International Journal of Institution of Safety Engineers (India)
"Published by Institution of Safety Engineers (India)"
Volume 7, Issue 2, April - June 2024 Available online at www.ijournal.iseindia.in

[1]FRAMEWORK FOR IMPLEMENTATION OF SAFETY MANAGEMENT SYSTEM (SMS) IN CITY GAS DISTRIBUTION SECTOR

SAHIL IMTIAZ ALI, B.Tech (FSE), PGP-HSE, MISE, Associate Fire-IFE (UK) & working as Senior Executive – HSE (UEPL), Ex. Officer - F&S (GGL), GET (IRM Energy)
Email id: sahil.ali@unisonenviro.com

ABSTRACT:

City Gas Distribution Business is at a nascent stage in India. Prior the foundation of PNGRB (Petroleum & Natural Gas Regulatory Board), the CGD sector was mostly unorganized. With the formation of PNGRB, a regulatory board has been formed to regulate the framework of CGD business across India in multiple geographical locations. The government of India has put a strong emphasis on CGD Infrastructure growth across India.

Considering the above, the growing CGD infrastructure which largely deals in the public domain poses a business threat from the on-site hazards & third-party Interference. Henceforth, it is a requirement of every CGD entity that they shall have their company safety management system in line with the requirements of PNGRB, Codes, OISD & ISO-45001 Standards.

Keywords: City Gas Distribution (CGD), Natural Gas, LNG (Liquefied Natural Gas), Safety Management System (SMS), CNG (Compressed Natural Gas), Piped Natural Gas (PNG).

1.0 INTRODUCTION:

City Gas Distribution (CGD) is an Oil & Gas Downstream company that distributes natural gas through pipelines to cater to commercial, domestic, and CNG consumers or industries. As the world is moving towards development, dependence entirely on Non-Renewable resources like petrol, diesel, coal, furnace oil, etc.hasbecomealong-term challenge considering the availability of resources & its pertaining environmental issues. Natural Gas (Mostly methane) till Nineteenth century was reasoned as a derivate of Crude Oil it used to be Flared or vented out in the past as per Industry practice.

In 1821, the first Industry incorporated in the world started solely with the business i.e., Natural Gas Distribution which was M/s Fredonia Gas Light Company. Subsequently, the Natural Gas Distribution business took its pace in the form of industries in several countries. In India, 1834 first time in India, gas was used as fuel for domestic lighting in Bombay by A.C. Wadia. Assam Gas Company LTD started supplying natural gas for commercial use from February 2, 1962. Baroda was the first Indian city to acquire gas for Residential use in 1971. The national government was instructed by Honorable Supreme Court Judge Sri M.C. Mehta in 2002 to begin the CGD drive in the India's sixteen most polluted cities. Due, Natural Gas abundance & environmentally friendly attributes Government of India took initiatives to regulate the unorganized CGD Sectors as well as to promote CGD / Oil & Gas Business primarily downstream & Midstream O&G sector PNGRB was constituted by Ministry of Petroleum & Natural Gas.

Considering the on-going CGD Infrastructure across India has its own underlying risks, potential hazards due to which a systematic health & safety approach is require that will monitor & regulate the Environmental, Occupational Health & Safety Parameters in line with statutory requirements.

2.0 MAINBODY:

Framework for the Safety Management system underlies with the detailed understanding with the business process hazards, risks, its control measure. Any hazardous business requires a step-wise applicable hierarchy of controls to keep the risks at an ALARP (As Low as Reasonably Practicable). This implies same with the City Gas Distribution business which deals primarily with Natural Gas (Hydrocarbon Product).

In view of above, following sub- parts will be addressed accordingly which are as follows:

2.1 Physical Properties Comparison: Natural Gas vs LNG

2.2 Hazards Associates with Natural Gas vs LCNG Business

2.3 Challenges in City Gas Distribution Sector & L-CNG Sector

2.4 Rules & Regulations applicable with CGD pertain to HSE

2.5 Implementation of Safety Management in CGD

2.1 Physical Properties Comparison: Natural Gas vs LNG

Natural Gas & LNG both are interlinked to each other. LNG however started late in India as vehicle fuel in

Comparison with Natural Gas. The most significant characteristic of LNG is it's volume i.e.,

1 m^3= 600 m^3 Natural Gas.

Table of Contents:

NATURALGAS(CH4)		LIQUIFIEDNATURALGAS(CH4)	
Composition	Methane (95%)	**Composition**	Methane(80-90%)
Temperature	Variable	**Temperature**	-168°Celsius
Pressure	Upto 250Kg/Cm2	**Pressure**	Atmospheric
State	Gaseous	**State**	Liquid
Density	0.73Kg/M3	**Density**	450Kg/M3@1Bar
Volume	1 cubic meter @ 1 atmosphere pressure and 15.56°C	**Volume: 1m 3 LNG**	600 m3 NG @ 20Deg Celsius
Flammability	5-15%	**Flammability Range**	5-15%
Range			
Odor	Odorless	**Odor**	Odorless

2.2 Hazards Associates with Natural Gas vs LCNG Business

2.2.1 Natural Gas: Hazards

- Highly Flammable Gas
- Highly Pressurized Gas (4 Bar(g) to 250 Bar(g))
- BLEVE
- Un Confined Vapor Cloud Explosion
- Flash Fire
- Jet Fire
- Asphyxia - Health

2.2.2 LNG (Liquefied Natural Gas): Hazards

- Highly Flammable
- Pool Fire, Jet Fire, Flash Fire etc.
- Roll- Over
- Rapid-Phase Transition
- Sudden BOG Generation
- Cold Burn: Hypothermia
- Piercing Injury
- Radiant Heat Hazards

- Vapour Cloud Dispersion
- Asphyxia – Health

2.3 Challenges in City Gas Distribution Sector & L-CNG Sector

2.3.1 Challenges in CGD Sector: NG Operation

- External Threat: Third Party Excavation on Pipeline Network: PNG /Steel Network
- Unawareness of Natural Gas Pipeline among general Public
- ROU Customer: Conflict of Interest
- Un-Intimated Modification work on or near vicinity of Internal Piping or GI Pipeline
- Corrosion in Steel Pipeline
- Interruption in Locator due to underground or above-ground HT Line or LT Line
- Un-Authorized Infrastructure work leading to Asset Damage or Marker Damage
- Geographical Challenges
- Cluster of Underground Utilities
- Hose Pulling Incidents in CNG Station
- Un-Authorized CNG Cylinder refueling at CNG Station
- Static Charge Incident at CNG Station
- Un-Covered Battery Terminals without dust cap leading to arc flash
- Arson
- In adequate spaces for CNG dispensing units leads to vehicle collisions.
- Lone Hazard at CNG Station
- Lack of Public Awareness among CNG Consumers
- Weather conditions, lack of road infrastructure affecting movement of MCV/CTV/LCV/HCV mounted with mobile cascades

2.3.2 Challenges at L-CNG Plant

- Lack of inadequate spaces for the Civil Construction
- Continuous Frosting situation
- Zone 0: Hazardous Area inside Dyke Area
- BOG Generation due to stratification
- No added Odor or Natural odor present in LNG or BOG
- BOG when released appear cloud whitish in nature
- Aged LNG can lead to Rapid Phase Transaction due to weathering
- Additional Fire Hazards like Pool Fire or Spill Fire upon spillage.

Fig 1: Typical Layout of CGD Network

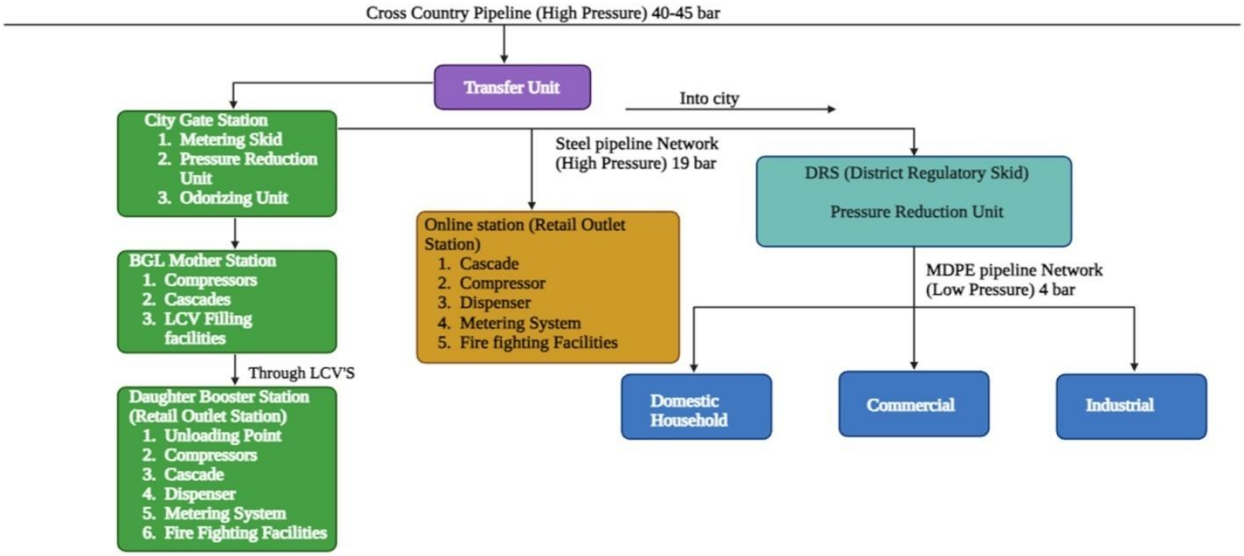
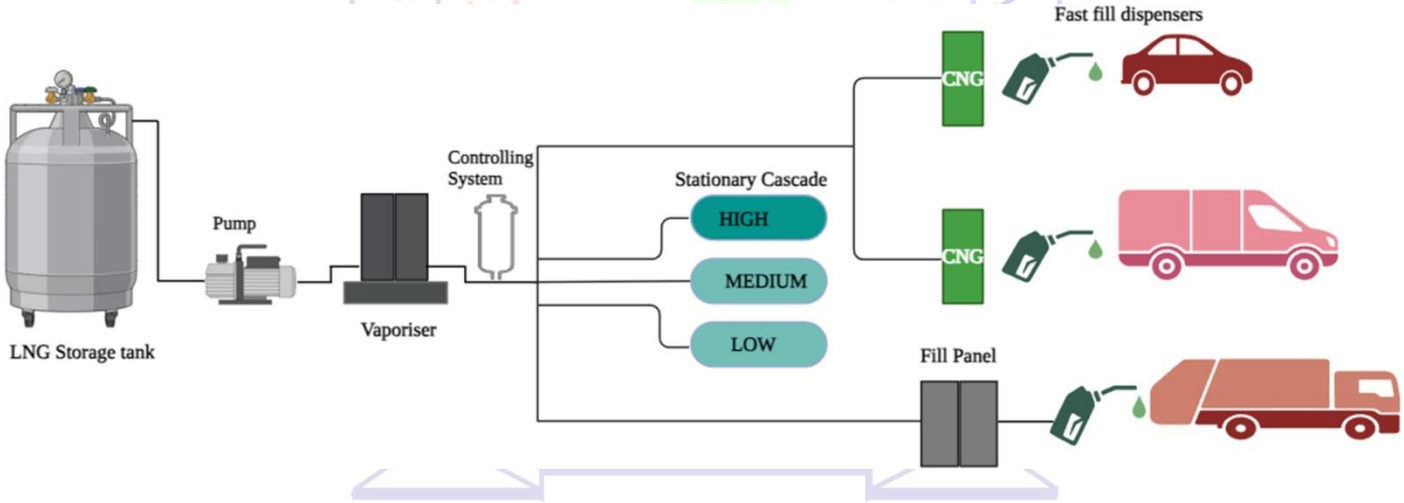


Fig 2: Typical Layout of L-CNG Plant



2.4 Regulatory Bodies Involve in CGD Infra pertain to HSE

- Petroleum And Natural Gas Regulatory Board Act (PNGRB) Government of India, 2006
  - Technical Standards and Specifications including Safety Standards for PNG/CNG/LNG/Commercial & Industrial

- Oil Industry Safety Directorate (OISD): OISD STD 226 Natural Gas Transmission Pipeline & City Gas Distribution Network, October 2024. OISD STD 179 Compression, Handling, Storage, and Re fuelling Safety Requirements for CNG in the Automotive Sector, March 2016.

- **Petroleum & Explosives Safety Organization, 1898:** PESO board is to Regulate, Control, Import, Export, Transport, Storage & Usage of Explosive, Flammable materials, Pressure Vessels, Cryogenic Vessels, Design & Installation of all necessary and relevant Infrastructure.

- **Directorate Of Factories/Directorate of Industrial Safety & Health (Under Ministry of labor and Employment):** To regulate working conditions, Health Safety & Welfare annual leave with wages for workers, special provision for women & adolescents working in factories
- **Central Pollution Control Board (CPCB) & State Pollution Control Board (SPCB):** To regulate the environmental parameters of the site, and ensure emissions & effluents are under permissible limits. Submission of Environment Statement either annually or half-yearly to SPCB Office.
- **State Fire Services Act:** Every State has its own Fire Service Act, which aligns with the National Building Code 2016 & other applicable statutory guidelines. It is to ensure that the fire protection installations are under operational conditions as per the NBC, NFPA, BIS, etc. requirement.

Other Applicable Regulations:

- The Motor Vehicle Act, 1988
- Factories Act, 1948 & Applicable State Factories Rules
- The Petroleum Act, 2002
- MSHIC Rules
- Air (Prevention and Control of Pollution) Act of 1981
- Water (Prevention & Control Pollution) Act, 1974
- The Radiation Protection Rules, 1971
- The Environment Protection Act & Rules, 1986
- The Hazardous waste (Management & Handling) Rules 1989
- The Manufacture, store & Import of Hazardous Chemicals rules 1989
- The building & other construction workers, 1996
- National Policy on Safety, Health & Environment at Work Place (NPSHEWP)

2.5 Implementation of Safety Management in CGD

Safety Management System is a systematic approach to safely manage the organization's assets & workforce.

SMS implies a structured process to design, implement & monitor the organization's Occupational Health & Safety Environment Indicators.

Major and minor industrial catastrophes reveal that it is not only a company's technology but also the organization and culture that are instrumental for establishing a safely run company. Analysis of industrial disasters shows that these are often not simply a consequence of direct technical failure or operator tasks carried out incorrectly. The underlined causes usually lie deeply rooted in the management aspect of the safety culture & the commitment to continual improvement.

Various Industry can have their own Safety Management Systems in line with their operations or processes. For, Oil & Gas Industry Code: 206 Guidelines concerning the Petroleum Industry's Safety Management System, is a well-drafted document drafted by the OISD Committee in 2013.

Elements of the Documents are:

1. Safety Organization
2. Employee Participation
3. Process Safety Information
4. Process Hazard Analysis
5. Operating Procedures
6. Trainings
7. Contractors
8. Pre -Startup safety review
9. Mechanical Integrity
10. Work Permit System
11. Management of Change
12. Incident Investigation and Analysis
13. Emergency Response and Planning
14. Compliance Audit
15. Occupational Health
16. Off-the-job Safety
17. Customers and Products
18. Road Transportation

19. Trade Secrets

1. Safety Organization:

For an established safety organization top management leadership commitment is very vital to ensure a safe work culture within the organization and to achieve that following things shall be ensured:

- Formulation of safety policy reflecting the management's commitment towards safety during various construction, operation & maintenance activities. It should convey intentions and commitment from the top management. And, it should be made available to all personnel in a language that it easily understood.
- Any position within the company should have safety goals and targets established and pursued. It ought to be updated as needed. Measurable KPIs shall be set for HSE indicators i.e., in Lagging & Leading in the form of Health, Safety & Environment same shall be reviewed by top management.
- Accountability should be built by assigning roles/responsibilities to all concerned.
- The organization should establish safety committees. The Committees should encourage employee
- participation. At least, in every quarter the safety committee meeting shall be conducted
- All employees are to be communicated about the disciplinary provision for willful noncompliance with SH&E practices and procedures.
- Management to review plans and resources to support the goals and progress of the same to be assessed regularly.
- Management commitment to SH&E must be visible in action including formulation of reward Programme.
- Information on SH&E to be shared/disseminated throughout the organization.

2. Employee Participation:

As per NPSHEW & Factories Act 1948, It is the duty of the occupier or Employer to ensure a safe workplace for the employees within the organization aware of the risks & hazards associated with:

To achieve that following things shall be ensured:

- Promotion of safety culture within the organization: Displaying of Caution, Information, Warning Signages
- Displaying of Do or Don'ts Records, Posters
- Encouraging Employees to engage in identifying safety indicators like Near Misses, Unsafe Acts, Unsafe Conditions, etc.
- Encouraging Employees to be involved in Kaizen, HSE & ESG Incentives.
- Encouraging Employees to participate in Quarterly Safety Committee Meetings.
- Recognition & Appreciation of employees for the HSE Contributions within the organizations.
- Involvement of Employees in Internal & External Training for Work Place Exposure.
- Various circulars, and notifications can be published to keep aware the employees of HSE.

3. Process Safety Information:

Process safety involves the proactive detection, examination, and measurement of hazardous material emissions and process mishaps. It relates to controlling the risks brought on by the physical and chemical characteristics of the materials we handle in our oil, gas, and energy operations. Information about the Process Safety can be categorized into three parts:

- Process Chemicals
- Process Technologies
- Process Equipment

In Process Chemical: Information on Chemicals involved in the CGD Industry shall be displayed & same records shall be kept in the office.

- Employees shall be aware of the associated hazards, toxicity, and spillage measures of the chemicals
- Detailed MSDS or SDS shall be displayed of hazardous chemicals involved in operations
- Chemicals may include Natural Gas, LNG, Odour (Mercaptan), Lubricants, Lubricants, Hydraulic Oils, Meter Oil, Class A or Class B Petroleum Products, etc.

- Health Hazard details shall be aware of the chemicals like TLV, STEL, PEL, LD 50, or LC 50.
- Physical, Chemical & Corrosive Properties of the chemical, run away reaction & pressure hazards shall be known to employees on daily exposure.

In Process Technologies: Process Technology Information should include the following

- Written Process Descriptions
- Process Chemistry
- Process Flow Diagrams (PFD) and P&ID (Piping & Instrumentation Diagram)
- Safe Operating Limits: Parameters of Pressure, Temperature, Flow Rate etc.
- Knowledge of P& ID
- Material Energy Balances

Process Equipment:

Process Equipment shall include the details of heat exchangers, Pressure Regulators, piping, valves, meters, Loading & unloading facilities, compression facility, storage facility, etc. The design of the equipment shall be documented & should include the following

- Material of Construction
- Pressure Limits: MAOP, Burst Pressure etc.
- Design Specifications: ASME, API, BIS etc.
- Electrical Classification: CIMFR, EN, PESO, IEC, CEA, IE rules etc.

4. Process Hazard Analysis:

- PHA assessments of present facilities ought to be carried out in order of importance about process risks. To ascertain if the process safety management standard is covered, a preliminary hazard analysis might be helpful. Prioritization should take into account a number of factors, including quantity, operational history, process complexity, proximity, severity, susceptibility to failure, and mode of failure.

- Studies like HAZID, HAZOP, QRA (Qualitative Risk Analysis), HAC, TRA (Transport Risk Assessment), or Journey Management Plan are some of the studies common in CGD Industries.
- The nodes of the piping instrument while identifying the existing safety interlocks in line shall be done with HAZOP Study.
- Assessment of risk will rely on the Individual Specific Risk on an annual basis, the Location Specific Risk each year, the FN Curve, and any other relevant RISK Contours.
- Studies on QRA shall be done with DNV-approved software like PHAST-SAFETI.
- A team with expertness in both engineering and process operations should conduct the process hazard analysis, and at least one team member should be aware about the process under investigation process.
- Prevalence of conducting Risk Assessment studies shall depend upon the company policy & Integrity Management System. However, for every critical modification of the existing system or expansion in the facility, PHA studies are recommended.

5. Operation Procedures:

- Tasks to be completed, data to be documented, operational conditions to be maintained, materials to be gathered, and safety and health measures to be followed are all outlined in operating procedures. Written-down Operating procedures must to be accessible for all process plants for safe operation.
- Operation Procedure which shall include: Safe Operating Procedure, Standard Operating Procedure,
- Standard Maintenance Procedure.
- Operation procedure shall be prepared by the entity for all phases of construction, operation etc.

Some of the Enlist Construction Phase Activities:

- Laying of Pipeline, Excavation Activities
- Welding of Pipeline

- HDD (Horizontal Directional Drilling)
- NDT (Non-Destructive Testing)
- Civil Construction
- Station Tubing Layout
- CP Installation (Cathodic Protection)

Some of the Enlist Operational Phase Activities:

- CNG Compressor Operation
- CNG Dispensing at Fueling Stations
- HCV/LCV Dispensing at Filling Nozzle
- Pipeline Monitoring - PSP, Thickness Inspection etc.
- LNG Dispensing
- Hourly Maintenance of Compressor, De-compression unit etc.

6. Training's:

Based on the analysis of their training needs, plant and facility personnel should receive ongoing training and retraining to enhance their comprehension and proficiency in their respective fields. Training's shall be carried out in three phases:

- Induction Training
- Safety Training for competency/Refresher Training
- HSE Functional Trainings

Induction Training:

- Every employee should get training on a process overview prior to participating in the operation of a newly assigned process.
- HSE Induction training shall be done to the employees in line with basic HSE requirements of the organization.
- Induction training will be delivered to all new joined personnel including Contractor personnel prior to their deployment on their respective site.

Safety Training for Competency/Refresher training:

- Safety Training for Competency shall be imparted to all workforce involve in the operational activities.

Separate STC Card shall be issued to work force. STC Training shall be valid for one or two years.

HSE Functional Trainings:

- HSE Functional training s shall be carried out on the targeted employees only on the basis of job applicability which may include various topics on-site awareness like: Lifting Plan Activity, Work Permit System, First Aid Training Behavior Based Safety etc.
- The employee's identify, the training date, and the methods used to confirm that the employee comprehended the material should all be included in the record.

7. Contractors:

- In Oil & Gas Industries selection, evaluation of contractors is important prior deputation of contractor workforce on the work site. Historical safety records of the contractor can be assessed through previous data, history of the company, resource of the manpower. Proper Contractor can be categorized in two types:

General Contractor or Prime Contractor.

- **General Contractor** involves work in low-hazard areas like electrical work, office related activities etc.
- **Prime Contractors** involve activities which possess high risk to work force & company physical asset.

Enlist measures shall be fulfilled prior or during manpower mobilization as mentioned below:

- Employers should make sure that contractors have the training they need to do for doing their jobs safely.
- Contractor shall adhere to requirements of company contractor management plan.
- Contractor must ensure that their employees adhere to safe working practice on site in addition with appropriate PPES.

- Contractor shall educate their employees to identify hazards, risks & near miss observed on their sites.
- Contractor shall participate in the safety meetings conducted by Client.

8. Pre-Start Up Safety Review:

- A methodical, comprehensive inspection of a process before adding a very dangerous chemical. The PSSR must confirm that there is adequate safety, operating, maintenance, and emergency procedures in place and that the construction and equipment satisfy design specifications.
- Every employee who manages a process has gotten the required training, and new facilities have had a process hazard analysis completed with recommendations addressed or implemented before opening. Additionally, modified facilities meet the criteria for change management.

Activities on which Pre-Start Up Inspection is required prior commission of any critical asset which may include:

- Commissioning of CNG Station
- Commissioning of L-CNG Station
- Commissioning of IPRS (Individual Pressure Reduction Skid)
- Commissioning of DPRS (District Pressure Reduction Skid)

9. Mechanical Integrity

An organization's supervision of all its processing equipment to make sure it is safe and in good working order is known as mechanical integrity. It entails routine maintenance inspections to guarantee that each component is suitable for use. To ensure the integrity of this process, procedures have to be drafted and followed.

Objective of Mechanical Integrity Programme:

- Life Cycle Assessment of the Aging Asset.
- Equipment shall be in accordance to approved design & codes.
- Routine based preventative maintenance program.

- Inspections, Testing & Calibrations of Mechanical Parts shall be done.
- Corrosion Monitoring of Mechanical Parts shall be done.
- CAPA shall be done after any break-down event.

E.g.: CNG Cascade Hydro testing in every 3 years as per BIS Code: 8451 & GCR 2016

10. Work Permit System

Work Permit System is a safety management process used to oversee and regulate possibly hazardous job operations. This system is designed to ensure that certain tasks or operations are conducted safely and efficiently while minimizing the risk of accidents, injuries, and incidents in the workplace.

To establish a system of work permit is to make sure that jobs are adequately planned, sufficient precautions have been taken in due consideration of hazards and risk related with the work and all concerns are aware about type and quantum of job and location where it is being performed by the maintenance / construction/project or any third agency with the written consent of the owner of the area within or out of the facilities. Requirements of Work Authorization System:

Systems are in place to ensure that a documented work permit procedure is established, maintained, periodically reviewed, and properly followed. Employees whose jobs encompass the system for work permit will receive formal training, refresher training, and competence testing. To detect work-related dangers and describe the necessary actions to manage them, key position holders in the work authorization system must get specialized training, including competency testing and refresher training. The procedures of the work permit document shall conform to the following points below:

Describe the work and identify the equipment/area of work.

- Confirm that the work area is properly prepared and inspected for the specific task before issuing the work permit.
- Specify valid timing for the permit.
- Confirm that all measures to control potential hazards related to the job are taken into Consideration; emphasis is to put on situations where work could affect or be affected by interfacing operations.

- Indicate requirement of stand-by personnel and equipment, including any special precautions, such as special PPE, hazardous materials monitoring, gas testing etc.
- Communicate the requirements in writing to all parties involved in executing and controlling the work.
- The procedures of work permit shall separately describe the conditions for different categories of work. As a minimum, a permitting system must deal separately and directly with different categories of cold work, hot work, work ay height, excavation work, confined space/vessel entry, electrical and other energy isolation.
- The procedures of work permit describing role and responsibilities for each category of work to be developed in line with OISD STD 105 & IS: 17839
- Gas testing and hazardous material monitoring are to be performed as required for all appropriate conditions, including hot work, confined space entry or situations where combustible or toxic materials shall be present.
- Only trained and authorized employees shall carry out gas testing and hazardous materials monitoring. Up-to-date records of those employees to be maintained.
- Criteria of acceptability for gas test, hazardous material limits, in terms of flammability, oxygen content and toxicity to be established.

Type of Work Permit System can be implemented as follows:

- Excavation Work Permit
- Confined Space Work Entry Permit
- Hot Work Permit
- Cold Work Permit
- Electrical Permit
- Critical Lifting Permit

11. Management of Change:

- An organized method for handling organizational change is called management of change (MOC). Although it is extensively employed in industrial settings and operations, it may be employed in any workplace, particularly by those who change their procedures and practices

regularly. Ensuring worker safety throughout the crucial changeover phase is MOC's main goal.

- Plants are primarily altered or updated to increase efficiency, enhance operability and safety, increase dependability, adapt to technological advancements, etc.
- Process engineering, instrumentation, maintenance, relief, safety, health, and the environment, as well as a review of the pipe and equipment specifications, should all be included in the change management procedure.

12. Incident Investigation and Analysis

An essential component of safety management is incident/accident investigation and analysis. An organization's primary goal when conducting incident investigations is to avoid similar occurrences from happening again and to generally enhance health and safety management. Requirements of Incident Investigation & Analysis shall be:

- Formation of Preliminary Investigation Team.
- Provide for timely reporting and investigation.
- Identify root causes and contribution factors.
- Indicate the action needed to reduce similar risk and related incidents.
- Ensure that appropriate action is taken and documented.
- Provide legal input.
- Procedures along with the responsibility and course of action are defined for fire prevention, personal safety, and property loss incident reporting requirements within the company premises and to government agencies.
- To determine the common causes of incidents information from all incidents is periodically analyzed and necessary actions are taken to prevent recurrence.
- The feedback of incident investigation like incident description, lessons learnt, and action taken to
- prevent recurrence are shared with all employees, committee members and employees of other sites of Company.

Requirements of Incident Reporting as per Statutory Bodies guidelines

PNGRB (Petroleum Natural Gas & Regulatory Body

Clause no 23(1) ERDMP – GSR 39(b)

The entity should keep a record of every occurrence included under Minor occurrence and Near Misses for inspection in the format given in Schedule VI. The PNGRB must receive reports of "major" incidents in the format provided and record them in Schedule-VI. The aforementioned report needs to be turned in within 48 hours of the occurrences taking place. Nevertheless, PNGRB must be notified of the First Information Report (FIR) on a "Major" incident by phone, email, or SMS as soon as possible, but no later than four hours after the incident occurs.

Clause No: 23 (2): Incident Reporting: An incident needs to be treated as major if any of the following occurs;

- Fire for more than fifteen minutes
- Explosion/blowout
- Fatal incident.
- Loss above [Rs. 20.0 Lac]
- Cumulative man hours lost more than five hundred hours.
- Plant shutdown/outage due to the incident

Clause No 23 (3): Within 30 days of the event occurring, the Board must receive a detailed investigative report of all "Major" occurrences as well as a time-bound mitigation plan of suggestions made during the inquiry. Any occurrence that results in a fatality, an estimated loss of more than Rs. 20 Lac, or a cumulative loss of more than 500 man hours is considered serious. Events of this nature must also be recorded as significant incidents right away using the format specified in schedule VI.

Clause No 23 (4): Within 30 days of the end of each quarter, the Board must receive a quarterly report that includes a summary of major occurrences (with a comprehensive investigation report) and minor incidents and near misses (only statistics).

Petroleum & Explosive Safety Organization (PESO)

Gas Cylinder Rule no 67

Notice of accidents:

1. Notice of an accident must be given immediately by subsection (1) of section 8 of the Act.

2. by fax, email, or telegraph to the region's controller or the Chief Controller. (Email address: explosives@explosives.gov.in; telegraphic address: Explosives, Nagpur) followed within 24 hours by a letter providing details on the incident.

- To the District Magistrate concerned and
- To the closest police station's officer-in-charge via the most expedient route.

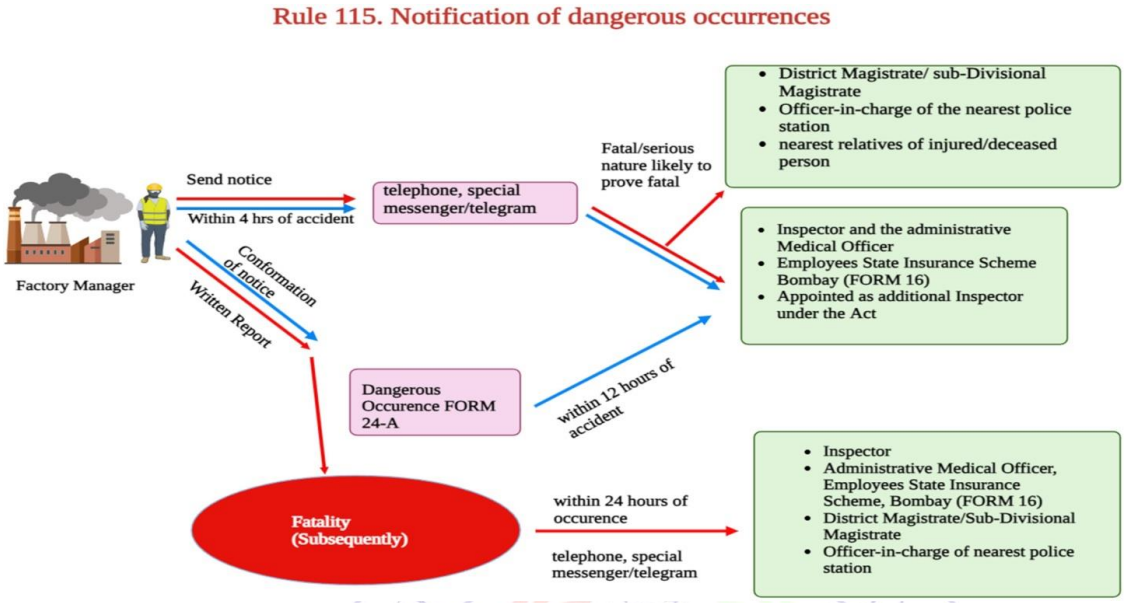
3. All debris and wreckage must remain undisturbed until the Chief Controller or Controller visits or until he gives instructions that that he does not desire to undertake any further investigation or inquiry, with the exception of any areas where its removal might be required to retrieve the bodies of those killed in the accident and the rescue of those injured, or for the restoration of a railway or road through communication or traffic.

SMPV Rules 2016 rule no 67: The license must keep track of any occurrences involving the handling, storage, or transportation of compressed gases and provide them to the inspection authorities upon request. Same as GCR Rules no 67, 68, 69

State Factory Rules: Maharashtra Factory Rules

Clause No: 115: Notification of accidents or dangerous occurrences

Fig 3: Flow Chart of Reporting of Incident as per Maharashtra Factory Rules, 1963



Note: Reporting of Incident varies state to state factory rules

14 Emergency Planning and Response

Emergency Planning & Responses of the CGD Entity should comply with the standards of PNGRB ERDMP Code G.S.R. 39(E)

Requirements of ERDMP shall be:

- Emergency Response and Disaster Manage plans (on-site & offsite) document certified by a third party authorized by PNGRB is communicated to all concerned about their roles and responsibilities in case an emergency arises within the installation.
- The emergency plans are prepared based on risk assessment which includes:
- Hazards associated with the process, products intermediates, and raw materials are identified and built on the trouble action plan, and basic infrastructure has been developed to mitigate the consequence of the emergency.
- Strategies for handling both internal and external emergencies have been considered.
- Organizational structure along with the responsibilities and authorities for different sorts of emergency situations has been clearly defined in the plan.
- Emergency response procedures have been defined.
- Resources including medical and other assistance have been defined.
- Key personnel and their role have been clearly defined to bring the emergency under control.

- The plan to contain at least the following elements:
- Emergency escapes procedures & Escape Route
  - Classification of Emergency
    - Various Emergency Scenarios & mitigation plan
    - Communication Plan
    - Course of action to be followed by personnel who remain to operate critical equipment before they evacuate.
    - Rescue and medical tasks for the workers who are supposed to execute them.
    - The most appropriate methods to report emergencies, including fires.
    - Pre-emergency planning and co-ordination with outside parties.
    - Provisions for certifying yearly competency by the employer and confirming that every worker has
    - attended and successfully finished the necessary training for the role they are expected to perform in an emergency.
    - Identification of Assembly points
    - Adequate resources both internal and external are to be provided / lined up to respond in emergency.
    - Turned over procedures and plans are available for emergency communication. Responsible personnel for interacting with the media and public are nominated and trained.
    - ERDMP is integrated with all concerned civic authorities and neighboring industries.
    - Neighboring community's concerned civil authorities and public en-route of pipelines are informed about the potential hazard of the gas / chemicals and how to respond during emergency.
    - Periodic mock drills are carried out on all aspects of ERDMP. Comprehensive drill is carried out at the minimum once in a year.
    - The drills are reviewed, and recommendations are documented, corrective action taken and communicated to authorities.
    - Risks are periodically assessed and ERDMP is revised, if required.

15 Compliance Audit:

The regular assessment of the safety system's operation is known as a safety audit. It provides insight into the efficiency of the safety system's implementation and the methods being used. The feedback mechanism is what gives management information about the various safety system components and actions, how successful they are, and how to appropriately govern these efforts.

Table 2: Following three types of safety audits can/shall be carried out:

Type of Audits	Frequency of Audits
Internal Safety Audit (As per IS:14489)	Once in a Year
External Safety Audit (As per IS:14489)	Once in a Two year
Internal MDT Audit (As per IMS, PNGRB)	Once in a Year
External Audit: IMS as Per PNGRB Code	Once in 3 Year
T4S Audit as Per PNGRB Code	Once in 3 Year
IMS Audit as per PNGRB Code	Once in a 3 Year
ERDMP Audit as per PNGRB Code	Once in a 5 Year
Electrical Safety Audit	Based on Company requirements
Internal Asset Audit	Monthly / Quarterly / Half - Yearly
ESG Audit External	Once in a 2 Year
ISO Audit: 9001, 14001, 45001 (External)	Once in 3 Year
ISO Audit: 9001, 14001, 45001 (Internal)	Based on Company requirements
Internal Asset Audits	Based on Company requirements

16. Off the Job Safety:

Off-the-job safety is the extension of an organization's on-the-job safety culture. Off-the-job safety programs educate employees about being safe while not at work.

Nowadays, an increasing number of companies believe that off-the-job safety is essential to effectively managing health care expenses, productivity, and profitability. More significantly, safety initiatives outside of the workplace save the lives of workers and their families. Elements of off-the Job Safety Management are:

Management Leadership & Commitment

- Organizations Communication & Systems Documentations
- Evaluations & Continuous Evaluations
- Hazard Recognition & Evaluation
- Employee Involvement
- Motivation, Behavior & Attitude
- Training & Orientation
- The company should have a policy to encourage covering off-the-job safety of the employees.
- The reporting and analysis of off-the-job injuries to employees and their families should be encouraged.
- Findings of the scrutiny of the off-the-job injuries should be known to all the employees through newsletters / bulletins.

17. Customers & Products:

Customer & Product shall be compatible for the intended use. It is the primary objective of the entity to display, aware of their end-use product to the consumers without causing harm to human beings & the environment.

Requirements to achieve that are

- Awareness of the Safety Norms related to the products.
- Do or don't involve in end use of CNG or PNGs.
- Identification of Gas Pipeline via their color Code.
- Identification of Gas Network via their on-road asset & color code.
- Material Safety Data Sheet Provision.

18. Road Transportation

Road Transportation which involves the movement of HCV/LCV with mounted CNG Cascades to cater CNG requirements at Daughter or Daughter Booster Stations.

Requirements:

- Design, optimum load carrying capacity of the HCV/LCV shall be sufficient for Mounted Cascade
- HCV/LCV Drivers shall be trained & possess a license for Hazardous transportation
- Design of Cryogenic Tankers shall conform to EN13530, ASME Section VIII
- Transport Risk Assessment or Journey Management Plan for their route shall be done it shall include the details of on-route important contact details like hospitals, police stations, crane services, etc.
- TREM (Transport Response Emergency Card containing all details of contact number, HAZCHEM Code, UN Number shall be displayed
- Drivers shall be aware of the Pre-Checks prior to starting the vehicle from the receiver to designated locations.
- Drivers shall be aware of the critical valve & safe vent position of the equipment.
- Drivers shall be aware of the SOPs, and ERP of the Vehicle
- Drivers shall be aware of the prohibited items while traveling with Hazardous Vehicles.
- Entity shall ensure the proper administrative control schemes are in place
- Entity shall ensure the regular training of the Drivers

19. Trade Secrets:

Employers must disclose all information necessary to meet PSM requirements to those responsible for collecting process safety data, conducting process hazard analyses, drafting operating procedures, managing incident investigations, planning for emergencies, and performing compliance audits, regardless of whether that information may be considered a trade secret. However, PSM does not prevent employers from asking those individuals to sign confidentiality agreements to keep the information private.

As Water Dill Scott States: **"The Future of the Safety Movement is not much dependent upon the invention of safety devices as on the improvement of methods of educating people to the ideal of caution & safety"** The City Gas Distribution business model is straightforward; however, the risks & underlying hazards are much more concerning. Rapid Urbanization, Exclusive Dependency on

outsourcing & unstable employees, unauthorized excavations, congested approach roads, and lack of public awareness are the common threats in CGDs.

Considering the above, SMS (Safety Management System) shall be implemented in every CGDs in line with OISD -206, ERDMP, IMS, and ISO 45001 Codes & other applicable statutory regulations to mitigate the uncertainties in the workplace. Adequate resources, structured reporting matrix, legal obligations, promotion & penalties, Functional Training mechanism, Quality Assurance & Control, IDLH reporting, regular drills, ESG stats monitoring, and Safety Committee Meetings shall become the fundamentals in every HSE Management System or Safety Management System.

"Safety Should Never be a priority, it should be a Pre-Condition" - Paul O'Neil

4.0 REFERENCES:

1. Dhyani R. City Gas Distribution Challenges: Challenges Faced by CGD, IGL: A Case Study with Solutions Adopted. In ASME India Oil and Gas Pipeline Conference 2019 Apr 26 (Vol. 58530, p. V001T04A004). American Society of Mechanical Engineers.

2. Faramawy S, Zaki T, Sakr AE. Natural gas origin, composition, and processing: A review. Journal of Natural Gas Science and Engineering. 2016 Aug 1;34: 34-54.

3. Sarkar SC. LNG as an energy efficient eco-friendly cryogenic fuel. Journal of Energy in Southern Africa. 2005 Nov 1;16(4):55-8.

4. Sircar A, Sahajpal S, Yadav K. Challenges & issues in natural gas distribution industry. STM J. 2017; 7:1-8.

5. Murrill BJ. Pipeline transportation of natural gas and crude oil: federal and state regulatory authority. Congressional Research Service; 2016 Mar 28.

6. Gholami A, Laal F, Jamali M. Implementation of Health, Safety and Environment Management System
(HSE-MS) Requirements with Emphasis on Payment Management. Archives of Occupational Health. 2022 Jan 10;6(1):1190-7.

7. Jayaraman G. Process Safety Management: The Experience of Essar Oil. Professional Safety. 2013 Nov 1;58(11):44-51.

8. Sachin D, Mani Shibu K, Guru B. Risk Management of Technological Accidents triggered by NaturalHazards (Natech): A Review of Relevant Indian Legislation.

9. Santos-Reyes J, Beard AN. Assessing safety management systems. Journal of Loss Prevention in the Process Industries. 2002 Mar 1;15(2):77-95.

10. Singh M. Transportation and distribution of Natural Gas in India: Legal and Regulatory Framework.

11. Mozaffarian M, Zwart RW, Boerrigter H, Deurwaarder EP, Kersten SR. Green gas as SNG (synthetic natural gas); a renewable fuel with conventional quality. Science in thermal and chemical conversion. 2004 Aug 1;30.

12. Kudaisya SK, Kar SK. A comprehensive review of city gas distribution in India. Natural gas markets in India: Opportunities and challenges. 2017:113-65.

13. Garg S P, Gupta K K, Tewari R. How to set up safety Management system in 91 days. A safety Management handbook for MSMEs and CGDs.

14. Md. Aftab. Fall Hazard Prevention at workplace: A Study. International Journal of Institution of Safety Engineers (India). 2020 April: 3(2); 24-7.

15. Pardeep Chutlekar. Assessing The Effectiveness of Occupational Health & Safety Management Systems in Promoting Workplace Safety. International Journal of Institution of Safety Engineers (India). 2023 June: 6(2); 11-20.