements [HT7][RBS8]~~

- ~~(a) **Integrity Management Plan (IMP):** This encompasses collection and validation of data, assessment of spectrum of risks, risk ranking, assessment of integrity with reference to risks, risks mitigation, updation of data and reassessment of risk;~~
- ~~(b) **Performance evaluation of Integrity Management Plan:** This is a mechanism to monitor the effectiveness of integrity management plan adopted and for further improvement;~~
- ~~(c) **Communication Plan:** This covers a structured plan to regulate information and data exchange within and amongst the internal and external environment;~~
- ~~(d) **Management of Change:** This is the process to incorporate the system changes (technical physical, procedural and organization changes) in to integrity management plan to update the integrity management plan;~~
- ~~(e) **Quality Control:** This is the process to establish the requirements of quality in execution of the processes defined in the integrity management plan.~~

~~These elements are further detailed in Schedule 6.~~

## SCHEDULE 3

### Description of CGD System

#### 3.1 Physical description.

Description of CGD Network should include specific description of the primary networks, secondary and tertiary networks with respect to design specifications, length, major installations details such as:

##### **3.1.1 Sub Transmission Pipeline (STPL)**

##### **3.1.2 City Gas Station (CGS)**

##### **3.1.3 LNG/ LCNG dispensing stations**

##### **3.1.4 Odorization System**

##### **3.1.5 Steel pipeline networks**

##### **3.1.6 Secondary PE networks**

##### **3.1.7 Tertiary networks, PE, GI and/ or copper**

##### **3.1.8 District Regulating Station (DRS)**

##### **3.1.9 Isolation Valves (Steel, PE)**

##### **3.1.10 CNG station-Mother, Online, Daughter Booster Station (DBS)**

##### **3.1.11 Compressor at CNG stations**

##### **3.1.12 Cascade & Cascade Transport Vehicle (CTV)**

##### **3.1.13 Individual Pressure Regulating Station (IPRS), Common Pressure Regulating Station (CPRS), Metering Station (MRS)**

##### **3.1.14 Control room and/or Master Control Station (if any)**

##### **3.1.15 Instrumentation and Electrical systems**

##### **3.1.16 Supervisory Control and Data Acquisition (if any)**

##### **3.1.17 Safety Equipments**

##### **3.1.18 Customer base (PNG, CNG, Industrial and Commercial)**

#### 3.2 Other description.

3.2.1 Interfaces with other Geographical Area / pipeline / Facilities (if available);

3.2.2 Asset damage incident reporting [RBS9][HT10]

3.2.3 Information on Documentation Relating to design, construction, operations, maintenance, etc.;

3.2.4 Statutory requirements [HT11][RBS12]

## SCHEDULE 4

### **Selection of appropriate Integrity Management System**

- 4.1 Integrity Management System for CGD Networks could employ either a Performance based IMS or a Prescriptive type Integrity Management System. Whereas, CGD industry has gathered a reasonable good experience of CGD operations and such CGD industry is fairly mature, a Performance based Integrity Management System are appreciated globally. However, where CGD networks are in developing stage, a Prescriptive type Integrity Management System is recommended. Whereas, the Performance based Integrity Management System recognizes the experience of the entity which has been operating the CGD network but the Prescriptive type Integrity Management System is more rigorous as it considers the worst case scenario of the failures in the CGD networks and therefore worst case scenario for mitigation.
- 4.2 Though subsequent schedule in these regulations apply to both prescriptive and performance based type of Integrity Management System, present regulations mainly focus on prescriptive aspects in absence of adequate historical Integrity Management System data. However, the industry can adopt the performance based typed of Integrity Management System based on analysis of the baseline data and subsequent trends.
- 4.3 A prescriptive type of Integrity Management System mandates the implementation of an established process for addressing the risks, their consequences and proven methods for mitigation. It also mandates the in-house development of Integrity Management Plan, Management of Change pertaining to technical aspects. Based on the development of CGD industry in India till date, the preparation of Prescriptive type Integrity Management System has been considered for implementation to all CGD networks in India. Further, as the CGD industry matures and gathers sufficient records or data as per the requirements prescribed in Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for City or Local Natural Gas



Distribution Networks) Regulations, 2008, a review mechanism may be considered by the Board for recommending a Performance Based Integrity Management System for CGD Networks.

Integrity Assessment Tools

Some of the tools for Integrity assessment are provided below. The operator should use as many support systems necessary to achieve the Integrity Management Plan for CGD networks. It may be noted that the baseline data for specific measurement should be available with the operator as a ready reckoner:

**(a) — Direct assessment and evaluation**

External Corrosion Direct Assessment (ECDA) can be used for determining integrity for the external corrosion threat on CGD network segments. The External Corrosion Direct Assessment process has the following four components:

- (a) Pre-assessment
- (b) Inspections
- (c) Examinations and evaluations
- (d) Post-assessment

While implementing External Corrosion Direct Assessment and when the pipe is exposed, the company is advised to conduct examinations for threats other than that for external corrosion also (like mechanical and coating damages)

**(b) Thickness assessment and periodic review against baseline values**

Periodic thickness assessment for all CGD network skids and pressure vessels and comparison to baseline values shall be done once a year.

**(c) Cathodic protection system surveys**

Cathodic Protection adequacy survey shall be carried out so as to cover the entire steel network of pipelines so as to detect insufficient Cathodic Protection levels and other irregularities and anomalies in the steel pipeline. Suitable procedures shall be established by the operator to account for adequate Cathodic Protection levels to pipeline extensions and new projects.

**(d) Pressure testing**

Pressure testing is appropriate for integrity assessment when addressing certain threats, at the pre-commissioning stage itself. Pressure testing shall comply with the requirements of applicable Petroleum and Natural Gas Regulatory Board regulations.

**Such other methods for integrity assessment may be also adopted by the CGD entity as it thinks fit, apart from the above mentioned ones.**

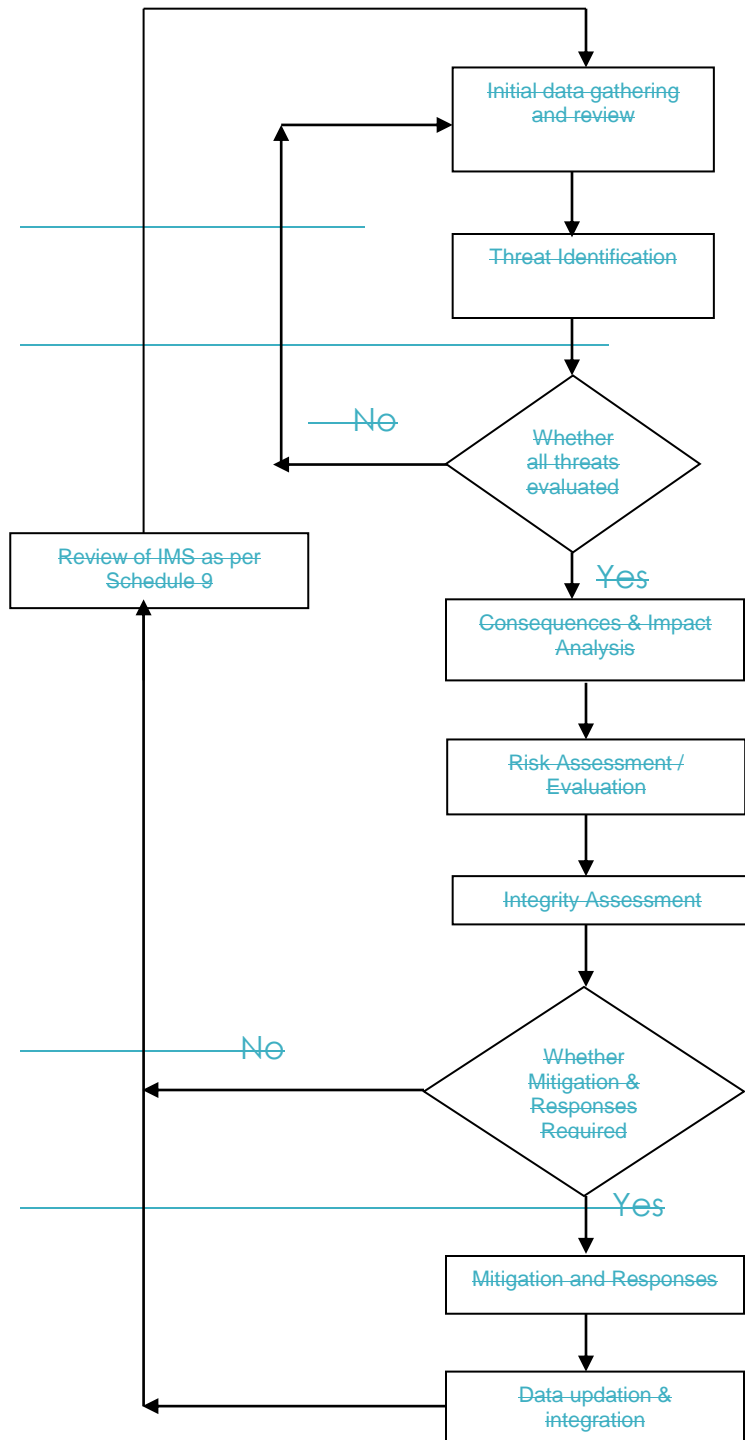
## **SCHEDULE 6**

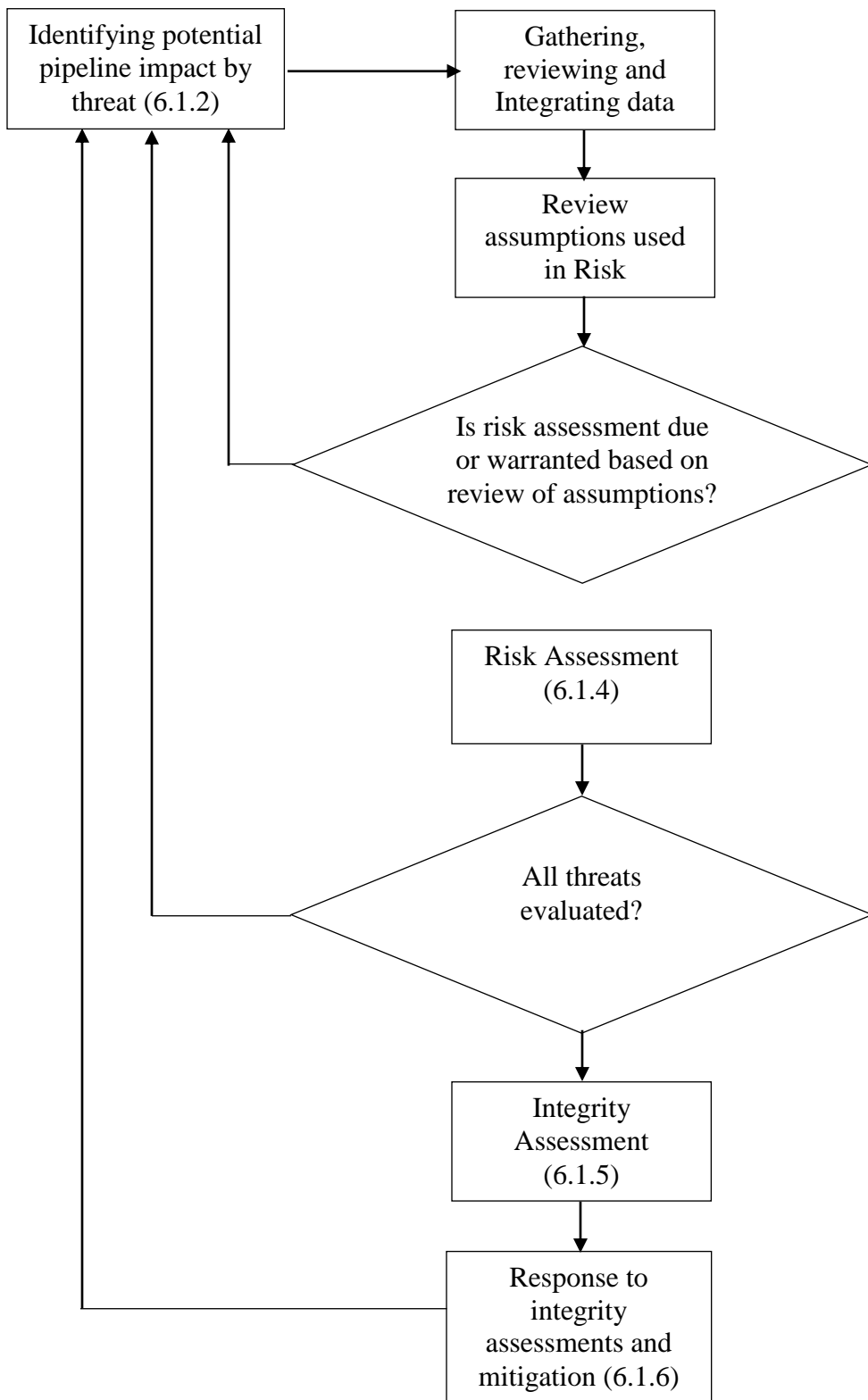
### **Designing applicable Integrity Management System for the CGD Network**

All operators of existing and new city gas distribution networks shall develop an integrity management programme comprising the necessary plans, implementation schedule and assessment of its effectiveness in order to ensure safe and reliable operation of the CGD networks. It is recognized that the comprehensive CGD networks integrity management programme is based on continuous exercise of extensive data collection, assimilation and analysis. Further, an integrity management programme can be devised on specified methods, procedures and time intervals for assessments and analysis or on the basis of performance of the programme with regard to efficacy of integrity assessment plan, its results and mitigation efforts. For operators implementing an integrity management programme in the absence of base line and performance data, it may become imperative to adopt a prescriptive integrity management programme initially.

#### **6.1 CGD networks integrity management plan.**

All CGD networks and associated facilities installed as a part of network shall be covered in integrity management plan. The cycle of basic processes of integrity management Plan is illustrated (Fig -1) and further detailed hereunder:





## Figure-1: CGD Network Integrity Management Plan - Flow Diagram

### 6.1.1 Initial data gathering, review and integration.

The types of data to support a risk assessment will vary depending on the threat being assessed. CGD Network and facility knowledge is an essential component of data collection.

Data may be of any form mentioned in the above section or customized as per the specific requirements. The data shall be in a form which would aid in effective risk assessment. It may be noted that the implementation of the integrity management programme would in itself drive the collection and prioritization of additional data. The volume and types of data will expand as the plan is implemented over years of operation.

The data collected shall as far as possible be relevant in applicability to the identified threats.

The unavailability of identified data elements is not a justification for exclusion of a threat from the integrity management programme.—Depending on importance of the data, sound engineering judgment based on available information, if possible in conjunction with industry-wide data and best practices may be used for risk assessment.

Four aspects should be visualized during data collection:

- 1) Data alignment -  
Integration of disparate data sources to a common location (GIS).  
[RBS14] This helps in pinpointing risks to be attended.  
Data history  
Ability to manage the temporal aspects of any data
- 2) Data Normalization  
Integration of disparate data sources that analyze same attributes from different aspects
- 3) Data accuracy and confidence  
Important piece of decisive data required to support decision making

**6.1.2 Identification of Threats:** Gas pipeline incident data analyzed and classified by Pipeline Research Council International (PRCI) represents 22 root causes for threat to pipeline integrity. One of the causes reported by the operator is “unknown”. The remaining 252+ threats have been grouped into three groups based on time dependency and further in to nine categories of related failure types according to their nature and growth characteristic as below:

**(I) Time Dependent Threats:**

- 1) **External Corrosion**
- 2) **Internal Corrosion**
- 3) **Stress Corrosion Cracking**

**(II) Stable Threats:**

**4) Manufacturing related defects**

- i. Defective pipe seam
- ii. Defective pipe

**5) Welding /fabrication related**

- i. Defective pipe girth weld
- ii. Defective fabrication weld
- iii. Wrinkle bend or buckle
- iv. Stripped threads /broken pipe /coupling failure

**6) Equipment**

- i. Gasket O-ring failure
- ii. Control/relief equipment malfunction
- iii. Seal pump packing failure
- iv. Miscellaneous

**(III) Time independent Threats:**

**7) Third party /mechanical damage:**

- i. Damage inflicted by first, second or third party (instantaneous /immediate failure)
- ii. Previously damaged pipe (delayed failure mode)
- iii. Vandalism
- iv. Rat bites

v. Electric Arching

vi. Joint failures (particularly in PE pipeline)[RBS15]

vii. AC / DC Interference

**8) Incorrect operational procedure**

**9) Weather related and outside force:**

- i. Weather related
- ii. Lightning
- iii. Heavy Rains or Floods

#### iv. Earth Movements

**Besides the above, certain other threats may be applicable based upon the land pattern:**

- i. Creek Area effects
- ii. Muddy Land effects
- iii. River bed movements

The CGD entity may choose its own method or source of data for identifying the threats to their network. Some of the sources of data may be -

- Previous technical audit / inspection reports,
- Cathodic Protection system survey and monitoring reports
- Incident investigation and records of analysis for finding root causes
- Accidental or opportunity based excavation and inspection
- CGD Network damage and defects reports
- Repair or maintenance activities
- Regular and past operational data
- Register of risks identified during design (including route survey records), construction, operations and maintenance / surveillance / patrolling
- Construction and maintenance records (including maintenance backlog), history, method of construction, test and inspection data etc.
- Company internal specifications under various heads
- CGD Network data from records like Piping and Instrumentation Diagram, pipe-book, design and manufacturer documents, as-built documents and drawings etc. and by use of Geographic Information System
- System modification records and history
- Consultations with Original Equipment Manufacturers and suppliers and other certified third parties.

It may be noted that the above list is only representative and the CGD entity is free to use any form of data based on its experience and sound judgment.

Also, the analysis of risks to the network may be carried out as convenient for the CGD entity, based on past experience of the type of threats and uniformity of network threats and characteristics.



**6.1.3 Consequence and Impact Analysis:** Once the hazardous events are identified, the next step in the risk analysis is to analyse their consequences, i.e., estimate the magnitude of damage to the public, property and environment of all the indentified threats. These consequences may include leak, fire, explosion, gas cloud etc. Consequence estimation can be accomplished by using mathematical models e.g. consequence modelling.

**Identification of High Consequence Area (HCA)** – Locations along the CGD Network system meeting the criteria for High-Consequence Areas are identified. Generally, these are high-population-density areas, difficult-to-evacuate facilities (such as hospitals or schools), and locations where people congregate (such as places<sup>[HT18]</sup> and worship, office buildings<sup>[RBS19]</sup>, or fields). Clause no. 3.2 of ASME B 31.8 S may be referred for detailed information regarding potential impact area.

#### **6.1.4 Risk Management and Risk Assessment**

The data assembled is used to conduct a risk assessment of the CGD network and related facilities. There are a variety of risk assessment methods that can be applied based on the available data and the nature of the threats. The CGD entity should tailor the method to meet the needs of the system.

Risk assessment helps organize data and information to help CGD entities prioritize and plan activities.

In carrying out risk assessment, the probability of occurrence and consequence shall be determined for every threat, and the individual risk ratings shall be added to yield final risk rating under consideration.

***Risk rating = Probability rating X Consequence rating***

**Probability rating** – Probability rating may be determined by assigning appropriate scalable values for the probability of occurrence, based on industry experience and company's past experience.

For example, a probability rating of scale 1 to 4, 1 to 5 or 1 to 6 may be applied, and probabilities may be characterized as weekly, monthly, half-yearly, yearly, etc. The rating shall be ascending for increasing probability of occurrence.

**Consequence rating** – Consequence rating may be determined similarly by assigning appropriate scalable values to consequence of a threat materializing, and these may be individually characterized under impact on people, environment, financial and business loss value and legal consequences. A CGD entity may consider as many factors as applicable from amongst these or define additional factors as required.

For example, a consequence rating of scale 1 to 4, 1 to 5 or 1 to 6 may be applied to each category (impact on people, environment, financial and

business loss value and legal consequences), and from amongst these, the highest rating may be taken as the consequence rating under consideration. As an example, impact on people may be characterized as minor or major injury, single fatality, multiple fatalities etc. In the same way, business loss may be characterized in terms of increasing monetary impact. The rating shall be ascending for increasing impact. A sample 5\*5 Matrix, 4\*4 Matrix, 6\*6 matrix is included in the Appendix IV???? which may be used to carry out the risk assessment in accordance with the entities own Policies. Stick to one single matrix (preferably 5x5) and include the same in document [RBS20]. A sample risk register is given in the regulations as Appendix V. An illustrative 6\*6 matrix attached as Appendix IV may be used to carry out the risk assessment. A typical risk register is attached as Appendix V.

A risk assessment model along the above lines helps provide in improved understanding of the nature and locations of risks along a CGD network or within a facility. But, risk assessment methods alone should not be completely relied upon to establish risk estimates or to address or mitigate known risks. Risk assessment methods should be used in conjunction with knowledgeable, experienced personnel (subject matter experts and people familiar with the facilities).

An integral part of the risk assessment process is the incorporation of additional data elements or changes to facility data. The risk ratings shall be reviewed and necessary changes made after a pre-decided interval or when changes take place or when additional data or information becomes available. To ensure regular updates, an effective process shall be established for major system changes and modifications which can impact risk rating of the system, and this shall incorporate the risk assessment process after the changes are made.

~~A company should carry out the following activities as part of risk assessment-~~

- ~~(a) Carry out Cathodic Protection system and CP adequacy survey for distribution pipelines and categorize the anomalies detected on the basis of risk levels;~~
- ~~(b) Carry out periodic analysis to determine the level of risks to assets (as an input to [HT21] asset replacement activity);~~
- ~~(c) Risk analysis and assessment for all reported asset-related incidents and findings (including incidental steel pipeline and MDPE exposures, or excavation);~~

~~Entity to Prepare, maintain [and] [HT22] update a register of known risks to assets, including their risk rating. [RBS23]~~

~~a) For Stable threats~~

~~b) For Time Dependent and time Independent threats,~~

~~(d) — Stable threats are normally threats which have fixed mitigation measures mostly are policy and procedural based and mostly global/generic in nature where as Time dependent and time independent are dynamic in nature also~~

they are specific to a section of pipeline or to the specific equipment. A typical risk register is attached as Appendix V. Refer Appendix 5 for the sample risk register

Prioritization ~~usually~~ involves sorting risk ratings in decreasing order. For initial efforts and screening purposes, risk results could be evaluated simply on a “high–medium–low” basis or as a numerical value. Identified high risk activities may be taken up as part of Annual improvement plan ( Also called asset integrity improvement plan) for close monitoring. When segments being compared have similar risk values, the failure probability and consequences shall be considered separately. Factors including line availability (flow stoppage options) and system throughput requirements can also influence prioritization.

### **6.1.5. Integrity Assessment.**

#### **6.1.5.1 Integrity Assessment Tools**

Some of the tools for Integrity assessment are provided below. The operator may use either of the methods a or b for integrity assessment techniques and and as many monitoring tools support systems necessary from c to h  
~~Some of the tools for Integrity assessment are provided below. The operator may use either of the methods a or b and as many support systems necessary from C to G whereas to achieve the Integrity Management Plan for CGD networks, maintaining the compliance with PNGRB T4S regulations . It may be noted that the baseline data for specific measurement should be available with the operator as a ready-reckoner:~~

[RBS24]

#### **(a) Direct assessment and evaluation**

Direct assessment is an integrity assessment method utilizing a structured process through which the operator is able to integrate knowledge of the physical characteristics and operating history of a pipeline system or segment with the results of inspection, examination, and evaluation, in order to determine the integrity.

External Corrosion Direct Assessment (ECDA) can be used for determining integrity for the external corrosion threat on CGD network segments. The entity may use NACE SP0502 to conduct ECDA. The ECDA process integrates facilities data, and current and historical field inspections and tests, with the physical characteristics of a pipeline. Nonintrusive (typically aboveground or indirect) inspections are used to estimate the success of the corrosion protection. The ECDA process requires direct examinations and evaluations. Direct examinations and evaluations confirm the ability of the indirect inspections to

locate active and past corrosion locations on the pipeline. Post-assessment is required to determine a corrosion rate to set the reinspection interval, reassess the performance metrics and their current applicability, and ensure the assumptions made in the previous steps remain correct. The External Corrosion Direct Assessment process has the following four components<sup>[HT25][SG26][RBS27]</sup>:

- (a) Pre-assessment
- (b) Inspections
- (c) Examinations and evaluations
- (d) Post-assessment

While implementing External Corrosion Direct Assessment and when the pipe is exposed, the company is advised to conduct examinations for threats other than that for external corrosion also (like mechanical and coating damages)

Or

### **Cathodic protection system surveys**

~~Cathodic Protection adequacy survey shall be carried out so as to cover the entire steel network of pipelines so as to detect insufficient Cathodic Protection levels and other irregularities and anomalies in the steel pipeline. Suitable procedures shall be established by the operator to account for adequate Cathodic Protection levels to pipeline extensions and new projects.~~

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### **(b) Pressure testing**

Pressure testing is appropriate for integrity assessment<sup>[a28]</sup> when addressing certain threats, at the pre-commissioning stage and subsequent testing after a pipeline has been put in service itself. Pressure testing shall comply with the requirements of applicable Petroleum and Natural Gas Regulatory Board regulations.

### **6.1.5.2 Monitoring Tools (O&M)**

#### **(c) Thickness assessment and periodic review against baseline values**

Periodic thickness assessment for all CGD network skids, station piping and pressure vessels and comparison to baseline values shall be done once a year. In absence of baseline data first recorded data or design data shall be taken as baseline value with a sound engineering judgment to ensure that the data are within the specified limits as per the design.

Whenever a pipeline is exposed, the entity shall take opportunity to examine the coating and pipe condition by conducting Visual examination, thickness testing and other NDT<sup>[RBS29]</sup> methods as suitable which can be recorded in GIS/SAP or as suitable. The examination may not be repeated for a similar pipeline segment (but after long time gap, if opportunity exist on same segment then examination can be repeated) . The preparation of segments

may be carried out as per Table 5 Example of Integrity Management Plan for Hypothetical Pipeline Segment (Segment Data: Line 1, Segment 3) of ASME B31.8S.

#### **(d) Patrolling**

Patrolling along the Right of Use which includes valve locations and other pipeline facilities, helps to observe pipeline markers, surface conditions, construction activity performed by external agencies, encroachments, soil washouts and any other factors affecting the safety and operation of the pipeline and other specific indication marks along the pipeline

#### **(e) Leakage Surveys**

Operating company must have an effective method to identify and locate leakages in the system. Any one or combination of methods described in ASME B 31.8, Appendix M can be adopted based on their effectiveness for the specific areas

Leakage Surveys using gas detectors shall be done in accordance with the requirements of ASME B 31.8. Gas detectors, duly calibrated, shall be available at all times in ready use conditions for emergency surveys and use.

#### **(f) Cathodic protection system surveys**

Cathodic Protection adequacy survey shall be carried out so as to cover the entire steel network of pipelines so as to detect insufficient Cathodic Protection levels and other irregularities and anomalies in the steel pipeline. Suitable procedures shall be established by the operator to account for adequate Cathodic Protection levels to pipeline extensions and new projects.

#### **(g) Annual maintenance plan covering the following activities**

##### **PNG maintenance**

- Service regulators
- Domestic connections
- GI Riser maintenance

##### **CNG/LNG/ LCNG Maintenance**

- Compressors
- Pumps
- Dispensers<sup>[RBS30]</sup>
- Cascade cylinder testing (inline with gas cylinder rule)

##### **Network Maintenance**

- Functional testing of CPRS/DPRS/DRS (Periodic stream changeover)

- Calibrations of critical inspection, measuring and test instruments (Entity to identify a set of their own safety critical equipment' instruments)
- Valve chamber Maintenance
- Greasing and operations of valves
- Operation and maintenance of Odorant system
- Cathodic protection monitoring
  - Inspection of casings at crossings
  - Monitoring of Anode Junction box, cathode junction box, Transformer rectifier unit, Insulation Joint
  - Monitoring of HT crossing, river crossing, foreign pipeline crossing
  - On/Off PSP monitoring of the CP

#### **(h) Incident Investigations and Root cause analysis**

Entity shall record high potential [RBS32] asset damage and failures to identify repetitive failures leading to initiation of investigation/RCA such failures can be recorded in GIS/SAP or as suitable. Performance indicators can be used as a source to identify these failures

Other proven integrity assessment methods for pipeline may exist for use in managing the integrity of pipeline. For the purpose of these regulations, it is acceptable for an operator to use these inspections as an alternative to pressure testing or direct assessment.

Such other methods for integrity assessment may be also adopted by the CGD entity as it thinks fit, apart from the above mentioned ones.

A plan shall be developed to address the most significant threats/risks as per previous section and determine appropriate integrity assessment methods to assess the integrity of the CGD Network. The following methods can be used for Integrity Assessment [HT33]—

- (a) Hydro [HT34] testing before commissioning at test pressure as per T4S standards;
- (b) External Corrosion Direct Assessment (ECDA);
- (c) Cathodic protection system surveys etc. [RBS35]

Brief description of various Integrity Assessment methods has been also provided in Schedule 5 of these regulations.

Selection of appropriate integrity assessment method shall be based on most significant threats to which particular segment are susceptible. One or more

integrity assessment method can be used depending upon the threats to particular segment of CGD Networks.

The operator of a CGD networks shall develop a chart of most suited integrity assessment method and assessment interval for each threat and risk. The operator shall further develop appropriate specifications and quality control plan for such assessment. After establishing effectiveness of assessment, the interval of assessment may be further modified subject to the requirements under Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for City or Local Natural Gas Distribution Networks) Regulations, 2008 and other relevant regulations.

### 6.1.6 Responses and Mitigation.

This section covers the schedule of responses to the abnormalities identified during inspections and maintenance activities as defined in the schedule 6.12.5 5.2.56.1.5.

A tracker sheet may be develop<sup>[RBS36]</sup> to capture the abnormalities, response plan and schedule for the closures ~~indications obtained by inspection, repair activities that can be affected~~ to remedy or eliminate an unsafe condition, ~~preventive actions that can be taken to reduce or eliminate a threat to the integrity of a CGD Network,~~ and establishment of the future inspection intervals. Such responses may be classified into the following<sup>[RBS37]</sup> categories

- ~~immediately implemented,~~
- sScheduled over a period of time
- ~~or the system may be s~~Simply monitored based on the inspection outcome.

Some of the mitigation actions are listed below -

(a) Actions for increasing the adequacy levels of Cathodic Protection, like increasing Cathodic Protection current levels, installation of additional capacity etc.;

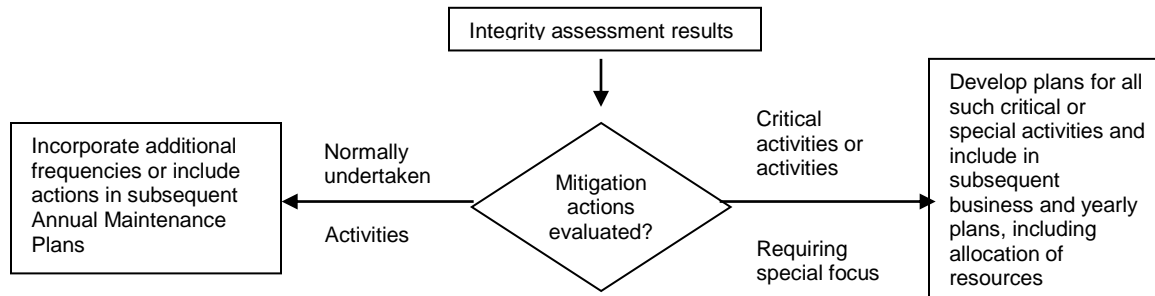
(b) Replacement / repair of assets based on analysis outcomes;

(c) Consultation with equipment suppliers for deciding course of actions.

~~(c) —A typical tracking sheet is attached as Appendix VI~~ A sample of such tracking sheet is included in Appendix 6

<sup>[RBS38]</sup>

In short, the below approach may be followed for mitigation actions:



The plans for critical activities shall be reviewed periodically by the company to address the resources (means) requirement and necessary changes in organizational and external factors affecting integrity management.

## 6.2 Performance Plan. (Under review)

Every CGD entity shall define suitable performance indicators which can be monitored to give a picture of the integrity levels of various aspects of the company's assets. The regular monitoring of these indicators (on a periodic basis) against pre-defined targets helps to assess the effectiveness of asset performance.

A company can evaluate a system's integrity management programme performance within their own system and also by comparison with other systems on an industry-wide basis.

Such performance evaluation should consider both threat-specific and aggregate improvements. Threat-specific evaluations may apply to a particular area of concern, while overall measures apply to the entire CGD network under the integrity management programme.

Performance indicator measures may measure either or all of the below as applicable -

- (a) Process measures;
- (b) Operational measures;
- (c) Direct integrity measures.

A performance indicator may be either leading or lagging indicator. Lagging measures are reactive in that they provide an indication of past integrity management programme performance. Leading measures are proactive in that they provide an indication of how the plan may be expected to perform.



I would suggest to finalize CGD specific leading / lagging indicators. Some of leading indicators can be – Maintenance backlog %, no. of alarms/ trips, coating defects etc. Lagging indicators – no. of LOPC incidents greater than 500 kg, Leak from corrosion, Third party damage per 100 km etc.[RBS39]

The company shall conduct periodic internal audits to validate the effectiveness of its integrity management programmes and ensure that they have been conducted in accordance with the plan.

A list of items is provided below in developing a company integrity management and performance evaluation programme -

- 1) An integrity management policy and program for all applicable elements shall be in place;
- 2) Written integrity management plan procedures and task descriptions are up to date and readily available;
- 3) Activities are performed in accordance with the plan;
- 4) Individuals have received proper qualification and training for activities which they are to undertake;
- 5) The integrity management program meets the requirements of this document;
- 6) All action items or non-conformances are closed in a timely manner;
- 7) The risk criteria used have been reviewed and documented;
- 8) Prevention, mitigation, and repair criteria have been established;
- 9) ~~Periodic internal audits shall be conducted to evaluate the effectiveness used to provide an effective basis for evaluation of the integrity management plan program~~[RBS40]. The findings of this audit shall be used to further upgrade the integrity management plan to enhance its effectiveness.

### **6.3 Communication Plan.**

The CGD entity shall develop and implement a communications plan in order to keep appropriate company personnel, jurisdictional authorities, and the public informed about their integrity management efforts and the results of their integrity management activities. The information may be communicated as part of other required communications[RBS41].

### **6.4 Management of Change Plan.**

Formal management of change procedures shall be developed in order to identify and consider the impact of changes to CGD network systems and their integrity.

Change should also include the changes in specification of materials used for either network or equipment's[RBS42]

A management of change process includes the following -

- (1) Reason for change

- (2) Authority for approving changes
- (3) Analysis of implications
- (4) Acquisition of required work permits
- (5) Documentation
- (6) Communication of change to affected parties
- (7) Time limitations
- (8) Staff involved
- (9) Planning for each situation
- (10) Unique circumstances if any.

## 6.5 Quality Control Plan. DOCUMENTATION, RECORDS AND CONTROL [RBS43] (Under Review)

Requirements of a quality control plan include documentation, implementation, and maintenance. The following activities are usually required -

- (1) Identify the processes;
- (2) Determine the sequence and interaction of these processes;
- (3) Prepare standard operation procedures and guidelines for critical processes including Non-routine operating processes [RBS44] (e.g. operation, maintenance, projects etc);
- (4) Provide the resources and information necessary to support the operation and monitoring of these processes;
- (5) Monitor, measure, and analyze these processes;
- (6) Implement actions necessary to achieve planned results and continued improvement of these processes.

Internal audits of the CGD network integrity management system shall be performed on a regular basis. The purpose of the audits is to ensure compliance with the policies and procedures as outlined in these regulations. Recommendations and corrective actions taken shall be documented and incorporated into the CGD network integrity management system.

Internal audits are conducted by the audit group nominated by Head of the Operations Team of the entity at least once in a year. Internal audits aim **is** to ensure that the integrity management system's framework is being followed.

The following essential items will be focused for any internal and external audit of the entire integrity management system -

- (a) Ensure that the Baseline Plan is being updated and followed and that the baseline inspections are carried out;
- (b) Verify qualifications of Operation and Maintenance personnel and contractors based on education qualification (Appendix III), formal training received through in-house or external program, demonstrated practical skills, and experience records in the relevant

areas. For guidance in this regard reference may be made to ASME B 31Q.

- (c) Ensure adequate documentation is available to support decisions made;
- (d) determine if annual performance measures have been achieved;
- (e) written integrity management policy and program for all elements;
- (f) written integrity management system procedures and task descriptions are up to date and readily available;
- (g) activities are performed in accordance with the integrity management system;
- (h) responsible individual has been assigned for each task;
- (i) all required activities are documented;
- (j) all action items or non-conformances are closed in a timely manner;
- (k) the risk criteria used have been reviewed and documented;
- (l) prevention, mitigation and repair criteria have been established, met and documented.

## SCHEDULE 7 (Under Review)

### **Approval of Integrity Management System (IMS)**

A CGD networks Integrity Management System is a management plan in the form of a document that explains to operator's employees, customers, regulatory authorities **and all those who will be directly or indirectly affected by our activities**<sup>[RBS45]</sup>, how the operator and its assets are managed, by stating:

- (a) who is responsible for each aspect of the asset and its management;
- (b) what policies and processes are in place to achieve targets and goals related to ensuring integrity of the assets;
- (c) how they are planned for implementation;
- (d) how Integrity Management System performance is measured and;
- (e) How the whole system is regularly reviewed and audited.

The document shall be agreed at Board level of the entity, **periodically**<sup>[RBS46]</sup> ~~constantly and systematically~~ reviewed and updated, and all levels of management comply with its contents. Necessary awareness shall also be created within and outside the company regarding benefits to the society for up keeping of the CGD Network system for all times to come.

Preparation of the document shall be done in following three stages and six steps -

#### **7.1 Management Approval.**

- **Step#1:** Prepared by In-house team or Consultant
- **Step#2:** Checked by In-house team Head or Consultant head
- **Step#3:** Provisionally approved by Head of Operation /Maintenance team of the entity
- **Step#4:** Verification of Conformity of Integrity Management System document with the Regulation by Third Party Inspection Agency (TPIA) and duly approved by CEO or Full time Director of the Entity

#### ~~7.2 Acceptance by Petroleum and Natural Gas Regulatory Board.~~

- ~~Step#5: Acceptance by Petroleum and Natural Gas Regulatory Board~~

#### ~~7.23 Submission of IMS document to PNGRB Approval for Implementation.~~

- ~~Step#56: Approval of Integrity Management System document for implementation by the Board of the entity for the first time and approval of subsequent periodic review by CEO or Full time Director of the entity~~ Approval of integrity management system document for implementation by the Board of the entity for the first time and approval of subsequent periodic

~~review by CEO or Full time Director of the entity. -A copy of IMS document shall be submitted to the PNGRB.~~

— **Step#6:** Submission of approved IMS document along with confirmation from entity of its implementation to PNGRB. ~~Approved IMS document along with confirmation from entity of its implementation~~

**Note:** — ~~A certificate regarding the approval of integrity management system document duly approved as specified at clause no. 7.1 above shall be submitted to the Petroleum and Natural Gas Regulatory Board that the CGD network integrity management system is in line with the requirements of the various regulations issued by the Petroleum and Natural Gas Regulatory Board from time to time and has been approved by the CEO or Full time Director of the company.~~

**SCHEDULE 8 (Under review)**

**Implementation Schedule of IMS**

Sr. No.	Activities	Time Schedule
1	Compliance with Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for City or Local Natural Gas Distribution Networks) Regulations, 2008	YES/NO confirmation within 1 month from date of notification of the Petroleum and Natural Gas Regulatory Board (Integrity Management System for City or Local Natural Gas Distribution Networks) Regulations, 2013
2	Preparation of Integrity Management System document and approval by Head of Operation team of the entity.	1 year from <del>date of notification</del> <sup>[RBS47]</sup> <del>the date of first gas commissioning</del> of the <del>GA Petroleum and Natural Gas Regulatory Board (Integrity Management System for City or Local Natural Gas Distribution Networks) Regulations, 2013</del>
3	Conformity of Integrity Management System document with regulation by TPIA authorized by Petroleum and Natural Gas Regulatory Board.	3 months from the approval by Head of Operation/ <b>Maintenance</b> team of the entity.
4	<del>Submission of Integrity Management System document to Petroleum and Natural Gas Regulatory Board with timelines for the actions</del>	<del>1 month from the conformity of Integrity Management System by TPIA</del>
45	<del>Approval by Petroleum and Natural Gas Regulatory Board for</del>	Within 3 months from the <b>conformity</b>

	implementation by Board the entity for the first time and approval of subsequent periodic review by CEO or Full-time Director of the entity	assessment by Third Party Inspection Agency (TPIA). submission of Integrity Management System document to Petroleum and Natural Gas Regulatory Board
<u>5</u>	<u>Start of Implementation</u>	Immediately after approval at Sr. No. 45 above
<u>6</u>	<u>Submission of Integrity Management System document to Petroleum and Natural Gas Regulatory Board</u>	1 month from the approval as mentioned at Sr. No. 4 above
<u>7</u>	Submission of Compliance Statement to Petroleum and Natural Gas Regulatory Board	Immediately after approval at Sr. No. 4 above. Shall be submitted every year to Petroleum and Natural Gas Regulatory Board

**Note: Steps for implementation to be followed as described in Schedule 7**

Suggest Above steps shall <sup>[RBS48]</sup> be applicable for the very first IMS certification.

## SCHEDULE 9 (-Under Review)

### **Review of The Integrity Management System**

#### **9.1 Periodicity of review of Integrity Management System.**

Entities shall review their existing Integrity Management System every 3 years based upon the:

- (a) Revised Baseline data;
- (b) Critical Inputs from various departments

#### **9.2 Review of Internal and External Audit**

There shall be a system for ensuring compliance to the provision of the Petroleum and Natural Gas Regulatory Board (Integrity Management System for City or Local Natural Gas Distribution Networks) Regulations, 2013 by conducting following audits during operation phase -

- (a) Internal Audit ~~as per the checklist (to include as an appendix<sup>(RBS49)</sup>) for CGD Networks provided by Petroleum and Natural Gas Regulatory Board~~ shall be carried out by the CGD entity every year;
- (b) External Audit (EA) ~~shall be carried out through PNGRB empaneled by third party, approved by the Board, as per the methodology specified by the Petroleum and Natural Gas Regulatory Board - third party agency~~ once in every 3 years.

## SCHEDULE 10

### **Adequacy of Manpower positioned at different stage of project**

Entity will have to address the requirement of manpower for different stage of project, namely: Design, construction, commissioning, operation and maintenance.

The entity which is preparing Integrity Management System should have to address the manpower requirement for its present and future operations. The qualification of such manpower shall conform to **Appendix III**.



|

## APPENDIX I

### References

Reference documents of Standard Operation and Maintenance procedures related to CGD networks Integrity may be developed for use of Operation and Maintenance personnel. Some of them are mentioned below for reference:

- 1) Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for City or Local Natural Gas Distribution Networks) Regulations, 2008.
- 2) Petroleum and Natural Gas Regulatory Board (Codes of practices for Emergency Response and Disaster Management Plan) Regulations, 2010;
- 3) ASME B31.8-Gas Transmission and Distribution Piping Systems;
- 4) ASME B31.8S – Managing System Integrity of Gas Pipelines;
- 5) ASME B31 Q- Pipeline Personnel Qualification
- 6) ASME B31G - Manual for Determining Remaining Strength of Corroded Pipelines.
- 7) API 1104- Welding of pipelines and related facilities.
- 8) ASME Boiler and Pressure Vessel (BPV) code: Section IX- Welding and Brazing qualification.
- 9) ASME B16.34 - Valves - Flanged, Threaded, and Welding End
- 10) API 6D – Specification for Pipeline valves
- 11) Gas Cylinders Rules, 2016
- 12) NACE requirements for Direct Assessment –
  - a. SP0206-2016-SG, Internal Corrosion Direct Assessment Methodology for Pipelines Carrying Normally Dry Natural Gas (DG-ICDA)
  - b. SP0502-2010, Pipeline External Corrosion Direct Assessment Methodology
- 13) OISD 179 – Safety requirements in compression, storage, handling & refueling of natural gas (CNG) for use in automotive sector

- 14) OISD 226 – Natural gas transmission pipelines and city gas distribution networks
- 15) ISO 11120 - Gas cylinders - Refillable seamless steel tubes of water capacity between 150 l and 3000 l- Design, construction and testing
- 16) ISO 4437 – Buried Polyethylene (PE) pipes for the supply of gaseous fuels
- 17) ISO 1239 – Steel tubes, tubulars and other steel fittings - specification

**APPENDIX II ( Under Review)**

**(see regulation 7)**

**List of Critical Activities In CGD Network**

<b>Sr. No.</b>	<b>Critical infrastructure/ activity/ processes</b>	<b>Time period for implementation</b>
1	Cathodic Protection adequacy survey to ensure an integrated Cathodic Protection system	6 months for baseline survey
2	Odourant smell survey at farthest point (s) from odouriser	6 months
3	GIS mapping of the network	3 years
4	Establish system for testing of Compressed Natural Gas cascade	3 months
5	Gas Loss computation based on the mass or volume balance for 3 months or other selected interval depending upon the billing cycle.	6 months
6	Integrity inspection system for Galvanized Iron and copper piping forming part of tertiary network and the Last Mile Connectivity <b>for domestic customers</b> <sub>[RBS50]</sub>	6 months
7	<b>Integrity inspection system for IP line Connectivity for Commercial and Industrial customers to identify unsafe installation and communicate customers for taking necessary action</b> <sub>[RBS51]</sub> <b>to make the installation good for carrying gas</b>	<b>Once in a year</b>

## **APPENDIX III**

**(see regulation 6, Schedule 6.5 and Schedule 10)**

### **Minimum Qualifications and experience for personnel involved in various CGD activities**

#### **1. Design Stage :**

- (a) Degree in engineering (BE/B Tech or equivalent) – experienced in various technical standards.
- (b) Degree in engineering (BE/B Tech or equivalent) – experienced in network simulation/ flow management.

#### **2. Construction Stage (Commissioning)**

##### a) Steel Pipeline

- i. Material Quality Assurance – Diploma in engineering with 1 year relevant experience
- ii. Welder – certification in line with API 1104 and/ or Boiler and Pressure Vessel Sec IX
- iii. Fitter – ITI qualification and/or 3 years relevant experience
- iv. Rigger – at least 1 year relevant experience and capable to read Hindi / regional language of the area where deployed.
- v. Supervisor – Diploma in Mechanical Engineering.
- vi. Quality Inspector (Nondestructive Testing) – American Society for Nondestructive Testing Level II<sub>[a52]</sub>

##### b) PE Pipeline

- i. Joiner/Technician – 10<sup>th</sup> standard with Internal Training (Training Modules) and assessment or at least 1 year relevant experience<sub>[a53]</sub><sub>[RBS54]</sub>
- ii. Supervisor – 10+2 standard with Internal Training (Training Modules) and assessment or at least 1 year relevant experience<sub>[RBS55]</sub>

##### c) Internal Installations

- i. Plumber – Internal Training (Training Modules) and assessment or at least 1 year relevant experience<sub>[RBS56]</sub>

ii. Supervisor – 10+2 standard with Internal Training (Training Modules) and assessment or at least 1 year relevant experience

**3. Facilities (erection, commissioning and O&M stage) – i.e. City Gate Station, Odorant stations, Pressure Reducing Station (PRS), Metering and Regulating Station (MRS)**

- i. Electrical – ITI Electrical and certification from electrical inspector
- ii. Instrumentation – ITI Instrumentation (technician)
- iii. Metering – ITI Instrumentation/ electronics (technician)
- iv. Maintenance – Engineer (Diploma/ BE), ITI mechanical (technicians) – for regulator maintenance; valve maintenance (trained at Vendor installations)
- v. Odorant handling – Diploma in engineering (mechanical/ chemical)

**4. Operation and Maintenance (gas network)**

- i. Emergency Response -- Internal Training (Training Modules) and assessment
- ii. Valve Maintenance – 1 fitter (ITI mechanical); 1 supervisor (internal trained); 2 helpers (internal trained)
- iii. Pipe replacement/ shifting etc – same as steel and PE construction teams
- iv. Fire and Safety – Diploma/ certification in fire and safety and relevant experience of 1 year

**APPENDIX V**  
**Asset Risk Register (-Under Construction)**

[Attached separately](#)

**APPENDIX VI**  
**Response and Mitigation Tracker Sheet (-Attached separately Under Construction)**

<u>Sr</u> <u>n</u> <u>e</u>	<u>Activity</u>	<u>Locati</u> <u>on</u>	<u>Descri</u> <u>ption</u> <u>of</u> <u>abnor</u> <u>mality</u>	<u>Categorisati</u> <u>on</u>	<u>Mitigati</u> <u>on-plan</u>	<u>Targ</u> <u>et</u> <u>date</u>	<u>Status</u> <u>Open</u> <u>/Close</u> <u>d</u>		
<u>1</u>	<u>ECDA/CP</u> <u>Survey</u>								
<u>2</u>	<u>LDI</u> <u>Survey</u>								
<u>3</u>	<u>Patrolling</u>								

K. Rajeswara Rao, OSD(R)

**APPENDIX IV**  
**(An illustrative 6\*6 matrix)**

Potential Consequence/Impact / Severity					Frequency / Likelihood						
					1	2	3	4	5	6	
					Rare	Remote	Unlikely	Seldom	occasional	Likely	
Cat	People	Asset	Environment	Reputation	Extremely Unlikely	Very Unlikely	Unlikely	Improbable	Probable		
					Less than once per 10,00,000 years	Between once per 10,00,000 to 10,000years	Between once per 10,00,000 to 10,000years	Less than once per 10,000 years to 100 years	Greater than once per Year		
					<10 <sup>-6</sup> Per Year	10 <sup>-6</sup> <10 <sup>-4</sup> Per Year	10 <sup>-6</sup> <10 <sup>-4</sup> Per Year	10 <sup>-4</sup> <10 <sup>-2</sup> Per Year	>1 per Year		
6	<b>Catastrophic</b>	- Multiple Fatalities - Kidnap & Ransom	- 100% Site shutdown - Site Access prohibited - Total loss of production	- Persistent damage - Severe nuisance over large area - Constant breach of statutory or prescribed limits	- Major international impact - International public attention - Extensive negative international media attention						
5	<b>Severe</b>	- Single Fatality - Shooting / Firearms incident	- Major site shutdown - Substantial site access restriction	- Severe damage - Extended breach of statutory or prescribed limits	- Major National impact - National public attention - Excessive negative national attention						
4	<b>Major</b>	- Major Injury - Lost Time Injury - Occupational illness - Burglary - Violent Assault	- Local damage - Partial shut down of site - Limited Access restriction	- Local effect - Significant damage - Repeated breach of statutory or prescribed limits	- Considerable regional impact - Regional public concern - Regional media attention						
3	<b>Moderate</b>	- Restricted Work Day - Medical Treatment	- Disruption to production - Isolation of Equipment for repair - Theft	Single breach of statutory or prescribed limits	- Local media attention - Local political attention						
2	<b>Minor</b>	- Minor injury - Minor Assault	- Minor damage	- Minor effect - Public complaint	- Limited impact - Local public concern						
1	<b>Incidental</b>	- First Aid	- Negligible damage - No disruption to production	- Slight effect	- Slight impact - Public Awareness						
Qualitative		Extreme Risk area	High Risk area	Medium Risk area	Low Risk area						
Quantitative Score		21 to 36	13 to 20	5 to 12	Less than 4						



## Appendix V (Typical risk register)

AI RISK REGISTER																	
Sr. No.	Date of Reporting	Asset / Section Description	Description of the Risk	Hazard / Probable Failures	Probability	Impact/Consequence				Overall Risk	Decided Mitigation/ Control Measures		Action Taken	Target date for Closure	Completion Status	Photo/ Evidence	Remarks (Risk after action taken, risk at acceptable level)
						People	Asset	Environment	Reputation		SHORT TERM (Soft controls supervisory/monitoring)	LONG TERM (Physical changes/ Engineering Changes)					
1		DRS	Low thickness of the piping	Rupture of the pipe													
2		PE pipeline Section from ??? To ???	Exposed in the drainage Chamber line by PWD department	Gas leakage into the drainage chamber													
3		Isolation valve nos ???	Valve Hard to operate inspite of greasing	Quick isolation not possible													
4		Burial of valve chamber by third party	Will lead to delay in identification and operation of valve	Loss of gas due to delay in valve closure in the pipeline													
5		Domestic Connection	Unauthorised extension by the customer nos ???	Improper installation , poor selection of material, Lack of testing procedure													

Review Date : \_\_\_\_\_

Team members involved in Review : \_\_\_\_\_

**APPENDIX VI**  
**(Response and Mitigation Tracker Sheet)**

Response and Mitigation Tracker Sheet										
Sr no	Name of the Activity	Date of the finding	Location	Description of abnormality	Categorisation	Mitigation plan	Target date	Status Open /Closed	Reverification required Yes/No date	REMARKS
1	Leak survey of Station piping CGS			Gas continuously minor passing from Isolation valve gasket	1	Cordened the area , Gasket replacement during shutdown , Changeover to standby stream		Open		
2	Leak survey of Station piping CGS			Gas leak False alarm continously on	3	Gas leak checked with portable gas detector no gas detected , Service call to the service provider, gas leak will be monitored again		Open	YES	
3	Patrolling			125 mm PE line exposed due to water washout	3	Increase the frequency of patrolling / will be rebullit after moonsoon		Open	Yes	
4	Cathodic protection inspection			Sacrificial anode getting degarded due to high consumption of current	3	Conduct inspection to identify the hot spot		Open	YES	Weekly reading will be conducted and recorded in the format of sacrifoscial anode
5										
6										
7										
8										
9										
10										
11										

**K. Rajeswara Rao, OSD(R)**

