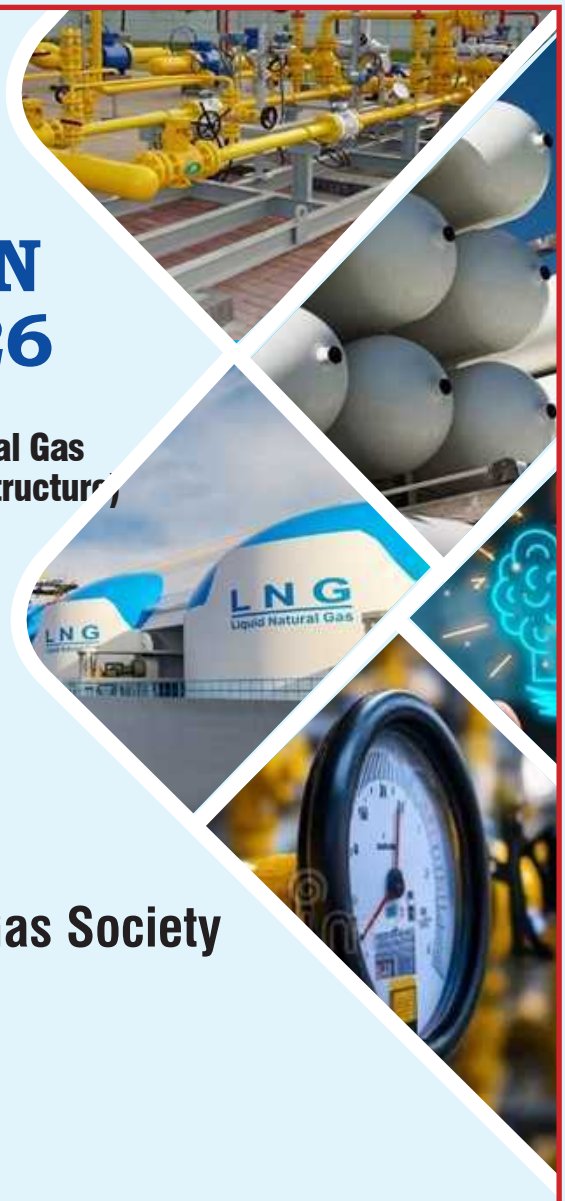

NGS CONCLAVE ON INNOVATIONS 2026

(Innovations & Operational Excellence in Natural Gas Transmission, CGD, LNG & Future-Ready Infrastructure)

6–7th August, 2026
at CSOI, KG Marg, New Delhi

Organised by Natural Gas Society (NGS)

Sponsored by

GAIL

MAHANAGAR GAS

INDRAPRASTHA GAS

A REPORT

NATURAL GAS SOCIETY: 129, PARC Building, GAIL Training Institute, Plot No. 24, Sector - 16A, Noida 201301
Tel: 0120 - 4222849 Email: ngs@ngsindia.org Website: www.ngsindia.org

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EXECUTIVE SUMMARY

NGS Conclave on Innovations 2026

The Natural Gas Society (NGS) organized the **NGS Conclave on Innovations 2026** on **6–7 August 2026 at CSOI, K.G. Marg, New Delhi**, under the theme "**Innovations & Operational Excellence in Natural Gas Transmission, CGD, LNG & Future-Ready Infrastructure**." The two-day Conclave brought together senior industry leaders, technical experts, operators, technology providers, academicians and other stakeholders to share innovative technologies, operational experiences and practical solutions for improving safety, reliability, efficiency, sustainability and long-term asset performance across the natural gas value chain.

The inaugural session highlighted the growing importance of natural gas in India's evolving energy landscape and emphasized that achieving the national objective of increasing the share of natural gas in the energy mix would require innovation, digitalization, operational excellence, technology adoption and close collaboration among stakeholders. Speakers stressed the need to make existing infrastructure smarter, more efficient and responsive through AI, automation and data-driven decision-making.

A major highlight was the Leadership Panel Discussion on "**Powering India's Gas-Based Future: Innovation Pathways towards a Secure, Affordable & 15% Gas Economy**." The panel examined the key requirements for accelerating natural gas consumption, including operationalizing existing pipeline infrastructure, strengthening last-mile connectivity, expanding CGD networks and creating demand across power generation, industry, refineries, petrochemicals, fertilizers and transportation.

LNG-based heavy-duty transportation was identified as an important near-term opportunity, subject to the development of an integrated ecosystem of vehicles, fueling infrastructure and reliable supply. Diversification of LNG sources and long-term supply arrangements were considered important for strengthening energy security. The panel also emphasized tax rationalization, bringing natural gas under GST, uniform policy frameworks and simplified approvals to improve competitiveness and accelerate sectoral growth. The future gas ecosystem was visualized as an integrated platform incorporating natural gas, CBG/biogas, LNG, hydrogen and other cleaner energy molecules, supported by stronger indigenous technology development and R&D.

The technical sessions presented a wide range of innovations in pipeline integrity, leak detection, compressor reliability, energy efficiency, LNG, future fuels, digitalization and CGD operations. A recurring theme was the transition from reactive maintenance towards preventive, predictive and intelligent asset management.

In pipeline integrity management, the integration of Artificial Intelligence, Inline Inspection, SCADA, GIS, satellite imagery, drones and predictive analytics was demonstrated for improved asset health assessment and risk management. These technologies can support corrosion-growth prediction, defect correlation, remaining-life assessment and prioritization of maintenance activities. Satellite intelligence and GIS integration can also provide early warning of river migration, erosion and washout risks.

Innovations in leak detection and Right-of-Way surveillance included Advanced Mobile Leak Detection using laser-based methane sensing, Real-Time Transient Modelling, Computational Pipeline Monitoring, Pipeline Intrusion Detection Systems and Distributed Acoustic Sensing. Drone-based surveillance was also highlighted for monitoring extensive pipeline corridors and identifying encroachments, erosion, excavation and other changes requiring timely intervention.

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The Conclave also examined AI-enabled predictive maintenance, IoT-based sensors, equipment-health monitoring and digital twins for improving centrifugal compressor reliability, availability and asset life. In CNG operations, the focus was on Variable Speed Drives, gas recovery systems, methane-emission reduction, advanced packing technologies, renewable gas integration and waste-heat recovery, demonstrating that sustainability initiatives can also provide significant operational and economic benefits.

Sessions on LNG, Small Scale LNG (SSLNG), hydrogen and future fuels highlighted opportunities for expanding cleaner energy access. SSLNG was presented as a flexible solution for supplying gas to remote consumers and heavy-duty transportation applications beyond the pipeline network. Hydrogen was discussed as an important future energy carrier for industrial applications, refineries, green ammonia, transportation and power generation, while recognizing challenges relating to cost, transportation, infrastructure and commercial viability.

The second Leadership Panel Discussion and subsequent technical sessions focused on urban CGD challenges, digitalization, automation, smart operations and asset-life enhancement. Third-party damage, utility congestion, pipeline leakage, emergency response and accurate asset records were identified as key concerns. GIS-based mapping, smart metering, advanced inspection technologies, competent manpower and public awareness were emphasized as important solutions.

The Conclave also addressed risks associated with river crossings, flooding and erosion, highlighting the need for improved hydrological and geotechnical assessment, continuous monitoring, satellite and drone surveillance and resilient crossing technologies.

Overall, the NGS Conclave on Innovations 2026 demonstrated that the future of India's natural gas infrastructure will depend on the effective integration of people, processes, technology and innovation. The central message was that innovation must translate into practical and commercially viable solutions that improve safety, reliability, efficiency, sustainability and customer value.

The Conclave concluded with a strong call for greater collaboration among industry, government, regulators, technology providers and academic institutions. Continued investment in digital technologies, indigenous R&D, workforce capability, asset integrity and future-ready infrastructure will be essential for supporting India's transition towards a cleaner, secure, resilient and increasingly gas-based energy economy.

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NATURAL GAS SOCIETY (NGS)

About Natural Gas Society (NGS)

The Natural Gas Society (NGS), a registered Society and an independent industry body, serving as the emerging voice of India's natural gas sector. It was established with the following objectives:

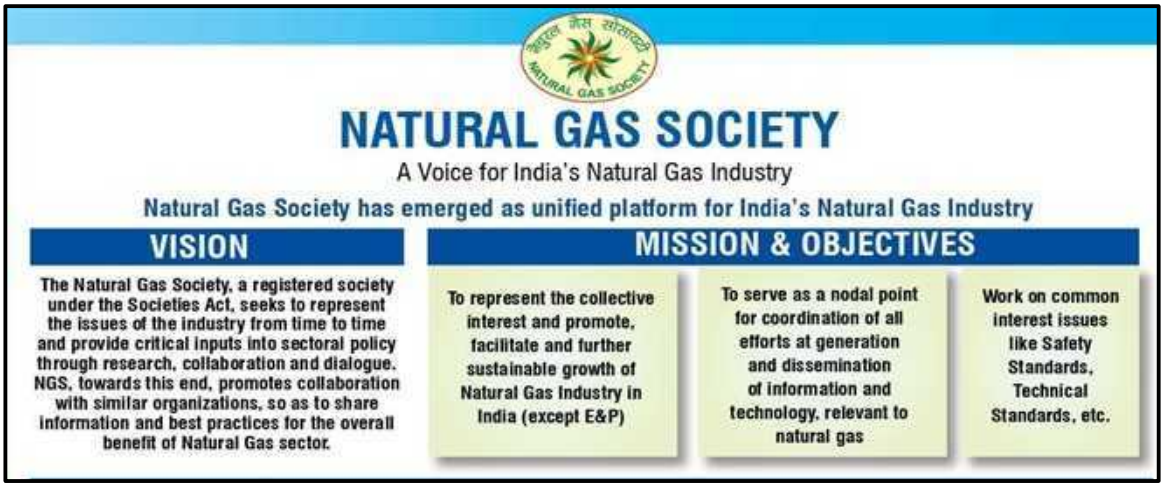
(1) to promote, facilitate and further sustainable growth of Natural Gas Industry in India.
(2) to represent the collective interest and promote, facilitate and further sustainable growth of Natural Gas Industry in India (Issue Based Policy Advocacy).
(3) to serve as a nodal point for coordination of all efforts at generation & dissemination of information and technology relevant to natural gas and to work on the issues of Common interests such as the Technical Standards, Safety Standards, etc. Society is also collaborating with relevant organizations at national & international levels.

NGS provides a meaningful platform for exchange of ideas and best practices across stakeholders in the Indian gas value chain. Through active engagement, it works to enhance the competitiveness of India's natural gas industry in global energy markets while promoting the responsible, safe, and sustainable expansion of gas infrastructure.

A core part of NGS's mission is to champion continual improvement in safety and service standards across the entire natural gas chain from transmission pipelines to city-gas distribution networks. NGS supports the adoption and transfer of new technologies and industry best practices, aiming to optimize resources and safeguard stakeholder interests.
Given India's diverse geography and vast population, NGS places special emphasis on the promotion and development of City Gas Distribution (CGD) networks. To conclude, NGS has established a dedicated CGD Forum to foster collaboration among gas utilities and address sector-specific challenges.

In addition to policy advocacy and industry-wide initiatives, NGS actively promotes capacity building and skill development. It aims to organize regular training programs, workshops, and knowledge exchange events enabling stakeholders across the sector to stay updated with evolving technologies, safety norms, and operational excellence standards.

Through its multifaceted role as a think-tank, collaboration platform, and safety- & quality-oriented promoter, NGS seeks to support India's journey towards an increasingly gas-based economy, contributing to energy security, environmental sustainability, and equitable access to clean energy for all



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ABOUT THE PROGRAM

NGS Conclave on Innovations 2026

The **Natural Gas Society (NGS)** organized the **NGS Conclave on Innovations 2026** on **6–7 August 2026 at CSOI, K.G. Marg, New Delhi**, under the theme **"Innovations & Operational Excellence in Natural Gas Transmission, CGD, LNG & Future-Ready Infrastructure."** The Conclave brought together senior industry leaders, technical experts, operators, technology providers and other stakeholders to deliberate on emerging technologies, innovative practices and strategies for enhancing **safety, reliability, efficiency, sustainability and operational excellence** across the natural gas value chain.

Conference Themes & Scope

The Conclave covered the broad spectrum of natural gas infrastructure, including transmission pipelines, CGD networks, LNG, compression systems, metering, asset management and emerging fuels. Key thematic areas included:

- **Innovation in Natural Gas Transmission, CGD, LNG & Compression Systems**, with emphasis on digitalization, AI, automation, smart infrastructure, network efficiency and future-ready systems.
- **Pipeline Integrity, Leak Detection & Asset Reliability**, including advanced leak detection, AI-powered monitoring, smart inspection, corrosion control, predictive risk assessment and compressor reliability.
- **Innovative Business Models & Future Fuels**, covering SSLNG, LNG applications, renewable-integrated CNG compression and LNG-CBG-Hydrogen hubs.
- **Urban CGD Challenges & Innovative Solutions**, including HDPE pipeline leakage, smart utility mapping, trenchless technologies, emergency response, third-party damage prevention, smart metering and public safety.
- **Digitalization, Automation & Smart Operations**, covering smart metering, digital assurance, information systems, network management and next-generation leak detection.
- **Performance, Safety, Integrity & Asset Life Enhancement**, including energy management, pipeline integrity, river-crossing challenges, pilferage prevention and AI-driven digital twins.

Program Highlights

The two-day Conclave featured **two Leadership Panel Discussions and four Technical Sessions**.

Day 1 covered **"Powering India's Gas-Based Future: Innovation Pathways to a 15% Energy Economy,"** followed by technical sessions on **Pipeline Integrity, Leak Detection, Compressor Reliability & Energy Optimizations** and **Innovative Business Models & Emerging Opportunities in LNG, Natural Gas and Future Fuels**.

Day 2 focused on **"Urban CGD Operational Challenges & Innovative Solutions,"** followed by technical sessions on **Digitalization, Automation & Smart Operations in Gas Infrastructure** and **Innovations in Performance, Safety, Integrity & Asset Life Enhancement**.

Expected Outcomes & Objectives: The Conclave aimed to:

- Provide a platform for **knowledge sharing and exchange of innovative industry practices**.
- Promote **technology-led operational excellence, safety, reliability and asset performance**.
- Strengthen **pipeline integrity, leak detection, compressor reliability and energy efficiency**.
- Share practical experiences and lessons learned from **CGD projects, pipeline operations and asset management**.

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• Explore emerging opportunities in **LNG, CBG, hydrogen and renewable-integrated gas systems**.

• Address challenges associated with **urban CGD expansion, network safety, metering and emergency preparedness**.

• Encourage collaboration among **operators, OEMs, technology providers and other stakeholders**.

• Support the development of **future-ready, sustainable and efficient natural gas infrastructure**.

The Conclave sought to translate innovation and industry experience into **practical, actionable solutions for enhancing operational excellence, safety, reliability, sustainability and long-term performance across the natural gas sector**.

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MINUTE TO MINUTE PROGRAM SCHEDULE

Organised by

Sponsored by

NGS CONCLAVE ON INNOVATIONS 2026

(Innovations to achieve Operational Enhancement & Excellence in Natural Gas Transmission, CGD, LNG and Future-Ready Infrastructure)
Date: 6–7th August, 2026 Venue: CSOI, New Delhi

Programme Schedule - Day 1

DAY 1

DAY 01 THEME: Innovation in NG Transmission, LNG & Compression Systems

Registration (9:00 HRS – 10:00 HRS)

Session – I: Inauguration (10:00 HRS – 11:15 HRS)

Welcome Address	Shri D V Shastry, ED, NGS
Keynote	Shri Kapil Jain, Executive Director (RM & TQM), GAIL
Inaugural Address	Shri Shailesh Tiwari, Divisional Head & ED(I/C - Pipeline), IOCL
Vote of Thanks	Shri R P Singh, Sr Consultant, NGS

TEA BREAK (11:15 HRS –11:30 HRS)

Day-1 SESSION-II (11:30 HRS – 13:00 HRS)

"Leadership Panel Discussion – I: Powering India's Gas-Based Future: Innovation Pathways to a 15% Energy Economy

Session Chair: Shri M V Iyer, Former Director (BD), GAIL

Panellists: Shri Ashu Shinghal, CEO, GAIL Gas / Shri Mohit Bhatia, DC, IGL / Shri Praveer Kumar Agrawal, Chairman, CUGL & ED (Training), GAIL / Shri Gyanendra Kumar Sharma, GGM & President, Marketing, PLL

LUNCH BREAK (13:00 HRS -13:45 HRS)

Day-1 SESSION – III: (13:45 HRS – 15:45 HRS)

"Technical Session – I: Innovations in Pipeline Integrity, Leak Detection, Compressor Reliability & Energy Optimisation"
Session Chair: Shri Rajiv Sikka, Former CEO IOAGPL

Presentation Topics:

• Innovations in Pipeline Integrity Management: Advance Leak Detection, AIPowered Monitoring, Smart Inspection, Corrosion Control & Predictive Risk Assessment	Shri Rohit Malhotra & Shri Subhadeep Debnath, GAIL
• Digital Innovations in Pipeline Integrity Management: AI, Smart Technologies & Predictive Asset Reliability	Md Amid, IOCL
• Next-Generation Mobile Leak Detection for Safer & Smarter Urban Gas Networks	Shri D Maratha, MGL
• Innovations in Centrifugal Compressor Management: AI-Driven Performance Optimization, Reliability & Predictive Maintenance	Shri Anmol Kumar Mishra & Shri Shashi Shekhar, GAIL
• Innovations in Energy Efficiency, Emission Reduction & Sustainable CNG Compressor Operations	Shri Anbarasan, Kirloskar Pneumatic

TEA BREAK (15:45 HRS – 16:00 HRS)

Day-1 SESSION – IV: (16:00 HRS – 17:45 HRS)

Technical Session – II: Innovative Business Models & Emerging Opportunities in LNG, Natural Gas and Future Fuels
Session Chair: Shri Praveer Kumar Agrawal, ED(Training) & Chairman, CUGL

Presentation Topics:

• LNG, Hydrogen & emmerging Energy Solutions: Shaping tomorrow's landscape	R K Jha, GAIL
• Innovations in safe Handling, Storage & Retail outlets for LNG for Heavy-Duty Transport, Mining & Marine Applications for decarburization & zero emission	Shri Shivank Bholanath & Ms. Neha Gupta, PLL
• Renewable Energy Integration in CNG Compression: Towards Low-Carbon City Gas Operations	Shri Pratap Ayarekar, MGL
• Innovations for integration of LNG-CBG-Hydrogen Hubs: A Multi-Fuel Energy Business Model	Shri Ravi Dagar, IGL

High Tea & Networking (17:45 Hrs - 18:00 Hrs)

End of Day 01

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NGS CONCLAVE ON INNOVATIONS 2026

(Innovations to achieve Operational Enhancement & Excellence in Natural Gas Transmission, CGD, LNG and Future-Ready Infrastructure)
Date: 6–7th August, 2026 Venue: CSOI, New Delhi

Programme Schedule - Day 2

DAY 2

DAY-2 SESSION-I (09:30 HRS – 11:00 HRS)

"Leadership Panel Discussion – II: Urban CGD Operational Challenges & Innovative Solutions"

Session Chair: Shri S Trehan, CEO, THINK LNG Investment Private Limited

Panellists: IRMEL – Shri M K Sharma, CEO / IGL – Shri Raman Srivastava, ED / GAIL Gas – Shri S K Dixit, COO / MGL – Ms. Pratibha Bijay, AVP-O&M

TEA BREAK (11:00 HRS –11:15 HRS)

Day-2 SESSION – II: (11:15 HRS – 13:15 HRS)

"Technical Session – III: Digitalization, Automation & Smart Operations in Gas Infrastructure"
Session Chair: Shri S Murali, Advisor, MGL

Presentation Topics:

• Smart Flow Meter Validation & Digital Assurance for High-Accuracy Gas Accountingin Flow Metering of CGD Network	Shri Shashank Pradhan, MGL
• Innovations in Smart Technologies for Gas Metering & Network Management	Shri Makarand Vairagare & Shri Ajay Khullar, Pietro Fiorentini DB India
• Innovations for Integrating Information Systems for Asset & Operations Management	Shri Vipin Kapoor, GAIL, CGD
• Challenges and Lessons Learned in Executing Large-Scale CGD Projects Across Diverse Geographical and Urban Environments.	Shri C Prabhakar Chakravarthy, CGDSPL
• Next-Generation Leak Detection for HDPE Gas Pipelines: Laser, Soil Gas, Bar Hole & Tracer Gas Techniques	Shri Vishaal Kaushal, Respo Safety Solutions Pvt Ltd

LUNCH BREAK (13:15 HRS –14:00 HRS)

Day-2 SESSION – III: (14:00 HRS – 16:00 HRS)

"Technical Session – IV: Innovations in Performance, Safety, Integrity & Asset Life Enhancement"
Session Chair: Shri Satish Geda, Sr. Consultant, NGS

Presentation Topics:

• Strategic and Innovative Approach for Operational Excellence through Energy Management Networks	Shri Joy M Shah, Innov8 ProTech Solutions
• Innovations for Integrity, Reliability & Safety Management of Steel & MDPE Pipeline Networks	Shri Sachin Kumar, IGL
• River-Crossing Pipeline Failures: Lessons Learned, Reinstallation Innovations & Asset Integrity Enhancement	Shri Nitin Singhal & Shri Pradeep Gupta, GAIL
• Innovative Strategies for Gas Pilferage Prevention & Network Integrity Protection	Shri Mahesh Nagnure, MGL
• Innovations in Pipeline Asset Management: AI-Driven Digital Twins for Enhanced Safety and Reliability	Shri S Ravishankar, Alethe Labs India Pvt Ltd

Valedictory Session (16:00 HRS – 16:15 HRS)

Networking Tea (16:15 HRS ONWARDS)

End of Day 02

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ORGANISING TEAM

NGS TEAM	
Shri D V Shastry – Executive Director, Natural Gas Society (NGS) **Chairman, Indian Society for Training & Development (ISTD), Delhi Chapter** **Member - Technical Committee: India Energy Week (IEW) 2026** **Member, Board of Studies, All India Management Association (AIMA)** **Member, GB, Foundation for Organizational Research & Education (FORE)** **Former Executive Director, GAIL (India) Ltd.** **Former Director, GAIL Gas Ltd.** **Former Director (P), Electronics Corporation of India Ltd. (ECIL)** E: edngs@ngsindia.org M: 9818231652	
Shri Satish Geda – Sr. Consultant Former ED, GAIL E: satishgeda@ngsindia.org M: 9911089320	Shri R P Singh – Sr. Consultant Former CGM, GAIL E: rpsingh@ngsindia.org M: 9414153070
Shri Shatendra Kumar Verma – Consultant Former DGM, GAIL E: shatendra@ngsindia.org M: 9818219887	Shri I C Sharma – Consultant (Administration) Former GAIL E: icsharma@ngsindia.org M: 9958529997

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INAUGURAL SESSION

Shri R. P. Singh, Senior Consultant, Natural Gas Society (NGS) and former Chief General Manager, GAIL (India) Limited, welcomed the dignitaries, Session Panellists, distinguished delegates, industry leaders, subject matter experts, speakers, sponsors, academicians and other participants to the **NGS Innovation Conclave 2026**.

He highlighted that the two-day Conclave serves as a knowledge-sharing and collaborative platform focusing on **innovation, operational excellence, digital transformation, safety, sustainability and future-ready infrastructure** in India's natural gas sector.

He expressed appreciation for the enthusiastic participation and continued support of all stakeholders. He encouraged the participants to actively engage in the deliberations and make the Conclave an opportunity to **learn, collaborate, innovate and collectively contribute to the advancement of India's Natural Gas Sector**.

The **"NGS Conclave on Innovations 2026"** commenced with the presentation of plant saplings to the Chief Guest, **Shri Shailesh Tiwari**, Executive Director (In-Charge), Divisional Head, Pipelines Division, Indian Oil Corporation Limited, and **Shri Kapil Kumar Jain**, Executive Director (RM & TQM), GAIL (India) Limited, as a symbolic gesture of welcome and commitment to sustainability. The inaugural ceremony was further marked by the traditional lighting of the ceremonial lamp, with all the distinguished dignitaries and invitees joining the dignitaries on stage to light the lamp and formally inaugurate the Conclave.

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Welcome Address

Shri D. V. Shastry, Executive Director, Natural Gas Society (NGS), warmly welcomed the Chief Guest, **Shri Shailesh Tiwari**, Executive Director (In-Charge), Divisional Head, Pipelines Division, Indian Oil Corporation Limited, **Shri Kapil Kumar Jain**, Executive Director (RM & TQM), GAIL (India) Limited; **Shri M. V. Iyer**, Former Director (BD), GAIL (India) Limited; **Shri Praveer Kumar Agrawal**, Executive Director, GAIL; **Shri Ashu Singhal**, CEO, GAIL; **Dr. V. K. Gupta**, G C Member, Natural Gas Society; **Shri Murali Srinivasan**, Sr Advisor, MGL; **Shri Tejveer Singh**, Director, Aaxis Nano Tech Pvt Ltd.; **Shri Anbarasan**, A V P, Kirloskar Pneumatic; Senior Industry leaders, Dignitaries, Speakers, Delegates and representatives from leading organizations across the Natural Gas Sectors.

In his welcome address, Shri Shastry highlighted the role of **Natural Gas Society**, he said that NGS focuses primarily on:

1. *Policy advocacy and industry representation*
2. *Knowledge and experience sharing and dissemination of best practices*
3. *Capacity building and contribution to technical and safety standards in association with BIS, ASME, PNGRB and other organizations.*

He also highlighted the important role of Natural Gas in India's transition towards a cleaner, more sustainable and secure energy future. **He emphasized that achieving the vision of increasing the share of Natural Gas in the country's energy basket to 15% would require continuous innovation, operational excellence, technological advancement and close collaboration among industry stakeholders.**

He briefly outlined the role of NGS, established in 2006, in promoting knowledge sharing, industry collaboration, policy advocacy, capacity building and the dissemination of best practices. He also highlighted NGS initiatives such as the ***Gyananubhav Pravah Sahayatra*** **(ानानुभव वाह सहया ा)**, which promotes practical learning through visits to operating facilities, and its quarterly publication, **Gas Statistics Review.**

Speaking on the need for innovation, **Shri Shastry emphasized the importance of developing smarter and more resilient infrastructure, strengthening pipeline integrity and asset reliability, improving energy efficiency, reducing methane emissions and adopting digital technologies**. He stressed that knowledge sharing is central to innovation and encouraged industry professionals to share experiences and solutions so that successful practices can be adopted across the sector.

He also urged participants to actively engage in the discussions, ask questions and openly exchange ideas. He emphasized that the **Conclave should serve as a platform for learning, questioning, innovation and collaboration** rather than being limited to one-way communication.

Concluding his address, **Shri Shastry** expressed the hope that the **two-day NGS Conclave would generate meaningful discussions, practical solutions, new ideas and opportunities** for collaboration, contributing to the continued growth and advancement of **India's Natural Gas industry**.

Keynote Address by Shri Kapil Kumar Jain, Executive Director (RM & TQM), GAIL (India) Limited

Shri Kapil Kumar Jain, Executive Director (RM & TQM), GAIL (India) Limited, appreciated the initiatives of the **Natural Gas Society (NGS)** in promoting knowledge sharing, industry interaction and adoption of best practices. **He highlighted NGS initiatives such as industry visits, workshops and collaborations with training and academic institutions**, which provide valuable insights into innovations and practices being adopted across the natural gas industry.

Speaking on the theme of innovation, **Shri Jain highlighted the changing energy landscape**, increasing dependence on imported gas, declining domestic production and the challenges arising from international supply disruptions and price volatility. **He appreciated GAIL's efforts in managing recent supply challenges through portfolio diversification and securing additional LNG cargoes to maintain supplies to various sectors.**

He emphasized that **innovation and technology adoption are essential** for the continued growth of the **CGD sector**. In particular, he highlighted the need for innovative solutions to accelerate **PNG connections, improve productivity and reduce execution time and costs.** Technologies such as **flexible piping systems**, **smart metering, gas leak detection, AI and digital monitoring** can significantly improve **operational efficiency and safety**.

Shri Jain identified Compressed Biogas (CBG) as a major opportunity for import substitution, given India's substantial biogas potential. He stressed the need to improve production efficiency and gas quality, particularly by reducing moisture, CO_2 and other impurities, to facilitate CBG injection into the natural gas pipeline network.

He also highlighted **pipeline integrity management and asset health monitoring** as important areas for technological innovation, particularly for addressing risks from third-party activities and environmental events. AI, real-time data analytics and digital control systems can support predictive monitoring, faster decision-making and improved asset reliability.

Shri Jain further discussed the potential of Small-Scale LNG (SSLNG) for supplying gas to areas beyond the existing pipeline network and emphasized the opportunities for LNG as transportation fuel. He noted the scope for developing modular and efficient LNG stations and fast-filling technologies to reduce turnaround time and improve commercial viability.

Concluding his address, **Shri Jain encouraged participants, particularly young professionals, to actively engage in the conclave** and leverage it as a platform for sharing knowledge, experiences and innovative solutions. He expressed confidence that the discussions would contribute to further technological advancement and operational excellence across the natural gas value chain.

Inaugural Address by Shri Shailesh Tiwari, Divisional Head & Executive Director (I/C-Pipeline), IOCL

Shri Shailesh Tiwari, Divisional Head & Executive Director (I/C-Pipeline), IOCL and **Chief Guest** at the inauguration of the NGS Innovation Conclave, highlighted the **evolving energy landscape in India** and emphasized the need to move **"from infrastructure to innovation".** He appreciated NGS for providing a platform to deliberate on issues relevant to the energy sector and encouraged participants to make the conclave a **forum for meaningful dialogue and exchange rather than monologues.**

He outlined the **Government of India's seven-pillar energy vision**, comprising cleaner use of fossil fuels, increasing the share of natural gas in the energy mix, expansion of renewable energy, promotion of biofuels, e-mobility, development of hydrogen and other future fuels, and digitalisation of the energy sector. He stressed that these energy sources should not be viewed as isolated verticals, but as interconnected components of an integrated energy ecosystem, with the **customer at the Centre**.

Speaking about natural gas, Shri Tiwari said that India's energy transition would be different from that of developed economies. Given India's low per-capita energy consumption and its growing energy requirements, the country's energy story would be one of **addition rather than mere replacement.**

Natural gas, therefore, would continue to play an important role in India's energy mix for the foreseeable future, alongside renewables, biofuels, electricity, hydrogen and other emerging energy sources. He also **highlighted the strategic importance of energy infrastructure**, particularly in the context of recent geopolitical developments. Referring to the resilience demonstrated by India's oil and gas sector in meeting changing requirements, he noted that infrastructure developed during normal times assumes critical importance during periods of crisis. He emphasised that speed of **infrastructure creation is as important as the direction of development, particularly in achieving the objectives of Vision 2047.**

The central theme of his address was the growing importance of **innovation, digitalization, automation and AI/ML** in improving the efficiency of existing energy infrastructure. He cited the **example of a pipeline optimization initiative in IOCL,** where data relating to pipeline capacity, volumes, demand, pumping configurations and energy costs was analyzed to identify more efficient operating configurations. The initiative reportedly resulted in **10–11% savings in operating costs**, demonstrating the potential of technology-driven optimization.

Shri Tiwari urged energy-sector organizations, startups and technology companies to collaborate and develop innovative solutions for improving the efficiency and performance of existing infrastructure. He stressed that the next decade should focus not merely on building infrastructure but on **making existing infrastructure smarter, more efficient and responsive through technology.**

Concluding his address, he called upon participants to keep the **consumer/customer at the center of all strategies, policies and innovations**. Referring to Amazon's practice of keeping an empty chair in the boardroom to symbolize the customer, he emphasized that innovation should ultimately translate into greater value, convenience and satisfaction for consumers. He expressed confidence that the deliberations during the two-day NGS Innovation Conclave would lead to meaningful and actionable ideas for the future of India's energy sector.

Vote of Thanks

Shri R. P. Singh, Senior Consultant, Natural Gas Society (NGS), delivered the **Vote of Thanks** at the inaugural session. He expressed sincere gratitude to the Chief Guest, **Shri Shailesh Tiwari**, for his inspiring inaugural address and valuable guidance, which set the tone for the Conclave. He also thanked **Shri Kapil Jain, Executive Director, GAIL**, for his **insightful keynote address** and **perspectives on innovation and operational excellence**. Shri Singh acknowledged the support of Patron Members, sponsors, session chairs, speakers, panelists, delegates and participants. He also appreciated the efforts of the Organizing Committee, NGS Secretariat, volunteers and technical team in successfully conducting the event.

A memento was presented to the Chief Guest and the Keynote Speaker as a token of gratitude and appreciation for their valuable presence and contribution to the event.

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Day 1, Session - II (Timing: 11:15 Hrs – 13:00 Hrs)

Panel Discussion: Ist

Topic: Powering India's Gas-Based Future: Innovation Pathways towards a Secure, Affordable & 15% Gas Economy

Panel Moderator: Shri M V Iyer, Former Director (Business Development), GAIL (India) Limited

Panellists:

1. **Shri Ashu Shinghal, CEO, GAIL Gas Limited**
2. **Shri Mohit Bhatia, Director Commercial, IGL**
3. **Shri P K Agrawal, ED(Trg), GAIL & Chairman, CUGL**
4. **Shri Gyanendra Kumar Sharma, CGM & President (MARKETING), Petronet LNG Limited**

Introduction of the Panel Moderator: Shri M V Iyer, Former Director (BD), GAIL

Shri M V Iyer, an Electrical Engineer, has over 36 years of extensive experience in the Natural Gas sector across Project Execution, Operations, and Maintenance.

He has led projects worth over ₹40,000 crores spanning 16 states and 150 districts, including several CGD initiatives. Having joined GAIL in 1986, he was part of the pioneering team for the HVJ Pipeline and has driven key diversification projects such as the Dabhol LNG Terminal and renewable energy ventures.

He is former Director (Business Development), GAIL also held additional charge as Chairman & Managing Director and Director (Marketing), GAIL (India) Ltd. and served as Chairman of GAIL Gas Ltd., MGL, KLL, and other subsidiaries, besides being on the Boards of Petronet LNG Ltd., China Gas Holdings Ltd., and ONGC Tripura Power Company Ltd.

Shri Iyer Initiated the discussion by introducing all the panelists, the bios of all the panelists are as follows:-

Shri Ashu Shinghal, CEO, GAIL Gas Ltd

Shri Ashu Shinghal is a Mechanical Engineering graduate from NIT Silchar and holds an MBA in Operations Management, having more than 35 years of multifarious experience in the Hydrocarbon and Energy sector, encompassing its Technical and Managerial aspects such as corporate strategy, risk management, and the execution of large-scale projects including cross-country Natural Gas Pipelines, Petrochemicals, LNG, and City Gas Distribution (CGD).

Presently, he is the Chief Executive Officer (CEO) of GAIL Gas Limited, leading the expansion of the company's City Gas distribution network and clean energy infrastructure initiatives across India. He is also the former Managing Director of Mahanagar Gas Limited (MGL) & Executive Director at GAIL (India) Limited. Additionally, he has held key board positions, including Chairman of Mahanagar LNG Private Limited and Director at ONGC Petro Additions Limited (OPaL) and Talcher Fertilisers Limited.

He has been actively involved in natural gas advocacy and stakeholder engagement, having had extensive participation as a speaker in several National Conferences, such as India Energy Week, to promote compressed biogas (CBG) and the transition to a sustainable, low-carbon energy future.

Shri Mohit Bhatia, Director (Commercial), IGL

Shri Mohit Bhatia is a Civil Engineering Graduate and an MBA from the S.P. Jain Institute of Management & Research, Mumbai. He has over 32 years of diverse experience in the Oil & Gas sector covering Operations, Engineering, and Marketing.

During his tenure with Bharat Petroleum Corporation Limited, he held key roles including State Retail Head (Punjab, Chandigarh & Jammu & Kashmir) and Territory Manager (LPG) at New Mumbai. Before joining IGL, he served as Chief Executive Officer, Haridwar Natural Gas Pvt. Ltd.

Shri Bhatia has been instrumental in driving business growth and operational excellence in oil, LPG, and natural gas marketing, contributing significantly to India's downstream energy sector.

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Shri PRAVEER KUMAR AGRAWAL, Executive Director(Training) GAIL and Chairman, CUGL

Shri Praveer Kumar Agrawal is Executive Director(Training), GAIL (India) Limited. He has more than three decades of distinguished experience in the Natural Gas and Energy Sector. He has successfully led several strategic initiatives and played a pivotal role in the execution and commissioning of major projects across Natural Gas Marketing, Domestic Gas, City Gas Distribution (CGD), Joint Ventures, Transmission, and Instrumentation & Control.

He is also the Chairman of Central U.P. Gas Limited (CUGL), while also leading GAIL's Learning & Development initiatives through the GAIL Training Institute, driving capability building and AI-enabled workforce transformation. An alumnus of IIT Kanpur and IIT Delhi, he also holds an MBA in Marketing Management.

Shri Agrawal has served as a Guest Faculty at IIT Delhi and is widely respected for his contributions to technical excellence, leadership development, and innovation in India's gas sector.

Shri Gyanendra Kumar Sharma, CGM & President (Marketing), Petronet LNG

Shri Gyanendra Kumar Sharma is a seasoned energy professional with nearly three decades of experience in natural gas marketing, LNG, city gas distribution, and business development. As Group General Manager & President (Marketing) at Petronet LNG Limited, he leads the company's marketing function, driving LNG/RLNG business growth, strategic partnerships, and customer engagement. He also serves as the Chief of Corporate Ethics at the company.

Before joining Petronet LNG in 2019, Shri Sharma held key leadership positions at Mahanagar Gas Limited and GAIL (India) Limited, contributing significantly to gas marketing and the expansion of city gas distribution.

He holds a Bachelor's degree in Mechanical Engineering, an MBA in Petroleum Management, and has completed an Executive Leadership Program at Columbia Business School. A multiple gold medalist, he is widely recognized for his strategic leadership and deep expertise in India's natural gas sector.

Leadership Panel Discussion – Key Highlights

The Leadership Panel Discussion provided an insightful perspective on the pathways available for accelerating the growth of natural gas in India and moving towards the national objective of increasing the share of natural gas in the primary energy mix to **15%**. The discussion brought together senior industry leaders who examined the issue from multiple dimensions, including demand creation, infrastructure development, LNG, CGD, technology, hydrogen, environmental benefits, affordability, energy security and policy reforms.

Moderator – Shri M. V. Iyer

Shri M. V. Iyer Ji moderated the discussion and structured the deliberations around the key question of how India can accelerate Natural Gas consumption and move closer to the **15% energy-mix target**. He invited the panelists to identify their top priorities and practical interventions for increasing gas demand and creating an enabling ecosystem.

The discussion under his moderation covered both **supply-side and demand-side considerations**, including infrastructure availability, gas sourcing, CGD expansion, LNG adoption, technology and emerging fuels. He specifically sought the panelists' views on making LNG more acceptable and affordable, the role of technology in improving efficiency and enabling new applications, the readiness of infrastructure for hydrogen, and the single most important policy intervention required to accelerate growth.

Through his focused questions, Shri Iyer ensured that the discussion moved beyond broad aspirations and addressed practical issues such as **affordability, access, infrastructure, commercial viability, taxation and regulatory support**. He concluded the session by highlighting the diverse perspectives shared by the panel and the potential for collective industry action to promote natural gas and emerging clean-energy solutions.

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Shri Ashu Shinghal

Shri Ashu Shinghal emphasized that natural gas should be viewed not merely as a short-term transition fuel but as an important component of India's energy mix for the coming decades. He observed that natural gas is likely to **coexist with other fossil and renewable energy sources** as India gradually transitions towards a cleaner energy system.

He highlighted the substantial growth potential of India's gas market and noted the important role being played by the **CGD sector** in driving natural gas consumption. According to him, the continued expansion of CGD and the growing penetration of natural gas across different geographical areas can make a significant contribution to the country's overall gas demand.

Shri Shinghal also emphasized the importance of **infrastructure development and diversified gas sourcing** to support the anticipated growth in demand. With increasing dependence on international gas supplies, diversification of sourcing from different geographical regions will be important for strengthening India's energy security and reducing exposure to geopolitical uncertainties.

A significant part of his intervention focused on **hydrogen as a future energy carrier**. He described hydrogen as particularly relevant for hard-to-abate applications and for converting surplus renewable electricity into an energy molecule that can be transported and utilized where direct transmission of electricity may not be feasible. However, he identified several challenges, including the high cost of hydrogen production, substantial water requirements, transportation issues and the need for greater commercial viability.

He suggested that existing gas pipeline infrastructure could potentially support **hydrogen blending and transportation**, while hydrogen could find applications in areas such as green ammonia, refineries and heavy transportation. He also noted that the future transport-energy landscape is likely to comprise a mix of fuels, with LNG, CNG, hydrogen and electricity each having roles depending on the application.

On policy, Shri Shinghal strongly advocated **tax rationalization** and bringing natural gas under GST. He pointed out that varying tax structures across states can create distortions and make natural gas less competitive against other fuels. He also stressed the importance of assessing competing fuels on the basis of their **overall lifecycle environmental impact**, rather than providing disproportionate policy advantages to any particular fuel.

Shri Mohit Bhatia

Shri Mohit Bhatia approached the issue primarily from the perspective of **infrastructure readiness, last-mile connectivity and supply security**. He highlighted that although India has created a substantial natural gas pipeline network, a significant portion of the infrastructure is yet to become operational. He stressed that the priority should therefore be to connect and operationalize the existing network so that gas can reach consumers across the country.

He particularly highlighted the challenge of **last-mile connectivity and evacuation infrastructure**, which can limit the utilization of available gas and regasification capacity. In his view, infrastructure development must go beyond laying pipelines and should focus on ensuring effective connectivity between supply sources and end consumers.

From the CGD perspective, Shri Bhatia noted that a number of geographical areas are still dependent on virtual or non-pipeline modes of gas supply. Accelerating physical connectivity to these areas would help expand the reach of natural gas and support sustained growth in CGD consumption.

He also stressed the importance of **diversification of gas sourcing**. In view of international geopolitical developments and supply uncertainties, he advocated sourcing natural gas from a wider range of geographical regions rather than relying excessively on any single source or region. Such diversification would strengthen India's resilience and improve the security of supply.

Responding to the question on policy intervention, Shri Bhatia proposed the development of a **uniform, nationwide CGD policy**. He observed that different states currently have different mechanisms and policies relating to CGD, resulting in variations in permissions and regulatory processes. A comprehensive national policy, supported by **single-window clearances and uniform mechanisms**, could significantly facilitate faster project implementation.

He further supported the need for tax reforms and a more consistent policy framework to enable the CGD sector to grow efficiently and contribute more substantially to India's natural gas demand.

Shri Praveer Kumar Agrawal

Shri Praveer Kumar Agrawal focused on the **demand-side opportunities** available for increasing natural gas consumption. While recognizing the importance of infrastructure and supply diversification, he emphasized that achieving the 15% target would ultimately depend on identifying and developing sectors capable of absorbing significantly larger volumes of natural gas.

He identified **CGD as one of the strongest growth drivers**, given its continuing expansion and increasing penetration across the country. With a growing number of geographical areas authorized for CGD and expanding consumer and CNG infrastructure, he expressed confidence that this segment could continue to contribute significantly to demand growth.

He also highlighted the **power sector as an important but underutilized opportunity**. Despite India's considerable gas-based power generation capacity, actual gas consumption by the sector remains relatively low. He suggested that greater attention needs to be given to the economic viability of gas-based power and to the environmental benefits of using natural gas in comparison with more polluting fuels.

Other sectors identified by him included **industrial and commercial consumers, refineries, petrochemicals and fertilizers**. He observed that while some sectors already consume substantial quantities of gas, others face economic and commercial challenges that restrict wider adoption. Appropriate policy support and improved economics could encourage greater fuel switching and create additional demand.

Shri Agrawal also presented a forward-looking view of the gas infrastructure as a **platform for multiple green molecules**. He envisaged natural gas pipelines progressively carrying or integrating green molecules such as biogas and, potentially, green hydrogen. In this context, he stressed the need for India to develop its own technological capabilities.

He pointed out that several technologies associated with **biogas, hydrogen production, LNG trucking and related equipment** continue to depend significantly on overseas technology. Strengthening domestic R&D and developing indigenous solutions would improve efficiency, reduce technology dependence and help India accelerate its transition towards a cleaner and more diversified energy system.

Shri Gyanendra Sharma

Shri Gyanendra Sharma brought a strong **commercial and consumer-oriented perspective** to the discussion. He identified the conversion of heavy-duty transportation from diesel to **LNG** as one of the most immediate opportunities for increasing natural gas consumption.

He highlighted the very large volume of diesel currently consumed by the transport sector, particularly heavy-duty trucking, and suggested that LNG could provide a commercially attractive alternative for a significant part of this segment. He stressed that environmental considerations alone would not be sufficient to drive such a transition; the proposition must also deliver **clear economic benefits to consumers and fleet operators**.

He therefore emphasized the need to create a complete LNG trucking ecosystem comprising vehicles, fuelling infrastructure, supply availability and consumer confidence. Once the required infrastructure is established, he suggested, the adoption of LNG trucks could accelerate significantly.

Shri Sharma also highlighted the wider economic benefits of LNG-based transportation, including reduced dependence on imported liquid fuels, benefits to ports and LNG infrastructure, business opportunities for marketers and savings for fleet operators. He stressed that the transition should be commercially sustainable across the entire value chain.

Another important opportunity identified by him was the development of an **East–West LNG corridor and LNG bunkering ecosystem** along India's extensive coastline. India's geographical position and maritime activity, according to him, create an opportunity for the country to emerge as a hub for LNG fuelling and bunkering.

He strongly advocated bringing natural gas under **GST**, noting that the existing tax structure can make gas less competitive compared with alternative fuels. His central message was that environmental benefits can be realized sustainably only when the underlying business model is commercially viable and attractive to all stakeholders.

On LNG affordability and supply security, Shri Sharma stressed the importance of **long-term LNG contracts** and stable, predictable supplies. He pointed out that geopolitical events can cause significant fluctuations in international LNG prices and that long-term arrangements can provide greater stability. He also called for coordinated efforts across the industry to develop a robust ecosystem capable of meeting the energy requirements of India's growing economy.

Major Takeaways from the Panel Discussion

The deliberations brought out a number of important areas requiring coordinated action to accelerate India's natural gas journey:

1. **Infrastructure and Connectivity:** Existing pipeline infrastructure needs to be fully operationalized, with greater emphasis on last-mile connectivity, evacuation facilities and effective utilization of available infrastructure.
2. **Demand Creation:** CGD will remain a major growth engine, while significant opportunities exist in power generation, industrial and commercial applications, refineries, petrochemicals, fertilizers and transportation.
3. **LNG for Heavy Transport:** LNG-based heavy-duty trucking was identified as an important near-term opportunity, provided a commercially viable ecosystem of vehicles, fueling infrastructure and supply is established.
4. **Supply Security:** Diversification of LNG sourcing across geographies and greater reliance on long-term contracts can help mitigate geopolitical and price-related uncertainties.
5. **Technology and Indigenous R&D:** India needs to strengthen domestic capabilities in biogas, green hydrogen, LNG systems, cryogenic equipment and related technologies to reduce dependence on imported solutions.
6. **Integration of Green Molecules:** The future gas ecosystem could progressively integrate **CBG/biogas and green hydrogen** with natural gas, supporting a more diversified and lower-carbon energy system.
7. **Hydrogen Readiness:** Hydrogen has significant long-term potential, particularly in hard-to-abate sectors, heavy transportation, refineries and green ammonia. However, cost, water availability, transportation and infrastructure requirements need to be addressed.
8. **Tax and Policy Reform:** A recurring theme across the discussion was the need for **tax rationalization and bringing natural gas under GST** to improve its competitiveness and remove distortions between different fuels.
9. **Uniform CGD Policy:** A nationwide CGD framework with uniform procedures and single-window clearances could facilitate faster development of CGD infrastructure and reduce state-level regulatory variations.
10. **Commercial Viability:** The panel repeatedly emphasized that environmental benefits must be supported by **sound economics and commercial viability**. Consumers and businesses will adopt cleaner fuels at scale when they are affordable, accessible and commercially competitive.

Conclusion

The Leadership Panel provided a comprehensive and forward-looking perspective on India's natural gas sector. The discussion established that achieving a higher share of natural gas in the energy mix will require more than supply augmentation alone. It will depend on the **simultaneous development of infrastructure, demand, technology, affordability, supply security and a supportive policy framework**.

The panelists broadly converged on the need for an integrated energy approach in which natural gas continues to play an important role while progressively incorporating **CBG, biogas, hydrogen and renewable energy**. Stronger collaboration among government, regulators, gas companies, technology providers and consumers will be essential to create the ecosystem required for accelerated growth.

The session concluded with a clear message that India possesses significant opportunities to expand natural gas consumption, but **policy enablement, infrastructure connectivity, technology innovation, indigenous R&D and commercial competitiveness** will be the key enablers for translating this potential into sustained growth and moving progressively towards the national 15% natural gas target.

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A memento was presented to the Panel Moderator and all the Panelist as a token of gratitude and appreciation for their valuable presence and contribution to the event.

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Day–1 | Session–III (13:45 Hrs – 15:45 Hrs)

Technical Session (Presentations): Ist

Theme: Innovations in Pipeline Integrity, Leak Detection, Compressor Reliability & Energy Optimization

Session Chair: Shri Rajiv Sikka, Former CEO IOAGPL

Shri Rajiv Sikka is a passionate start-up mentor, active blogger, and seasoned industry expert with over 32 years of rich experience in retail management, sales operations, and project management.

His career spans leadership roles at Bharat Petroleum Corporation Limited, Indraprastha Gas Limited, and Indian Oil Adani Gas Private Limited, where he successfully opened new markets, standardized sales operations, and delivered strong business growth.

Mr. Sikka is recognized as a master strategist, repeatedly securing accolades as a winner of BPCL's IDEAS award for his innovative contributions.

His blend of extensive industry knowledge, entrepreneurial spirit, and forward-thinking approach makes him a valued guide for growing ventures and companies navigating their path toward sustained success.

Shri Sikka chaired the Technical Session having five Presentations by seven speakers.

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Session: Day-1, Session-III – Technical Session-I

Ist Presentation Topic: **Digital Innovations in Pipeline Integrity Management: AI, Smart Technologies & Predictive Asset Reliability**

Speaker: Shri Mohammad Amid, **Manager (Inspection), Indian Oil Corporation Ltd.**

Presentation Brief:

The presentation focused on the application of **Artificial Intelligence (AI), smart technologies and predictive analytics** to strengthen pipeline integrity management and enhance the safety, reliability and performance of pipeline assets. It emphasized the transition from conventional reactive practices towards **predictive and eventually autonomous integrity management**.

Challenges and Digital Integrity Ecosystem

Conventional pipeline integrity management faces challenges such as **ageing infrastructure, corrosion, dents and cracks, fragmented data, manual assessment processes, extensive historical records and difficulties in predicting future degradation**. These challenges highlight the need for an integrated digital ecosystem that converts inspection, operational and historical data into actionable engineering intelligence.

The proposed framework integrates technologies such as **SCADA, cathodic protection monitoring, Inline Inspection (ILI), leak detection systems, PIMS, drone inspection, GIS and AI-based analytics**. Together, these systems support real-time monitoring, centralised data management, risk assessment and improved maintenance and repair decisions.

AI-Based ILI and Corrosion Growth Assessment

ILI plays a vital role in assessing pipeline condition, identifying defects and monitoring corrosion growth through comparison of successive inspection runs. The presentation proposed replacing conventional rule-based defect matching with **AI-based defect correlation**, using multi-parameter similarity analysis and validated feedback to improve accuracy.

The presentation also highlighted the limitations of applying a single corrosion growth rate across an entire pipeline section. AI and ML-based models can support **location-specific corrosion prediction** by incorporating factors such as coating condition, AC interference, soil characteristics and elevation. This enables improved **Remaining Useful Life estimation, repair prioritization and inspection planning.**

AI-Enhanced Dent Assessment

ILI can identify geometrical anomalies such as **dents, ovality, wrinkles and buckles**, which may be subjected to fatigue due to pipeline pressure fluctuations. The presentation discussed the use of **Rain flow Counting** to convert pressure histories into fatigue cycles and assess dent fatigue life.

AI can improve this process by optimizing filtering and binning parameters, identifying representative pressure cycles and improving the consistency of **Spectrum Severity Index (SSI)** calculations. This can lead to more reliable dent fatigue-life prediction and better repair prioritization.

Satellite-Based Washout Prediction

The presentation also demonstrated the use of **satellite imagery and Global Surface Water (GSW) datasets** to identify potential pipeline washout risks caused by river migration, flooding and soil erosion. Such conditions can expose pipelines, create free spans and reduce soil support.

By overlaying pipeline GIS alignment with satellite-based water datasets, operators can monitor changes in **water extent, occurrence, recurrence, seasonality and water transitions**. This provides an early-warning mechanism for identifying vulnerable river crossings and planning preventive interventions, compared with conventional periodic field inspections.

Key Takeaways and Conclusion

The presentation demonstrated that the integration of **AI, ILI, GIS, satellite intelligence, SCADA and predictive engineering models** can significantly strengthen pipeline integrity management. Key benefits include:

1. Improved **ILI defect matching and corrosion growth assessment**;
2. Location-specific prediction of **corrosion and remaining useful life**;
3. Enhanced **dent fatigue assessment and repair prioritisation**;
4. Proactive identification of **washout-prone pipeline locations**; and
5. Development of an integrated digital ecosystem for improved engineering decisions.

Overall, the presentation highlighted a clear pathway for the industry to move from **reactive → preventive → predic ve → autonomous integrity management**. The integration of AI, smart inspection technologies and satellite intelligence has significant potential to improve pipeline safety, reliability and long-term asset performance.

Session: **Day-1, Session-III – Technical Session-I**

IInd Presentation Topic: **Next-Gen. Mobile Leak Detection for Safer & Smarter Urban Gas Networks**

Speaker: **Shri Dilip Kumar Martha, GM–O&M, Mahanagar Gas Limited (MGL)**

Summary of the Presentation

The presentation highlighted Mahanagar Gas Limited's approach towards strengthening leak detection and pipeline safety through **next-generation mobile leak detection technologies** and the use of digital intelligence for faster identification and resolution of gas leaks.

MGL presented an overview of its extensive CGD network and operational assets, covering **three geographical areas—Mumbai, Thane and Raigad**, with approximately **623.92 km of steel pipeline network and 6,781.32 km of low- and medium-pressure network**, supported by city gate stations, CNG stations, service regulators and valve chambers. The scale of the network underlined the importance of efficient, rapid and technology-enabled leak detection and risk prioritization.

The presentation emphasized the need for **rapid hazard classification** as an important operational requirement. Early identification and classification of hazardous locations can help in reducing gas losses, preventing avoidable revenue losses, maintaining monitoring and inspection records for compliance, and prioritizing high-risk locations, particularly in ageing pipeline assets. The underlying approach was summarized around the principle of **classifying risks quickly and acting first on the highest-risk locations**.

A key technology discussed was **Advanced Mobile Leak Detection (AMLD)**. The presentation explained the use of laser-based methane detection, wherein gas from the surrounding environment is drawn into an analyzer and methane molecules absorb laser light at a specific wavelength. The resulting change in the laser signal is measured to determine methane concentration, enabling the detection of very small natural gas leaks while the detection system is in motion.

The presentation further demonstrated the transition from conventional field inspection towards **digital intelligence and real-time data analysis**. Gas readings collected during field surveys can be captured, mapped and analyzed in real time, enabling faster identification, tracking and resolution of leakage indications.

The leakage data presented included parameters such as **geographical coordinates, source type, methane and ethane concentration peaks, baseline methane concentration, indication duration, wind speed and vehicle speed**. Such data provides a basis for analyzing leakage indications and supporting subsequent field investigation and corrective action.

Key Takeaways

- Mobile and laser-based technologies can enhance the speed and sensitivity of natural gas leak detection.
- Rapid hazard classification enables operators to prioritize high-risk locations and undertake timely corrective action.
- Integration of field survey data with digital mapping and real-time analytics can improve leak tracking and resolution.
- Data-driven leak detection can support pipeline integrity, operational efficiency, regulatory compliance and reduction of gas losses.
- The approach demonstrates the increasing role of **digital technologies and intelligent field data** in managing large urban CGD networks.

Conclusion

The presentation demonstrated how MGL is leveraging **mobile leak detection, laser-based methane sensing and digital data analysis** to move towards a faster and more intelligence-driven approach to gas pipeline surveillance. The integration of real-time field data with risk classification and location-based analysis offers significant potential for improving **urban gas network safety, pipeline integrity and operational responsiveness**. The presentation was well aligned with the conclave's broader objective of promoting innovation and operational excellence in natural gas infrastructure.

Session: Day-1, Session-III – Technical Session-I

IIIrd Presentation Topic**: Innovations in Pipeline Integrity Management**

Speaker: **Shri Rohit Malhotra, CM (CO O&M), GAIL & Shri Subhadeep Debnath, CM (CIMG), GAIL**

Summary of the Presentation

The presentation highlighted GAIL's technology-driven initiatives for strengthening **pipeline integrity, leak detection and Right-of-Way (RoW) surveillance**. The key innovations discussed were **modelling-based leak detection, Pipeline Intrusion Detection System (PIDS), and drone-based aerial RoW surveys**.

Modelling-Based Leak Detection

The presentation discussed the implementation of **Real-Time Transient Modelling (RTTM)-based Computational Pipeline Monitoring (CPM)** software for providing real-time alerts related to potential pipeline leaks. The system utilizes operational parameters captured through SCADA, particularly **pressure, temperature and flow variations**, to identify abnormal operating conditions that may indicate leakage.

The system provides continuous monitoring under both steady-state and transient operating conditions and supports **alarm generation with operator guidance**, pipeline inventory and line-pack calculations, as well as event replay and historical analysis for incident investigation.

The technology offers several operational benefits, including **early detection of both small and large leaks, reduction in product losses and environmental impact, improved pipeline safety and regulatory compliance, fewer false alarms and faster decision-making during pipeline emergencies**.

Pipeline Intrusion Detection System (PIDS)

A major focus of the presentation was the **Pipeline Intrusion Detection System (PIDS)**, designed to detect and provide alerts against unauthorized activities near the pipeline Right-of-Way. These activities may include excavation, drilling, theft attempts, sabotage and other forms of human intrusion that could threaten pipeline infrastructure.

PIDS provides **real-time intrusion detection and instant alarms**, precise location identification through GPS coordinates, and the potential for integration with **SCADA, CCTV, GIS and security control rooms**. The presentation also highlighted the possibility of improving system reliability through the adoption of AI/ML algorithms.

The system can identify a wide range of activities, including manual and mechanical excavation, tunnelling, vehicle and human movement, HDD/boring/piling, road construction, grading, pigging activities and other distinctive acoustic patterns.An important advantage of PIDS is its ability to provide **early warning of third-party intrusion**, allowing maintenance and security teams to respond before an excavation or other activity causes pipeline damage. This can help prevent pipeline rupture, gas releases, repair costs and associated liabilities.

Additional Leak Detection Capability through DAS

The presentation further highlighted an additional capability of the same fibre-optic infrastructure using

Distributed Acoustic Sensing (DAS) technology. The system can potentially identify pipeline leaks based on physical characteristics such as changes in **noise, pressure, temperature and ground strain**.

According to the presentation, the fibre-optic cable can detect a leak within an approximate **1–2 metre radius** of the leak point, while the system can allocate the leakage source to within approximately **±20 metres of the actual location**. Detection algorithms may utilise minimum-orifice noise, negative pressure pulse or strain-change characteristics.

Aerial RoW Survey Using Drones

The third major innovation discussed was the use of **drones for aerial surveillance and change detection along pipeline corridors**. The presentation highlighted GAIL's implementation of a central contract for quarterly drone-based change detection surveys across pipeline corridors.

The drone surveys provide **high-resolution imagery of approximately 5 cm Ground Sample Distance (GSD)**, with flights conducted up to 120 metres above ground and imagery covering approximately 70 metres width of the pipeline corridor. The initiative covers around **12,000 km of pipeline corridor in green-zone areas**. The captured imagery is stored in cloud infrastructure and published in Web Map Service (WMS) format for integration with GAIL's PGIS application based on the ESRI platform.

The presentation identified several changes and activities that require immediate attention through drone surveillance. These include **pipeline exposure, erosion, landslides, washouts, removal of earth cover, new structures, wells, ponds, fencing, changes in river width or proximity to water bodies, heavy machinery movement, new development, quarrying/mining, trenching, pipeline laying and HDD activities**.

The presentation also referred to the regulatory framework governing drone operations, including the **Drone Rules, 2021**, categorization of airspace and the Digital Sky platform.

Key Takeaways

- **RTTM-based CPM** can provide continuous, real-time monitoring of pipeline operating conditions and early identification of potential leaks.
- **PIDS** strengthens pipeline integrity by providing early warning against third-party activities and unauthorised intrusion along the RoW.
- **DAS-based technology** can provide an additional mechanism for detecting and locating pipeline leakage.
- **Drone-based RoW surveillance** enables systematic, high-resolution monitoring of large pipeline corridors and identification of changes requiring timely intervention.
- Integration of **SCADA, GIS, CCTV, fibre-optic sensing, drones and digital platforms** can significantly enhance the overall pipeline integrity management framework.

The combined approach supports a shift from reactive maintenance towards **proactive, technology-enabled risk identification and preventive action**.

Conclusion

The presentation demonstrated how emerging technologies can be integrated into pipeline integrity management to improve **leak detection, third-party intrusion prevention and RoW monitoring**. The combination of real-time computational monitoring, PIDS/DAS-based fibre sensing and drone-enabled aerial surveillance provides a multi-layered approach to identifying potential threats before they develop into major pipeline incidents.

The initiatives presented by GAIL reflect the growing role of **digitalisation, sensing technologies, automation and aerial surveillance** in enhancing the safety, reliability and integrity of natural gas transmission infrastructure.

IVth Presentation :

Session: Day-1, Session-III – Technical Session-I

IVth Presentation Topic: **Innovations in Centrifugal Compressor Management: AI-Driven Performance Optimization, Reliability & Predictive Maintenance**

Speaker: Shri Shashi Shekhar & Shri Anmol Kumar Mishra,
GAIL (India) Limited

Presentation Summary

The presentation focused on the critical role of **centrifugal compressors in the natural gas industry** and explored the application of **Artificial Intelligence (AI), advanced analytics and predictive maintenance** to improve compressor reliability, availability, performance and asset life. It covered compressor fundamentals, major failure modes, dry gas seal innovations and the transition towards AI-driven asset management.

Role and Importance of Compressors

Compressors were described as the **backbone of the natural gas industry**, with applications in gas gathering, processing, pipeline transmission, LNG plants, petrochemical and fertilizer facilities, and gas storage. Compressor stations in transmission pipelines maintain the required operating pressure by compensating for pressure losses.

Various compressor technologies, including centrifugal, reciprocating, screw and axial compressors, were discussed. **Centrifugal compressors** were particularly highlighted for their suitability for high-flow, continuous-operation applications with relatively low maintenance requirements.

Compressor Components and Dry Gas Seal Technology

The presentation reviewed key compressor components, including the **rotor, impellers, journal and thrust bearings, vibration monitoring systems and lubrication arrangements**.

Special emphasis was placed on **Dry Gas Seal (DGS) technology**, including an improved coaxial seal arrangement designed to reduce nitrogen consumption and emissions while improving seal life and reliability. Such advanced sealing systems can reduce leakage, minimise barrier-gas requirements and lower maintenance needs.

Performance Monitoring and Reliability Challenges

A case study demonstrated how variations in **inlet and outlet pressures** influence compressor operating conditions and compression ratio. The example reinforced the importance of continuously monitoring process parameters and assessing compressor performance under changing operating conditions.

The presentation identified several important failure mechanisms affecting compressor reliability, including

Dry gas seal damage and gas leakage;

Excessive vibration and rotor instability;

Thrust-bearing damage, particularly during abnormal operating conditions;

Impeller fatigue and cracking;

Compressor surge and flow instability;

Fouling, erosion and corrosion affecting efficiency;

Degradation of **labyrinth seals**; and

Failures of **lubrication, anti-surge, control and instrumentation systems**.

The need for effective vibration monitoring, seal protection, lubrication management and reliable anti-surge and control systems was strongly emphasised.

Transition Towards AI-Driven Maintenance

A major theme of the presentation was the transition from traditional time-based and reactive maintenance towards **condition-based and AI-driven predictive maintenance**.

The proposed digital ecosystem combines **smart sensors, operational dashboards, integrated equipment data platforms, asset-performance management systems and AI-based predictive analytics**. Continuous collection and analysis of equipment data can help identify abnormal behaviour, detect early signs of degradation and predict potential failures before they result in unplanned shutdowns.

AI-Based Performance Optimisation

AI-driven analytics can analyse large volumes of operational and equipment-health data to identify performance trends and anomalies. The proposed asset analytics framework converts real-time data into actionable information for maintenance and operational decision-making.

The presentation also outlined a structured implementation pathway involving:

1. **Equipment health assessment and baseline establishment**;
2. **Installation of smart and IoT-enabled sensors**;
3. **Data collection and integration**;
4. **Development of AI and machine-learning models**;
5. **Digital twin deployment**;
6. **Implementation of predictive maintenance**; and
7. **Continuous performance optimisation**.

This approach provides a progressive pathway from establishing a strong data foundation to developing intelligent and continuously optimised asset management.

Expected Benefits and Key Takeaways

AI-driven compressor management can potentially deliver significant benefits, including reduced **unplanned shutdowns and emergency maintenance**, lower maintenance costs, improved **Mean Time Between Failures (MTBF)**, higher equipment availability and extended asset life. Additional advantages include improved safety, better maintenance planning, optimised spare-parts management and enhanced production availability.

The key message of the presentation was that the integration of **AI, IoT-enabled sensing, advanced analytics and digital twins** can transform centrifugal compressor management by enabling early fault detection, predictive maintenance and continuous performance improvement.

Conclusion

The presentation demonstrated the significant potential of **AI, smart sensing, advanced analytics and predictive maintenance technologies** to improve the reliability and performance of centrifugal compressors. By integrating equipment-health monitoring with operational data and AI-based analysis, operators can progressively move from **reactive maintenance to predictive and proactive asset management**.

Overall, the presentation highlighted the development of an **intelligent, data-driven reliability ecosystem** as the future of centrifugal compressor management, with the potential to enhance safety, availability, maintenance efficiency and asset life across natural gas facilities.

Session: Day-1, Session-III – Technical Session-I

Vth Presentation Topic: **Innovations in Energy Efficiency, Emission Reduction & Sustainable CNG Compressor Operations**

Speaker: **Shri Anbarasan R., Associate Vice President – PGS, Kirloskar Pneumatic Ltd.**

Presentation Summary

The presentation focused on improving the **energy efficiency, environmental performance and sustainability of CNG compressor operations** through compressor optimisation, gas recovery, renewable gas integration, emission reduction measures, waste heat recovery and advanced packing technologies. It emphasised that energy efficiency is not only an environmental objective but also an important strategy for improving the economic performance and profitability of CNG stations.

Energy Efficiency in CNG Compressor Operations

The presentation identified **energy efficiency, gas recovery systems and renewable gas integration** as the three key elements of sustainable CNG compressor operations. Compressor optimisation through **Variable Speed Drives (VSDs)** and appropriate priority-panel adjustments can reduce unnecessary compressor cycling, electricity consumption and equipment wear.

Since compressor motors account for a major share of the operating expenditure of a CNG station, optimisation of compressor operation can provide both **energy savings and improved equipment longevity**.

Gas Recovery and Reduction of Gas Losses

A significant focus was placed on recovering gas that would otherwise be vented during compressor operation, maintenance and pressure-related events. Gas recovery can simultaneously contribute to **methane emission reduction, improved resource utilisation and economic savings** by retaining usable natural gas within the system.

The core recovery measures discussed included:

- **Inlet recycling:** Routing blowdown and relief gas back to the suction side of the primary compressor.
- **Packing leakage capture:** Recovering gas escaping through packing or piston-rod blow-by.
- **Automated valves:** Using PLC-controlled valves to safely manage recovery pathways during standby and purging operations.

Renewable Gas Integration

The presentation highlighted **Renewable Natural Gas (RNG)**, produced by upgrading biogas from organic waste, as an important pathway for reducing the carbon footprint of CNG operations. RNG can serve as a direct substitute for fossil-based CNG without requiring a change in system performance, while also supporting a circular-economy approach by converting methane from organic waste into useful fuel.

Reducing the Carbon Footprint of Existing CNG Stations

For existing CNG stations, the presentation proposed a combination of **emissions auditing, equipment optimisation and retrofitting**. One of the immediate measures recommended was conducting a gas-leak audit using **Optical Gas Imaging (OGI)** to identify fugitive emissions from joints, valves and flanges, followed by prompt repair and sealing of detected leaks.

Compressor efficiency can further be improved through:

- Retrofitting **Variable Speed Drives** to compressor motors.
- Optimising compressor sequencing so that compressors operate according to actual fuelling demand and cascade-storage pressure.
- Regular maintenance of filters and lubrication systems and proper mechanical alignment to prevent unnecessary energy consumption.

Green-by-Design Approach for New CNG Stations

The presentation proposed that new CNG stations should adopt a **"green-by-design" engineering philosophy**, incorporating energy efficiency and emission reduction measures at the design stage rather than relying on costly retrofits later.

Key measures suggested include:

IE4/IE5 high-efficiency motors for compressor drives.

- Integrated **Variable Speed Drives** matched to real-time fuelling demand.
- Direct-fill architecture and appropriately designed cascade storage to reduce intermediate storage losses.
- **Zero-bleed pneumatics** using instrument air or electric actuation instead of natural-gas-powered pneumatic systems.
- Fixed-point laser or acoustic methane detection around compressor skids and storage areas.
- Low-dead-space **dry-break couplings** to minimise gas release during nozzle disconnection.

The presentation also proposed sustainable site infrastructure such as **solar-ready canopies** and provision for **Battery Energy Storage Systems (BESS)** to support renewable power generation and peak-demand management.

Waste Heat Recovery

Another important energy-efficiency opportunity discussed was **waste heat recovery from engine-driven CNG compressor packages**. The presentation identified engine exhaust, jacket water/coolant and lubrication oil as potential sources of recoverable heat.

For a **300 kW engine-driven CNG package**, the presentation indicated that significant thermal energy can potentially be recovered from the exhaust and jacket-water cooling systems. Possible applications include **hot-water/process heating**, while conversion of recovered heat into electricity was identified as technically possible, although with a comparatively long payback period.

Case Study – Reduction of Packing Leakage

The presentation included a case study demonstrating the economic and environmental impact of packing leakage from compressor packages. Conventional packing was shown to have leakage rates that increase significantly as the packing wears. For the example presented, the cumulative gas loss from operating and standby periods was estimated at approximately **52,000 SCM annually**, corresponding to an indicated economic loss of around **₹26 lakh per year** at the assumed gas value.

An advanced packing arrangement was subsequently presented with significantly lower leakage rates. The new packing was reported to operate at **near-zero leakage when new**, with substantially lower leakage even under worn and idle/pressurised conditions compared with conventional segmented ring pairs.

This case study demonstrated that seemingly small sources of gas leakage can have a substantial cumulative impact on **gas conservation, emissions and operating economics**, making packing technology an important area for improvement.

Three Pillars for Future CNG Compressor Operations

The presentation identified three major areas for the future of CNG compressor operations:

1. **Smart Automation**
2. **Renewable Gas Integration**
3. **Energy Efficiency**

Together, these pillars provide a pathway towards more efficient, lower-emission and future-ready CNG infrastructure.

Key Takeaways

- Energy efficiency in CNG stations can simultaneously improve **environmental performance and operating profitability**.
- VSDs, compressor sequencing and preventive maintenance can reduce electricity consumption and unnecessary equipment cycling.
- Gas recovery systems can minimise methane losses while recovering valuable fuel.
- RNG integration provides an opportunity to reduce the carbon footprint of CNG operations.
- Existing stations can reduce emissions through **leak audits, OGI-based detection, equipment optimisation and retrofits**.

- New CNG stations can incorporate sustainability from the outset through **high-efficiency motors, VSDs, zero-bleed systems, methane monitoring, dry-break couplings, solar-ready infrastructure and BESS provisions**.
- Waste heat recovery provides an additional opportunity to utilise thermal energy that would otherwise be rejected.
- Advanced packing technology can significantly reduce fugitive gas losses and associated economic losses.

Conclusion

The presentation demonstrated that sustainable CNG compressor operations require an integrated approach combining **energy efficiency, gas conservation, emission reduction, renewable energy integration and smart automation**. The examples and case study showed that sustainability initiatives can also deliver tangible operational and economic benefits.

Overall, the presentation provided a practical roadmap for transitioning CNG stations towards **lower energy consumption, reduced methane emissions, improved equipment efficiency and greater operational sustainability**, while highlighting the importance of incorporating these principles into both existing-station retrofits and the design of new CNG infrastructure.

A memento as a token of gratitude was presented to the session chair & all the speakers. Also a Certificate for appreciation was presented to all the speakers:

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Day–1 | Session–IV (16:00 Hrs – 17:45 Hrs)

Technical Session (Presentations):IInd

Theme: Innovative Business Models & Emerging Opportunities in LNG, Natural Gas and Future Fuels

Session Chair: Shri Praveer Kumar Agrawal, ED(Training), GAIL and Chairman, CUGL

Shri Praveer Kumar Agrawal is Executive Director(Training), GAIL (India) Limited. He has more than three decades of distinguished experience in the Natural Gas and Energy Sector. He has successfully led several strategic initiatives and played a pivotal role in the execution and commissioning of major projects across Natural Gas Marketing, Domestic Gas, City Gas Distribution (CGD), Joint Ventures, Transmission, and Instrumentation & Control.

He is also the Chairman of Central U.P. Gas Limited (CUGL), while also leading GAIL's Learning & Development initiatives through the GAIL Training Institute, driving capability building and AI-enabled workforce transformation. An alumnus of IIT Kanpur and IIT Delhi, he also holds an MBA in Marketing Management.

Shri Agrawal has served as a Guest Faculty at IIT Delhi and is widely respected for his contributions to technical excellence, leadership development, and innovation in India's gas sector.

Shri Agrawal chaired the Technical Session having four Presentations by five speakers.

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Session: Day-1, Session-IV – Technical Session-II

Ist Presentation Topic: **LNG, Hydrogen & Emerging Energy Solutions: Shaping Tomorrow's Energy Landscape**

Speaker: Shri Rajesh Kumar Jha, General Manager (PC-CO), GAIL (India) Ltd.

Presentation Brief:

The technical presentation provided an overview of the emerging opportunities in **Small Scale LNG (SSLNG), hydrogen and other clean-energy solutions**, highlighting their potential contribution to India's transition towards a cleaner, more diversified and future-ready energy system. The presentation particularly focused on GAIL's initiatives in SSLNG and hydrogen and their alignment with the broader national objective of enhancing the role of natural gas in India's energy mix.

The presentation began by highlighting the importance of **energy self-sufficiency and clean-energy innovation** in achieving the objectives of *Atmanirbhar Bharat*. In this context, SSLNG was presented as an important technology for extending the reach of natural gas to consumers and locations where conventional pipeline connectivity is not readily available. The initiative is aligned with the broader objective of increasing the share of natural gas in India's primary energy mix from approximately **6.5% to 15% by 2030**, thereby contributing to energy security and a cleaner energy transition.

Small Scale LNG – Expanding Access to Natural Gas

A significant portion of the presentation was devoted to **Small Scale LNG (SSLNG)**. SSLNG provides an alternative means of supplying natural gas to **remote industries, commercial consumers and the transportation sector that are not connected to the natural gas pipeline network**. GAIL's SSLNG plant at **Vijaipur, Madhya Pradesh**, was highlighted as a pioneering initiative and was described as the first of its kind in India.

The presentation also highlighted the potential of SSLNG to support the **transportation sector**, particularly heavy-duty vehicles. LNG can provide a longer driving range and an economical fuel option for high-horsepower applications. The LNG dispensing station associated with the project has a **56 kL storage tank**, maximum dispensing capacity of approximately **20 MT/day**, and refuelling capability of around **50–60 trucks per day**.
An interesting dimension discussed was the integration of **Compressed Biogas (CBG)** with the LNG ecosystem. The presentation referred to an SSLNG unit installed at the **Punjab Verbio CBG plant**, which converts CBG into LNG for transportation to the nearest natural gas/pipeline network. This illustrates how renewable gas sources can potentially be integrated with LNG infrastructure and transported economically to locations where direct pipeline connectivity may be challenging.

LNG Liquefaction Technologies

The presentation also provided an overview of different liquefaction technology options, namely **Cascade, Mixed Refrigerant (MR), and Gas Expansion** processes. These technologies were compared in terms of thermodynamic efficiency, equipment complexity, capital cost and suitability for different applications.

The key observation was that **Mixed Refrigerant technology generally provides a practical balance between efficiency, flexibility and cost for large onshore LNG plants**. Cascade technology can offer high efficiency where additional system complexity is justified, while Gas Expansion technology offers a simpler and more compact configuration that is particularly suited to smaller-scale and flexible applications.

SSLNG Plant Configuration and Technology Features

The SSLNG configuration presented comprises **gas pre-treatment, natural-gas liquefaction, LNG storage and LNG truck loading facilities**. The system is designed to receive natural gas at approximately **16–18 barg**, with a standard production capacity of around **18 tonnes/day per module**. Gas pre-treatment involves removal of contaminants such as water and CO_2 through zeolite adsorption. The treated gas then undergoes compression, cooling and expansion to achieve the required LNG conditions.

The modular nature of the SSLNG system was identified as one of its major advantages. The presentation highlighted the **portable, plug-and-play configuration**, with each Cryobox module designed around a 40-foot container footprint. This facilitates transportation and relocation and reduces the infrastructure requirement at the installation site.

Other operational features highlighted included **automatic boil-off gas recovery, rapid cold start-up, easy LNG transfer, high availability and remote monitoring**. The system can reportedly achieve cold start-up to peak production in around 10 minutes, while remote monitoring through a SCADA-based system enables operation with relatively low manpower. These features make modular SSLNG particularly relevant for remote and geographically dispersed applications.

Hydrogen – A Future Energy Carrier

The second major theme of the presentation was **hydrogen as a future fuel**. The presentation discussed GAIL's hydrogen production initiative at the **USAR Petrochemical Complex**, where the reported hydrogen production capacity is approximately **73 TPD**, equivalent to around **24 KTA**. Of this production, up to **49 TPD** can be utilized within the complex, while a minimum of approximately **24 TPD** is indicated as potentially available for sale. The reported hydrogen purity is **99.5 vol.% minimum**.

The presentation outlined several possible pathways for hydrogen offtake and utilization. These included a **dedicated hydrogen pipeline, hydrogen cascade transportation, supply to nearby consumers, ammonia production and hydrogen-based power generation**. This indicates the wide range of applications that could emerge as hydrogen infrastructure and demand develop.

At the same time, the presentation recognized the importance of **regulatory enablement and infrastructure development** for the wider adoption of hydrogen. In particular, the presentation noted the regulatory status concerning cross-country hydrogen pipelines and the need for appropriate frameworks to facilitate transportation and commercial utilization of hydrogen.

Hydrogen-Based Power Generation

The presentation further explored hydrogen as a fuel for power generation by comparing **Gas Turbine Generators (GTG)** and **Solid Oxide Fuel Cells (SOFC)** operating on 100% hydrogen. The comparison indicated that GTGs offer advantages in terms of **lower capital cost, compact footprint and longer major overhaul intervals**, while SOFC technology offers significantly higher electrical efficiency. The presentation indicated an efficiency range of approximately **35–45% for GTGs** compared with **55–65% for SOFCs**, while also highlighting the higher capital cost and stack replacement considerations associated with SOFCs.

Overall Session Takeaways

The presentation provided a comprehensive perspective on how **SSLNG and hydrogen can complement the existing natural gas ecosystem and contribute to India's clean-energy transition**. SSLNG can play an important role in overcoming the limitations of pipeline-based gas distribution by providing a flexible and transportable solution for remote consumers and the heavy-duty transportation sector.

At the same time, the development of **hydrogen production, transportation, offtake and utilization infrastructure** will be important for establishing hydrogen as a future energy carrier. The presentation demonstrated that hydrogen has potential applications not only in industrial consumption but also in **ammonia production and power generation**.

The integration of **CBG, LNG and hydrogen technologies** also points towards an increasingly diversified energy ecosystem in which different fuels and technologies can complement each other depending upon geography, application, infrastructure availability and economics.

In conclusion, the session emphasized that innovation in SSLNG, LNG infrastructure and hydrogen technologies can become important enablers for wider gas accessibility, cleaner mobility, industrial decarbonization and long-term energy security. The initiatives presented by GAIL demonstrate practical steps towards building a more flexible and future-ready energy infrastructure for India.

Session: Day-1, Session-IV – Technical Session-II

IInd Presentation Topic: **Innovations in safe Handling, Storage & Retail outlets for LNG for Heavy-Duty Transport, Mining & Marine Applications for decarburization & zero emission**

Speaker: Shri Shivank Bholanath, Sr Manager(Tech) & Ms. Neha Gupta, Sr Manager(Tech), PLL

Presentation Brief:

1. **Corporate Profile & Infrastructure**

Dahej Terminal: Operational since 2004 with a regasification capacity of 22.5 MMTPA, featuring 3 jetties (handling LNG, Ethane, and Propane) and truck-loading facilities.

Kochi Terminal: Operational since 2013 with a 5 MMTPA regasification capacity, offering LNG reloading, ship cooling (GUCD), and marine bunkering capabilities.

LNG Academy: A dedicated training center providing expert-led, hands-on learning in safety and operational excellence for LNG professionals.

2**. Fundamentals & Economic Viability**

Physical Properties: LNG is natural gas cooled to (-)162^{0}C, reducing its volume by 600 times. It is non-toxic, non-corrosive, and cannot ignite in liquid form.

Financial & Range Advantages:

Running costs are roughly 20% cheaper than diesel.

Eliminates fuel theft/pilferage.

Delivers up to 2.5 times the density of CNG (~600 km range per fill vs. ~250 km for CNG).

3. **Environmental Impact & Policy Alignment**

Decarbonization: Replaces high-emitting heavy-duty vehicles (which make up ~3% of India's road fleet but generate ~45% of road transport emissions).

Emissions Reduction: 50 Volvo FM Gas trucks handed to Delivery: up to 20% lower CO_2, 15–20% better fuel efficiency.

National Goals: Supports India's target to reduce the carbon intensity of its GDP by 45% by 2030 and achieve Net Zero by 2070.

4. **Small-Scale LNG (SSLNG) & Market Applications**

SSLNG uses virtual pipelines (truck tankers) to connect supply hubs directly to diverse end-use markets without relying on fixed pipelines:

Long-Haul Transport: Fleet fueling for heavy-duty trucks.

Industrial Fuel: Reliable energy for manufacturing clusters and MSMEs.

Marine Bunkering: Cleaner marine fuel for inland and coastal vessels, anchored by Cochin Shipyard infrastructure and Kochi terminal upgrades.

Mining Equipment: Powering off-grid, heavy mining machinery.

Remote CGD Networks: Extending City Gas Distribution off the pipeline grid.

Micro-Grids: Distributed power generation for remote facilities.

5. **Ecosystem Ecosystem Readiness & Infrastructure Deployment**

Regulatory Milestones: Pioneered by PLL via amendments to CMV Rules, PESO SMPV rules, and PNGRB T4S guidelines for mobile/containerized dispensing.

Dispensing Network: Over 33 operational auto-LNG stations across India, with 40+ under construction. PLL operates 4 stations in South India (Hosur, Coimbatore, Namakkal, M.K. Hubli) and is rolling out 10 additional stations along key freight corridors (Delhi–Mumbai & Mumbai–Bangalore).

OEM Commercialization:
Production-ready heavy trucks and retrofits are available from major manufacturers including Blue Energy Motors (700+ vehicles deployed), Tata Motors, Volvo, Ashok Leyland, and Eicher

Session: Day-1, Session-IV – Technical Session-II

IIIrd Presentation Topic: **Renewable Energy Integration in CNG Compression – Towards Low Carbon Operations**

Speaker: Shri Pratap Ayarekar, AVP(O&M), Mahanagar Gas Limited (MGL)

Presentation Brief:

The presentation on **"Renewable Energy Integration in CNG Compression: Towards Low Carbon Operations"** highlighted MGL's integrated approach towards **renewable energy adoption, energy efficiency, power-quality improvement, digital energy management, predictive maintenance and sustainability**. The initiatives aim to achieve simultaneous **cost reduction, operational improvement, enhanced asset reliability and reduction in carbon emissions**.

1. MGL's Integrated Energy Strategy

MGL operates a large CNG infrastructure comprising **8 City Gate Stations, more than 400 CNG stations and over 470 compressor packages**, including around 450 motor-driven compressors. With a total electrical load exceeding **50 MW** and significant annual energy expenditure, energy optimization has become an important operational and sustainability priority.

MGL's strategy combines **Green Open Access, solar and wind power, high-efficiency IE3/IE4 motors, power-factor optimization, power-quality management, predictive maintenance and digital monitoring**, thereby creating an integrated framework for energy and sustainability management.

2. Green Open Access

A major initiative presented was MGL's **Green Open Access (GOA)** program for procuring renewable electricity through the State Transmission Utility network. Phase-I commenced in 2026 with **6.5 MW capacity**, supplying renewable power to **26 CNG stations**. The long-term roadmap envisages expansion to **45 MW**, with approximately **10.81 million units of renewable energy annually** from the initial phase.

The initiative provides both economic and environmental benefits, including lower landed electricity costs, reduced tariff fluctuations, and lower carbon footprint. The presentation indicated annual savings of approximately **₹1.57–2.04 crore** from Green Open Access.

3. On-Site Renewable Energy

MGL is also deploying **solar and wind installations** across offices, City Gate Stations and CNG stations. An innovative **Hybrid Thermal Solar Panel** application for HVAC optimization was highlighted. By transferring solar thermal energy to the refrigerant, the system reduces compressor loading and electricity consumption.

The initiative has demonstrated **up to 59.1% reduction in HVAC energy consumption**, with annual savings of up to **₹1.24 lakh**, while also contributing to reduced Scope-2 emissions.

4. Electrification and High-Efficiency Motors

MGL has progressively shifted towards **motor-driven compressors**, which offer lower direct emissions, lower heat losses and higher energy efficiency compared with engine-driven compressors. Modern IE3/IE4 motors with VFDs can achieve efficiency exceeding 90%.

The presentation highlighted the transition from **IE2 motors (93.2% efficiency)** to IE3 (95.8%) and IE4 (96.6%). The IE3 program across five stations delivers approximately **1,92,900 kWh/year energy savings and ₹16 lakh annual savings**, with a 1.6-year payback.

The IE4 program, also implemented at five stations, provides approximately **2,41,935 kWh/year energy savings and ₹21 lakh annual savings**, with a payback period of about two years.

5. Power Quality and Digital Energy Management

MGL has deployed **APFC panels, Static VAR Generators (SVG) and Active Harmonic Filters** to improve power factor, voltage stability and power quality while reducing electrical losses and utility penalties.

The use of **SCADA and ICCC platforms** enables real-time monitoring of compressor-wise energy consumption, operational parameters, alarms, OEM benchmarks and cross-station performance. This supports data-driven decision-making and improved operational control.

6. Predictive and Preventive Maintenance

MGL follows a multi-tier maintenance strategy combining preventive and predictive maintenance. Activities include motor alignment, bearing and switchgear inspection, vibration analysis, insulation testing, specific-power-consumption monitoring and power-quality analysis. The approach aims to maximize equipment availability, extend asset life and maintain safe operations, with reported station uptime of **more than 98%**.

7. Financial and Environmental Benefits

The presentation quantified the combined annual savings from Green Open Access and IE3/IE4 motor programs at approximately **₹1.94–2.41 crore/year**, with more than **4.35 lakh kWh of annual energy savings from the motor programs alone**.

The initiatives also reduce dependence on conventional grid electricity and contribute to lower Scope-2 emissions. The presentation reported approximately **10.91 million units of annual renewable generation/procurement** through Green Open Access and on-site renewable sources.

8. Future Roadmap

MGL plans to scale Green Open Access from the current **6.5 MW towards 20+ MW**, with an ultimate target of **45 MW** renewable capacity. Additional rooftop solar installations, including **100 kW planned for FY 2026–27**, are also envisaged.

On the energy-efficiency front, MGL intends to progressively replace IE2 motors with **IE4 motors** and standardize IE4 for new installations. A five-year plan envisages deployment of **50 IE4 motors**, with estimated annual savings of around ₹4.5 lakh per motor.

Overall Session Takeaway

The presentation demonstrated that **renewable-energy integration, electrification of CNG compression,**

high-efficiency motors, power-quality management, digital monitoring and predictive maintenance can collectively transform CNG operations into a more efficient and lower-carbon system.

MGL's experience shows that sustainability initiatives can deliver **measurable financial returns alongside environmental benefits**. The roadmap from 6.5 MW of renewable power towards a 45 MW portfolio, combined with large-scale IE4 motor deployment, provides a practical pathway for progressively reducing the energy intensity and carbon footprint of CNG operations.

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Session: Day-1, Session-IV – Technical Session-II

IVth Presentation Topic: **Innovations for integration of LNG-CBG-Hydrogen Hubs: A Multi-Fuel Energy Business Model**

Speaker: Shri Ravi Dagar, DGM(BD & CS), Indraprastha Gas Limited (IGL)

Presentation Brief:

Indraprastha Gas Limited (IGL) outlines a multi-fuel energy business model designed to integrate_ Compressed Bio-Gas (CBG), Liquefied Bio-Gas (LBG/Bio-LNG), Hydrogen, E-Methane, and EV charging into unified forecourt hubs. This strategy addresses India's high natural gas import reliance (~51%), decouples heavy commercial vehicles (HCVs) from diesel dominance (~99.9%), and establishes a pathway toward net-zero emissions.

Key Highlights

1. **Indian Gas & CBG Market Potential**

Import Reliance: India currently imports ~51% of its natural gas requirement.

Demand Distribution: Natural gas consumption is 200 MMSCMD, where CGD accounts for 45 MMSCMD (with CNG + DPNG covering ~78% of CGD demand).

Market Outlook: City Gas Distribution (CGD) is projected to account for 29% of natural gas demand by 2030 and 44% by 2040. CBG has an estimated national potential of ~60 MMT (~200 MMSCMD) to bridge current supply shortfalls (~52%).

Policy Initiatives: Driven by government schemes like the CBG Blending Obligation (CBO: scaling from 1% in FY26 to 5% by FY29), Biomass Aggregation Machinery (BAM), and Pipeline Infrastructure Development (DPI).

2. **Heavy-Duty Commercial Vehicle (HCV) & LBG Transition:** Fleet Baseline: India operates ~3.5 million heavy trucks consumed by 75–80 million tons of diesel annually.

Liquefied Bio-Methane (LBG): Provides 2.34× the mass energy density of compressed Bio-CNG (424.12 kg/m3 vs 181.27 kg/m3), enabling long-haul logistics without vehicle modifications.
Growth Trajectory: Projections suggest that expanding LNG/LBG truck fleets (backed by policy interventions) could displace 18–55 MT/year of diesel and save up to $38.5 Billion in foreign exchange annually by 2035.

3. **Bio-Hydrogen Pathways & Technology Maturity:**
Sustainability & Economics: Bio-hydrogen achieves negative carbon footprints (−26.5 kg CO_2/kg H_2 with CCS/organic feedstock) at competitive costs ($1.36–$11.42/kg) compared to Green Hydrogen ($2.97–$14.13/kg).

Technology Readiness (TRL): Biomethane Steam Reforming (BMSR) has achieved TRL 9 (Production stage), followed by Gasification at TRL 7–8.

4**. E-Methane & AI Innovation**

E-Methane Concept: Produced by combining RE-derived Hydrogen with captured biogenic CO2 from CBG/industrial plants, converting non-storable electricity into storable green gas.

AI Optimization: IGL is running a Proof of Concept (PoC) using Cognitive Intelligence to optimize CBG plants—enhancing methane yield, cutting operational variance, reducing downtime, and enabling early anomaly alerts.

The Multi-Fuel Integrated Energy Hub Model

The core proposal features a Five-Layer Architecture combining multiple fuels onto single forecourts to optimize capital deployment:

LNG / LBG: Serves long-haul freight and acts as an immediate decarbonization anchor.

CBG / Bio-CNG: Injected into local CGD networks or blended directly for gaseous fleets.

Hydrogen: Deployed modularly for heavy, high-utilization, payload-sensitive fleets.

EV Fast Charging: Integrated with smart scheduling and on-site solar/battery storage to mitigate peak grid tariffs.

Operational Synergies: Thermal integration (using waste heat from SMR/CHP for digester heating) and carbon capture for biogenic CO2 utilization or E-methane synthesis.

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Day 2, Session - I (Timing: 09:30 Hrs – 11:00 Hrs)

Leadership Panel Discussion – IInd

Topic: Urban CGD Operational Challenges & Innovative Solutions

Panel Moderator: Shri S Trehan, Founder & CEO, Think LNG Investment Private Limited

Panellists:

1. **Shri M K Sharma, CEO, IRM Energy Limited**
2. **Shri Raman Srivastava, Executive Director, IGL**
3. **Shri Sudhir Dixit, COO, GAIL Gas Limited**
4. **Smt Pratibha Bijay, AVP, MGL**

Introduction of Shri Sandeep Trehan, CEO, THINK LNG Investments Pvt Ltd.

Shri Trehan is presently the Chief Executive Officer, THINK LNG Investments Pvt Ltd. He is a distinguished leader in India's energy sector with over four decades of experience in Petroleum, Natural Gas, LNG, Marketing, Business Development, and Energy Infrastructure.

He is also the Founder of THINK LNG Investments Pvt. Ltd. and Co-Founder of THINK Gas Distribution Pvt. Ltd., where he has played a pivotal role in building one of India's leading private City Gas Distribution (CGD) companies. His leadership has been instrumental in expanding natural gas infrastructure, promoting LNG adoption, and driving customer-centric, technology-enabled growth.

Prior to his entrepreneurial journey, Shri Trehan held senior leadership positions with Indian Oil Corporation Ltd. (IOCL), ExxonMobil, Reliance Industries Limited, and the Jay Madhok Group.

A Mechanical Engineer with postgraduate qualifications in Thermal Engineering, Systems Management, and Marketing Management, he is a passionate advocate of innovation and sustainable energy solutions for India's gas-based economy.

Introduction of the Panelists:

1. Shri Manoj Kumar Sharma, CEO, IRM Energy Limited

Shri Manoj Kumar Sharma is the **Chief Executive Officer of IRM Energy Limited** with over **40 years of experience** in Finance, Accounts, Project Finance, and Business Development in the oil and gas sector.

Before joining IRM Energy, he served as **Executive Director – Business Development at Indian Oil Corporation Limited (IOCL)**, leading key businesses including Natural Gas, Exploration & Production, Petrochemicals, Alternate Energy, and Sustainable Energy. During his distinguished career, he managed projects worth over **USD 6.6 billion (approximately ₹50,000 crore)** and developed expertise in project finance, treasury management, greenfield projects, foreign currency loans, and regulatory compliance. A **Certified Management Accountant (CMA)**, Mr. Sharma holds a **B.Sc. (Hons.) in Chemistry, an LLB, and an MBA in Finance**. He has also served on the Boards of several leading domestic and international energy companies, bringing rich leadership and corporate governance experience.

2. Shri Raman Srivastava, Executive Director, Indraprastha Gas Limited

- Shri Raman Srivastava is a **Electronics Engineer** and an **MBA in Marketing**, with over **30 years of experience** in the Gas sector.
- He has successfully led and implemented large-scale **projects and business solutions** at Indraprastha Gas Limited (IGL), the largest CNG distribution company in India.
- Shri Srivastava serves on key **industry committees**, including as **Member, High Power Technical Committee of ISA**, and **Board of Governor, India Smart Grid Forum**.
- A recipient of the **National Safety Council's Appreciation (2022–23)** and **Safety Innovation Award**, he continues to advance safety and automation excellence in the gas industry.

3. Shri Sudhir Kumar Dixit, Chief Operating Officer, GAIL Gas Limited

Shri Sudhir Kumar Dixit is an Electrical Engineer with an MBA in Finance and over **32 years of experience** in the oil and gas industry, spanning petrochemicals, major project execution, plant operations, and City Gas Distribution (CGD).

He is currently the **Chief Operating Officer (COO) of GAIL Gas Limited**. Previously, as **CEO of JBF Petrochemicals Ltd. (now GAIL Mangalore Petrochemicals Limited – GMPL)**, he led major construction activities, revived plant operations, and steered the company towards production readiness. Earlier, he was part of the leadership team at **GAIL's Pata Petrochemical Complex**, contributing significantly to operational excellence.

Shri Dixit has also played an active role in India's clean energy transition, representing GAIL Gas at key industry forums and contributing to initiatives promoting **Compressed Biogas (CBG)** integration into CGD networks. He has been recognized with the **'Pioneer in Energy Transformation – Energy Brand'** award on behalf of GAIL Gas.

4. Ms Pratibha Bijay, AVP, Mahanagar Gas Limited

Ms. Pratibha Bijoy (Bijay) is an experienced professional in the Natural Gas and City Gas Distribution (CGD) industry, encompassing Technical and Managerial aspects such as operations and maintenance (O&M) and digital infrastructure.

Presently, she is the Assistant Vice President (O&M) at Mahanagar Gas Limited (MGL), where she is responsible for overseeing advanced digital operations and control centres to optimize the company's extensive city gas distribution network.

Throughout her career with MGL, she has focused on enhancing operational efficiencies, implementing state-of-the-art technological solutions, and ensuring a safe and uninterrupted natural gas supply for consumers. She actively contributes to industry dialogues and has had notable participation as a speaker in National Conferences and Summits.

She notably presented at the Annual Business Conclave by Enersider, where she shared key insights on the implementation of advanced digital operations and the critical role of control centres in modernizing India's CGD infrastructure.

The Leadership Panel Discussion on **"Urban CGD Operational Challenges & Innovative Solutions"** focused on the key operational, technical, safety and commercial challenges facing the rapidly expanding City Gas Distribution (CGD) sector and the innovative solutions being adopted by leading CGD companies.

1. Opening Remarks by the Moderator – Shri Sandeep Trehan

Shri Sandeep Trehan highlighted the rapid expansion of the CGD sector and the need to convert the geographical areas authorised by PNGRB into vibrant gas markets. He emphasised that increasing natural gas consumption and moving towards the **15% share of natural gas in India's energy mix** would require rapid infrastructure development, wider customer adoption and continuous innovation.

He observed that the industry needs to address increasing customer expectations while ensuring safety, reliability and cost effectiveness. The discussion was accordingly focused on the operational challenges faced by CGD companies and the technologies and innovative practices being used to overcome them.

2. Shri M. K. Sharma – IRM Energy Ltd.

Shri M. K. Sharma observed that **natural gas is essentially a "pull" commodity**, and therefore infrastructure development alone is not sufficient. A complete ecosystem involving customers, infrastructure, affordability and demand creation is necessary for sustained growth.

He highlighted the following major challenges:

- Congested and unplanned urban areas.
- Limited space for underground utilities.
- Multiple permissions from municipal and other authorities.
- Road-cutting and restoration restrictions.
- Shortage of skilled manpower and contractors.
- High cost of domestic PNG connections.
- Competition from LPG and other fuels.
- Economic viability of low-consumption customers.

He stressed that CGD growth requires stronger coordination between industry and government agencies and a supportive regulatory framework.

Shri Sharma also emphasised that **safety and commercial sustainability must go together**. Regular inspection, GIS-based analytics, SCADA, IoT and technology-enabled monitoring can improve both safety and operational efficiency.

He advocated lifecycle-based planning of infrastructure rather than focusing only on initial capital cost. Pipeline capacity, joints, fittings and other components should be designed and monitored keeping future demand and emerging fuels such as hydrogen blending in mind.

3. Shri Raman Srivastava – IGL

Shri Raman Srivastava highlighted **safety and rapid PNG penetration** as two major priorities for IGL.

With a large network spread across Delhi-NCR and adjoining areas, IGL faces challenges associated with contractual manpower, network expansion and customer conversion.

Safety Initiatives

IGL has strengthened its safety systems through:

- Competency-based training of contractual workers.
- Digital work-permit systems.
- Linking contractor payments with compliance.
- Regular safety reviews by senior management.
- Greater focus on contractor competency and field supervision.

PNG and Technology Initiatives

To accelerate domestic PNG connections, IGL has expanded its contractor and manpower base and introduced incentives.

Technology initiatives discussed included:

- **SCADA-based monitoring** of CNG stations.
- **GIS-based pipeline management**.
- Smart/automated metering.
- Online billing and POS-based CNG systems.
- Data analytics for maintenance and operational monitoring.
- Greater use of predictive maintenance approaches.

He emphasised that digitalisation would be essential for managing larger networks, improving reliability and reducing operational costs.

4. Ms. Pratibha Bijay – MGL

Ms. Pratibha Bijay shared MGL's experience of operating in the highly congested urban environment of Mumbai.

Utility Congestion and Third-Party Damage

She identified underground utility congestion as one of Mumbai's biggest challenges, with gas pipelines competing for space with electricity, telecom, water and sewerage networks.

MGL has adopted several initiatives for preventing third-party damage, including:

- Sharing pipeline network information with disaster management authorities.
- "Dial-before-you-dig" awareness initiatives.
- Awareness programmes for JCB operators and contractors.
- Public awareness campaigns.
- Encouraging citizens to report unauthorised excavation.
- Rapid emergency response mechanisms.

MGL also uses excavation-related data and analytics to identify damage-prone areas and understand the causes of third-party damage.

Smart Metering

Smart meters have been deployed for industrial and commercial customers, enabling real-time monitoring of consumption and identification of abnormal consumption and meter tampering. This has helped in improving revenue protection and operational control.

MGL has also undertaken initiatives to address customer reluctance towards PNG connections, particularly in tenant-dominated housing societies.

5. Shri S. K. Dixit – GAIL Gas

Shri S. K. Dixit highlighted the diverse operational challenges faced by GAIL Gas across metropolitan cities,

hilly areas, coastal regions and remote locations.

Pipeline Construction and Permissions

He noted that customers expect rapid connections, but gas pipeline construction has to meet stringent safety requirements. Major challenges include:

- Road-cutting permissions.
- Municipal restrictions.
- Industrial-site safety requirements.
- Seasonal and monsoon restrictions.
- Highway and river-crossing permissions.
- Difficulties associated with HDD works.
- Restrictions during major religious and public events.

He highlighted that such constraints can significantly affect project schedules and contractor productivity.

Skilled Manpower

A major future concern is the shortage of trained plumbers and technicians. With the expected rapid increase in DPNG connections, large-scale skill development and training programmes will be essential.

Gas Loss Reduction and Technology

Shri Dixit shared several technology-based initiatives adopted by GAIL Gas:

- **Laser-based methane leak detection** for identifying underground and surface leakage.
- **IoT-enabled pressure monitoring** across pipeline segments.
- Automated pressure control to reduce leakage.
- Centralised monitoring of multiple compressors through IoT.
- Smart metering and automated billing.

These initiatives have helped improve network monitoring, reduce manpower requirements and control gas losses.

6. Key Issues Emerging from the Panel Discussion

The panel collectively identified the following major challenges:

Area	Key Issues
Infrastructure	Utility congestion, limited RoW and urban expansion
Permissions	Multiple agencies and lengthy approval processes
Construction	Road restoration, HDD, river crossings and seasonal restrictions
Safety	Contractual manpower, third-party damage and field activities
Customer conversion	LPG competition, tenant issues and connection costs
Manpower	Shortage of skilled plumbers and technicians
Network integrity	Leakage, ageing assets, joints and pressure management
Gas losses	Leakage, meter tampering and inaccurate consumption data
Commercial viability	High infrastructure cost and fuel competition
Future readiness	Rising demand, urbanisation and hydrogen blending

7. Major Innovations and Solutions Discussed

The panel showcased several practical innovations that can be replicated across the CGD sector:

- SCADA and centralised control systems.
- GIS-based network management.
- IoT-based pressure and equipment monitoring.
- Smart and automated metering.
- Laser-based methane leak detection.
- Data analytics and predictive maintenance.
- Automated billing and digital customer management.
- Digital work-permit systems.
- Data-driven third-party damage prevention.
- Public participation in pipeline protection.
- Contractor and manpower skill development.
- Future-oriented pipeline capacity planning.
- Lifecycle-based economic evaluation of infrastructure

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8. Concluding Observations by Shri Sandeep Trehan

In his concluding remarks, Shri Sandeep Trehan emphasised that **CGD infrastructure must become increasingly reliable, smart and technology-driven** as natural gas networks expand into new cities and Tier-2 and Tier-3 locations.

He stressed that technology should be used to accelerate pipeline construction, monitor networks, provide faster connections, improve reliability and enhance customer service. At the same time, the industry must address the shortage of skilled manpower through dedicated training and partnerships with competent organisations.

He concluded that the challenges facing CGD will continue to evolve with urbanisation and increasing customer expectations, and therefore the industry must continuously **learn, innovate and adopt new technologies**.

9. Conclusion

The panel discussion provided a comprehensive industry perspective on the **operational challenges and innovative solutions required for the next phase of CGD growth**. While the challenges vary across geographical areas, common concerns include permissions, utility congestion, safety, manpower, customer conversion, gas losses and commercial viability.

The experiences shared by IRM Energy, IGL, MGL and GAIL Gas demonstrated that **digitalisation, automation, smart metering, IoT, GIS, advanced leak detection, analytics and skilled manpower development** can significantly improve safety, efficiency and reliability.

The overall message of the session was that future CGD networks must be **safe, smart, reliable, cost-effective and future-ready**, with innovation embedded across the complete lifecycle—from planning and construction to operation, maintenance and customer service.

A memento as a token of gratitude was presented to the Panel Moderator & all the Panelists:

Shri D. V. Shastry, ED, NGS, acknowledged the valuable contributions of the Session Moderator and all the panelists and expressed his sincere gratitude for their participation and for sparing time from their busy schedules to contribute to the session.

Session: Day-2, Session-II, Technical Session – III

Theme: Digitalization, Automation & Smart Operations in Gas Infrastructure"

Day-2 SESSION – II: (11:15 HRS – 13:15 HRS)
Session Chair : Shri Murali Srinivasan, Advisor, MGL

Shri Murali Srinivasan is Advisor to Mahanagar Gas Limited (MGL) and an accomplished industry leader with nearly 39 years of experience in Design & Engineering, Project Execution, Operations & Maintenance, and Strategic Management.

He successfully led the post-acquisition integration of UEPL with MGL and is currently guiding the company in achieving its Board-defined strategic objectives. Previously, he served as Senior Vice President, MGL (2002–2023), where, as a member of the Strategic Management Group, he ensured the safe, reliable, and efficient operation of MGL's City Gas Distribution network across Mumbai Metropolitan Region. Before joining MGL, he held key leadership positions with Cabot India, BILT Chemicals, Indian Aluminum Company Limited (INDAL), and Cement Corporation of India (CCI).

Shri Srinivasan holds a Bachelor's Degree in Mechanical Engineering from IIT (BHU), Varanasi, and an MBA in Finance. He is widely recognized for his expertise in engineering, asset management, operational excellence, safety, and organizational transformation in India's City Gas Distribution sector.

Session: Day-2, Session-II, Technical Session-III

Ist Presentation Topic: **Flow Meter Verification & Digital Assurance for High-Accuracy Gas Accounting**

Speaker: Shri Shashank Pradhan, Chief Manager – O&M

The presentation focused on the importance of accurate, reliable and traceable gas measurement for effective gas accounting, regulatory compliance and customer confidence. It explained the distinction between **calibration, verification and validation**. Calibration involves comparison with a reference standard and corrective action to minimize measurement error; verification confirms that the required accuracy has been achieved; while validation establishes that the complete metering system performs reliably and as intended.

The presentation highlighted the role of accurate flow measurement in maintaining **data integrity, preventing out-of-specification results, avoiding costly deviations and investigations, meeting regulatory requirements and building customer confidence**. In CGD operations, reliable metering is particularly important for resolving customer complaints, ensuring correct billing and maintaining overall gas balance.

A key feature presented was the **flow test bench established by MGL for verification of volumetric flow meters**. The facility can verify different types of meters, including diaphragm, thermal, rotary, turbine and ultrasonic flow meters. The test bench operates with air under atmospheric conditions and uses sonic nozzles for flow measurement. It covers a wide measurement range of **0.01 to 1000 m^3/hr**, corresponding from G1.6 to G650 meters, with a stated Calibration and Measurement Capability (CMC) of ±0.28%.

The automated facility includes a nozzle drum with six high-flow nozzles and a smaller nozzle register with ten nozzles. It can simultaneously test **six small diaphragm meters or one large rotary, turbine or ultrasonic meter**, depending on the configuration. Automatic nozzle selection, system checks, automated data logging and system-generated verification certificates substantially reduce manual intervention and the possibility of human error. The presentation also highlighted the long-term stability of the sonic-nozzle arrangement, with a nozzle recalibration period of up to ten years.

Another important aspect was the emphasis on **digitalization of calibration and verification activities**. Digital signal processing can reduce errors associated with conventional analogue signal conversion. Standardized digital workflows ensure that prescribed calibration procedures are followed consistently, while direct electronic data capture eliminates manual transcription errors. Electronically generated certificates with date and time stamps also enable quick retrieval of records and facilitate audits.

The presentation further explained how integration with **Quality Management Systems (QMS)** can strengthen data integrity and auditability. Electronic records provide traceability, while audit findings and non-conformances can be systematically tracked until closure. Such a digital approach enables the quality team to generate reports directly from the system instead of manually compiling calibration records.

From a CGD perspective, the facility can support **testing of new meters, investigation of complaints related to over-charging or fast meters, and assessment of meter performance and usable life** based on meter type, manufacturer and size. Such analysis can help CGD entities improve meter replacement strategies and overall measurement reliability.

As a way forward, the presentation proposed **ISO/IEC 17025 accreditation of the volumetric flow-meter testing laboratory** and establishment of a **mass-flow-meter testing laboratory**. These initiatives would further strengthen the technical credibility, standardization and measurement assurance framework for gas metering.

Key takeaway: The presentation demonstrated that automated and digitally integrated meter verification can significantly improve **measurement accuracy, data integrity, traceability, audit readiness and customer confidence**, thereby supporting more effective gas accounting and efficient CGD operations.

Day-2, Session-II, Technical Session-III

IInd Presentation Topic: **CGD Sector: Innovation in Assets & Operation Management**

Speaker: Shri Vipin Kapoor, GM (CGD), GAIL

The presentation provided a comprehensive overview of the **current CGD landscape, operational challenges and technology-led opportunities for improving asset and operational management**. It placed CGD development in the broader context of India's objective of transitioning towards a gas-based economy and increasing the share of natural gas in the country's energy mix from around 6% towards the aspirational **15% level**.

The presentation noted the rapid expansion of the CGD network, with **307 Geographical Areas (GAs)** authorized after the 12th bidding round and CGD coverage extending to almost the entire geographical area and population of the country. It also highlighted the growth of domestic PNG connections, CNG stations and CNG vehicles, demonstrating the increasing scale and importance of CGD infrastructure.

Against this background, the presentation identified several challenges affecting the **cost, efficiency, reliability and safety of CGD operations**. These included high operational costs, CNG dry-out situations, inefficient utilization of LCVs, gas losses, metering and billing inaccuracies, pipeline leakage, theft, third-party damage, corrosion and challenges associated with non-piggable and non-standardized networks. These issues can lead to financial losses, customer dissatisfaction, supply interruptions, environmental impacts and regulatory concerns.

The presentation proposed greater use of **Artificial Intelligence, Machine Learning, cloud computing, SCADA, GIS and automation** to address these challenges. SCADA was highlighted as a key platform for real-time monitoring and control of CGD networks, enabling visibility from City Gate Stations and District Regulating Stations through valve stations to customers. Integration through OFC, cellular and radio telemetry provides multiple communication paths and improves operational visibility.

A major innovation discussed was the **AI-based LCV Fleet Management System**, developed to address CNG dry-out and optimize the transportation network. The system uses information such as LCV location, pressure data, hourly sales, traffic conditions, MS/DBS status and historical operational data. Analytical modules can estimate DBS stock-outs in advance, calculate LCV ETAs, optimize LCV schedules and recommend re-routing to minimize the possibility of dry-outs.

The **DBS stock estimation module** provides advance warning of potential stock-outs, allowing the control centre to take preventive action. The LCV re-routing module can identify suitable vehicles and suggest the least-time route to an affected DBS. The system also supports optimization of the number of LCVs required and their contractual kilometre utilization, thereby helping reduce unnecessary operational expenditure.

The presentation indicated positive results from the application of AI tools, particularly in the Varanasi network, where transportation cost per kg of gas was reduced while improving gas movement efficiency and controlling dry-out situations. This demonstrated the potential of analytics-driven fleet management to deliver measurable operational and financial benefits.

Another important area was **gas reconciliation and loss management**. The presentation covered reconciliation at different levels, including CNG stations, LCV/DBS systems, steel pipelines and MDPE networks. Measures such as network-section-wise reconciliation, integration with SCADA, online connectivity of gas chromatographs and flow computers, leak checking and zero checks of mass-flow meters were highlighted as important measures for identifying and controlling losses.

Safety innovations formed another major component of the presentation. These included **GIS-integrated mobile work permits, GPS-based patrolling, vehicle tracking, leak detection and Pipeline Intrusion Detection Systems (PIDS)**. PIDS uses Distributed Acoustic Sensing technology through optical fibre to detect disturbances such as digging and other external activities along the pipeline corridor. The system can provide continuous monitoring along the fibre and support real-time identification of potential intrusion events.

The presentation also demonstrated the role of **GIS in operational decision-making**, including visualization and mapping, outage management and emergency response. GIS can assist operators in identifying affected customers, locating valves and pipeline assets, and coordinating emergency response activities.

Looking ahead, the presentation emphasized the application of **AI and predictive analytics** for gas demand forecasting, procurement optimization, infrastructure planning and risk management. AI can also support early leak detection, predictive maintenance, asset-life estimation and faster emergency response. Customer-facing applications such as AI-based billing, abnormal-consumption detection, chatbots and customer segmentation were identified as further opportunities for improving service quality.

Key takeaway: The presentation established that the future of CGD asset and operational management lies in **integrated digitalization**, combining SCADA, AI/ML, GIS, smart metering, predictive analytics, fleet optimization and advanced safety systems. Such integration can improve network reliability and safety while reducing gas losses, operating costs and customer service issues.

Session: Day-2, Session-II, Technical Session-III

IIIrd Presentation Topic: **Challenges and Lessons Learned in Executing Large-Scale CGD Projects Across Diverse Environments**

Speaker: C. Prabhakar Chakravarthy (Managing Director, CGDS Pvt Ltd)

The presentation provided a comprehensive overview of the challenges involved in planning, constructing,

commissioning and operating large-scale City Gas Distribution (CGD) projects across diverse geographical and urban environments. It emphasized that the rapid expansion of CGD networks in India is an important component of the transition towards cleaner fuels, but successful implementation requires coordinated management of technical, regulatory, financial, commercial, safety and stakeholder-related issues.

The presentation first outlined the complete CGD project lifecycle, beginning with Geographical Area (GA) authorization, feasibility and demand assessment, route surveys, utility mapping, detailed engineering and statutory approvals, followed by procurement, pipeline construction, testing, commissioning, customer acquisition and O&M. A key message was that early-stage planning and coordination can significantly reduce project delays and cost overruns.

<u>Major Construction Challenges</u>

The presentation highlighted several practical challenges associated with pipeline construction in urban and difficult terrains. For steel pipelines, dense urban development, rocky terrain, waterlogged areas, existing underground utilities, restricted working space, traffic congestion and public inconvenience were identified as major concerns. Detailed route reconnaissance, phased construction, early engagement with local authorities and effective public communication were recommended.

For MDPE pipeline construction, frequent utility clashes, incorrect trench depth, third-party excavation damage, improper electrofusion joints and inadequate reinstatement were identified. The presentation recommended GPS/GIS-based pipeline mapping, deployment of skilled fusion operators, continuous quality inspection and public awareness before excavation.

For HDD and road crossings, challenges such as hard rock formations, high groundwater levels, bore collapse, utility interference and limited entry/exit space were highlighted. Detailed geotechnical investigations, proper drilling-fluid management, experienced HDD contractors and real-time bore tracking were suggested as mitigation measures.

The presentation also discussed welding, NDT, coating and hydrotesting, emphasizing qualified welders, strict WPS compliance, appropriate NDT, coating inspection and leak-free hydrotesting.

Regulatory, RoW and Stakeholder Challenges

Obtaining statutory approvals was identified as a significant challenge because CGD projects often involve multiple agencies, including NHAI, Railways, Forest Departments, Municipal Corporations, Smart City authorities, airport authorities and defence authorities. The presentation recommended initiating approvals during the engineering stage, maintaining a dedicated liaison team, using digital approval tracking and undertaking regular follow-up.

Right-of-Way challenges included private land disputes, encroachments, compensation delays, public objections and political interventions. Community engagement, transparent communication, route optimization and alternate alignments were suggested to reduce these difficulties.

Safety and Integrity

Safety was presented as a non-negotiable component of CGD project execution. Key risks identified included excavation collapse, traffic accidents, gas leaks, confined-space entry, hot-work hazards and public safety concerns. Daily toolbox talks, Job Safety Analysis (JSA), Permit-to-Work (PTW), continuous HSE supervision and emergency-response drills were highlighted as essential practices.

The presentation also addressed cathodic protection challenges, including improper current distribution, electrical interference, poor earthing and monitoring difficulties. Proper CP design, periodic monitoring, remote monitoring systems and annual surveys were recommended.

Supply Chain and Financial Challenges

Supply-chain constraints such as long delivery periods, vendor limitations, imported-equipment delays, logistics disruptions and price escalation were highlighted. Multiple approved vendors, buffer inventories, long-term procurement planning and digital inventory management were suggested.

Financial challenges included high capital requirements, delayed customer revenue, inflation, escalating construction costs, interest burden and cash-flow mismatches. Better project phasing, financial-risk assessment, cost optimization and strong project monitoring were recommended.

The presentation also covered working-capital and banking issues, including high interest rates, delayed loan disbursements, cash-flow constraints and delayed contractor payments. Adequate working-capital planning, diversified funding, financial discipline and milestone-based financing were suggested.

Gas Availability and Commercial Challenges

The presentation identified APM gas shortages as a commercial challenge, resulting in reduced domestic gas allocation, increased dependence on imported LNG, margin pressure and customer dissatisfaction. Diversified gas sourcing, long-term contracts, efficient gas allocation and demand forecasting were suggested.

LNG price volatility, including international price fluctuations, currency risks and higher operational costs, was another concern. Hedging, blended gas procurement and long-term procurement agreements were proposed as mitigation measures.

Customer Acquisition and Digital Transformation

Customer acquisition challenges included low consumer awareness, high connection costs, apartment permissions, slow PNG conversion and commercial competition. Consumer awareness campaigns, digital applications, attractive financing schemes and engagement with Resident Welfare Associations were suggested.

A significant portion of the presentation focused on digital transformation, including GIS-based asset management, SCADA for remote monitoring, AI-based leak detection, drone surveillance, predictive maintenance, digital twins and mobile inspection applications. These technologies were presented as tools for improving safety, accelerating decision-making, reducing operational costs and enhancing reliability.

Key Lessons and Recommendations

The presentation concluded that successful CGD development requires more than engineering capability. The major lessons identified were:

- **Engineering quality is fundamental to project success.**
- **Early stakeholder engagement helps avoid delays.**
- **Digitalization can substantially improve efficiency.**
- **Safety culture must remain uncompromising.**
- **Accurate utility mapping reduces rework.**
- **Skilled manpower improves productivity.**
- **Financial planning is as important as engineering planning.**
- **Customer satisfaction is essential for long-term sustainability.**

Session: Day-2, Session-II, Technical Session-III

IVth Presentation Topic: **Leakage Identification in Underground HDPE Pipelines: A Two-Tier Gas Detection Approach**

Speaker: Vishaal Kaushal (Respo Products)

Leakage Identification in Underground HDPE Pipelines – A Two-Tier Gas Detection Approach

The presentation addressed the specific challenge of detecting leaks in underground HDPE pipelines, particularly in Indian CGD networks. It highlighted that HDPE is widely used for underground gas distribution, but its non-metallic characteristics make several conventional steel-pipeline inspection techniques unsuitable. Leaks can occur at electrofusion and butt-fusion joints, mechanical fittings and locations affected by third-party excavation. Moreover, gas can migrate through soil without producing visible surface indications.

Need for a New Detection Strategy

The presentation explained that conventional methods such as cathodic protection, magnetic flux leakage and electromagnetic surveys are applicable to steel pipelines but are not suitable for non-conductive/non-magnetic HDPE pipelines. Consequently, gas detection and soil-gas surveys become the principal approaches for identifying leakage from underground HDPE networks.

Two-Tier Leak Detection Approach

The core proposal was a two-tier methodology:

Tier 1 – Screening:
A Laser Methane Walkover Survey is used to rapidly screen long pipeline routes. The presentation described the use of TDLAS technology to detect methane column density, with surveys possible either on foot or from a vehicle. The output is GPS-tagged alarm points for further investigation.

Tier 2 – Pinpointing:
Once a potential leak location is identified, a soil-gas survey is undertaken to determine the precise leak location and gas type. The method uses bar holes, detector tubes and a hand pump to obtain quantitative gas concentration readings.

HRLD 300/600 – Laser Methane Detection

The presentation explained the operating principle of the HRLD 300/600. The instrument uses a near-infrared tunable diode laser tuned to methane's absorption wavelength of approximately 1653 nm. Methane migrating from an underground pipeline absorbs the laser light, generating an alarm and ppm.m reading.

The stated specifications include detection ranges of up to 150 m for HRLD-600 and 60 m for HRLD-300, sensitivity of 5 ppm.m, response time below 0.05 seconds, ATEX Zone 0 certification, Bluetooth connectivity and GPS-tagged data logging.

Advantages and Limitations

The technology offers several operational advantages:

- **Non-contact detection without drilling or excavation.**
- **Rapid screening over several kilometres per day.**
- **High selectivity for methane.**
- **Real-time response.**
- **GPS-tagged data collection.**
- **ATEX Zone 0 safety certification.**
- **Long sensor life and relatively low maintenance requirements.**

However, the presentation also identified limitations. The HRLD system is designed for methane detection and therefore cannot detect LPG, hydrogen or other gases. Detection effectiveness may be affected by pipeline depth, paved surfaces and soil characteristics.

Soil Gas Survey and Detector Tubes

The Tier-2 approach involves drilling a hole of approximately 0.85 m, inserting the detector tube, drawing a gas sample and reading/triangulating the results.

The presentation also listed different detector tubes for different pipeline contents, including natural gas, LPG, tracer gases, odorant and H_2S. This provides flexibility for different applications and gas compositions.

Combined Workflow

The recommended workflow is:

Survey Planning → Tier-1 Walkover Survey → Rank Alarms → Tier-2 Soil-Gas Survey → Confirm Leak.

This approach allows rapid screening of large pipeline networks while reserving the more detailed and localized soil-gas investigation for areas where potential leakage has already been identified.

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Vth Presentation Topic: **Smart Gas Metering & Network Automation (AMI 2.0)**

Speaker: Shri Makarand Vairagare, Pietro Fiorentini DB India Private Limited

Smart Gas Metering & Network Automation – AMI 2.0, Command Center Intelligence and Automated Workflows

The presentation focused on the evolution of gas metering from conventional measurement towards smart metering, Advanced Metering Infrastructure (AMI), unified data management, AI-based analytics and automated operational workflows.

The presentation began by introducing the Pietro Fiorentini Group and its experience in natural-gas solutions and smart metering. The company presentation highlighted more than 80 years of history, operations across more than 100 countries, 20 manufacturing facilities, more than 2,400 employees and a substantial installed base of smart gas meters.

Smart Metering – Business and Operational Benefits

The presentation identified several benefits of smart gas metering, including:

- **Prevention of gas pilferage.**
- **Daily gas reconciliation.**
- **Reduced bad debt through prepaid metering.**
- **Availability of daily consumer consumption data.**
- **Flexible price changes.**
- **Data monitoring and analytics.**
- **Reduced working capital requirements.**
- **Easier payment processes.**
- **Total-cost-of-ownership savings for CGD companies.**

Thus, smart metering was positioned not simply as an advanced measuring device, but as a means of improving commercial control, customer service, revenue assurance and operational decision-making.

Proven Smart Metering Track Record

The presentation stated that the group has produced more than 24 million diaphragm measurement units, including more than 11 million smart gas meters. It also presented a reliability figure of less than 0.7% field return rate for the referenced RSE 3.0 solution with NB-IoT communication. The Indian manufacturing initiative was also highlighted. The Pietro Fiorentini DB facility at Talegaon was

presented as having an installed capacity of 2–3 million gas meters per year, with the stated objective of becoming a market leader in gas-meter manufacturing and supply in India.

Smart Meter Design Considerations

The presentation identified three important design considerations for smart metering systems:

1. **Data communication – availability, power consumption and bandwidth.**
2. **Data security – protection of consumer information and prevention of cyberattacks.**
3. **Interoperability – compatibility between wireless networks, head-end systems and open-standard communication protocols.**

These factors are particularly important for large-scale CGD deployments involving millions of connected devices and multiple technology platforms.

Current CGD Metering Environment

The presentation realistically addressed the brownfield nature of existing CGD networks. Domestic meters represent the largest volume, while commercial and industrial consumers require higher-quality readings and faster exception management. CGS/SKID stations may still use older EVCs and mixed control systems, while mechanical meters, retrofits and equipment from different OEMs generate different data models and alarm types. The resulting challenge is fragmented information and multiple disconnected systems. The presentation therefore proposed a unified operational command centre as a common information layer.

AMI 2.0 – End-to-End Architecture

The proposed AMI 2.0 architecture extends from the City Gas Station to the last-mile consumer. It envisages integration of custody-transfer metering, SKIDs, regulation and EVCs, communications networks, AMI core systems and domestic/commercial/industrial consumers. The communication architecture referenced Cellular, RF, LoRaWAN and LPWAN technologies, while the AMI core incorporates MDM, VEE, APIs and multi-system integration.

AI can be applied at multiple points to predict pressure drift, detect feeder-main imbalance, identify meter tampering and forecast demand at consumer clusters. The objective is to resolve issues earlier and reduce unnecessary field interventions.

Unified Command Centre

A major theme of the presentation was the creation of one operational truth for a fragmented CGD data environment.

The proposed system would: Detect → Correlate → Predict → Act

Events from multiple OEM meters and field assets are collected, merged with GIS, SCADA and billing information, analysed for risk/demand/impact and then converted into operational actions.

The presentation further explained that a command-centre workflow can receive an event from a meter, SKID, SCADA system or customer portal; use AI to estimate its impact and urgency; automatically create tasks and route field crews; notify customers; and finally verify resolution and feed the outcome back into the model.

Trigger-to-Action Automation

The presentation illustrated how automation can convert events into operational actions. For example:

- **A tamper alarm can automatically generate a field ticket.**
- **A demand spike can trigger a supply-planning review.**
- **Communication loss can initiate network diagnostics.**
- **A pressure anomaly can alert operations before a service issue develops.**
- **Repeated meter failures can trigger replacement prioritization.**

The concept therefore moves CGD operations from monitoring and reacting to predicting and acting.

Multi-OEM Integration

A particularly relevant feature for existing CGD networks is the proposed single-dashboard/multi-OEM approach. The presentation suggested that smart meters from multiple manufacturers, retrofitted mechanical meters and new AMI meters can be normalized into a common data model and displayed through a single operational dashboard. Common KPIs and unified workflows can reduce training requirements and improve response time.

Roadmap to AI-Enabled CGD Operations

The presentation proposed a four-step transformation: Connect → Normalize → Predict → Automate

The first step is to bring systems into a common data fabric. OEM-specific signals are then translated into common KPIs, followed by AI-based prediction of risk, demand and asset health. Finally, automated actions are triggered and the results are used to improve future decisions.

A memento as a token of gratitude was presented to the session chair & all the speakers. Also, a Certificate for appreciation was presented to all the speakers:

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Session: Day-2, Session-III, Technical Session – IV

Theme: "Technical Session – IV: Innovations in Performance, Safety, Integrity & Asset Life Enhancement"

Session Chair: Shri Satish Geda, Former Executive Director, GAIL

Mr. Satish Geda has 35 years of leadership in India's natural gas sector and retired as Executive Director (O&M) at GAIL. He led multi-billion-dollar projects across natural gas, petrochemicals, LPG/GPU, compressor stations, HRSGs, pipelines, and hydrogen plants. He oversaw administration and asset integrity of NG infrastructure and maintenance bases. With deep expertise in reciprocating compressors and rotating equipment, he worked extensively with global OEMs including Rolls-Royce, GE, Siemens, Burckhardt, Linde, and Dresser-Rand. He served 14 years on BIS committees and strengthened asset integrity and global collaboration across GAIL's networks. He is currently Senior Consultant to the Natural Gas Society.

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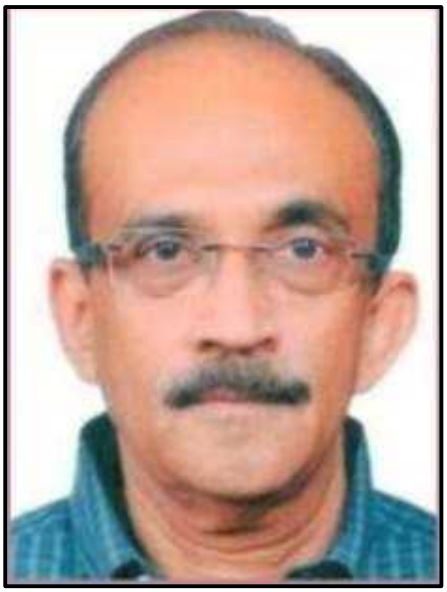
Ist Presentation Topic: **Strategic and Innovative Approach for Energy Management for Operational Excellence (Virtual Mode)**

Speaker: Shri Joy Shah (Founder & Chief Consultant, Innov8 ProTech Solutions)



The presentation (**on virtual Mode)** focused on establishing energy management as a strategic business function rather than a conventional cost-reduction activity. It presented an integrated framework combining energy efficiency, digitalization, benchmarking, audits, advanced process modelling, employee participation and continuous improvement.

Energy Management as a Strategic Priority

The presentation challenged the perception that energy optimization is less important where energy costs are relatively low. It emphasized that energy costs can represent a substantial portion of variable operating costs and that even moderate energy-cost reductions can have a significant impact on overall operating economics.

Energy efficiency was also positioned as an important pathway towards decarbonization and Net Zero objectives.

Policy and Regulatory Framework

The presentation referred to India's energy-efficiency framework, including the Energy Conservation Act, Perform, Achieve and Trade (PAT), National Mission for Enhanced Energy Efficiency (NMEEE), energy-efficiency financing mechanisms, standards and labelling and demand-side management initiatives.

Energy Management Self-Assessment

A useful element of the presentation was the Energy Management Self-Assessment framework, which categorizes organizations according to their maturity level:

- **Transformative approach: circular economy, digital and IIoT initiatives and energy productivity.**
- **Integrated approach: energy-efficiency design, pinch analysis and advanced technologies.**
- **Must-do activities: minimum energy assessment, waste-heat recovery, insulation, combustion control and Energy Management Systems.**
- **Reactive approach: leak reduction, flare/vent reduction and housekeeping.**

The framework encourages organizations to progressively move from reactive energy conservation towards strategic and transformative energy management**.**

Organizational Energy Management Structure

The presentation proposed a multi-level structure consisting of corporate/apex leadership, site-level energy groups, energy coordinators, technical professionals and shop-floor participation.

The structure supports strategic planning, benchmarking, energy monitoring, audits, implementation of improvement schemes, knowledge sharing and employee engagement.

Energy Management Strategy

The proposed strategy includes:
Site and corporate energy policies / Benchmarking and gap analysis / Energy monitoring / Employee engagement / Identification and screening of energy-saving ideas / Detailed project evaluation / Implementation and review / Development of an energy-improvement roadmap.

The approach is essentially a continuous improvement cycle, where ideas are generated, evaluated, implemented and reviewed for sustained performance improvement.

ISO 50001 Framework

The presentation recommended integrating energy efficiency into the early design and procurement stage, rather than attempting to optimize energy consumption only after commissioning.

ISO 50001 was presented as an important framework for establishing systematic energy management, monitoring and continual improvement.

Benchmarking and Energy Audits

Benchmarking was highlighted as a major component of the energy-management strategy, enabling comparison at plant, national and international levels.

The presentation proposed comprehensive energy-system audits covering : ISO 50001 systems / Insulation / Steam leakage / Furnaces / Cooling-water systems / Electrical systems / Heat integration / Steam and hot-oil traps / Monitoring, Measurement and KPIs

A structured monitoring and review system was proposed using management, operational, energy and engineering KPIs. The KPIs should be measurable, controllable, strategically relevant and capable of driving continuous improvement and investigation.

Digital and Analytical Tools

The presentation highlighted the use of: Utility-system modelling tools / Advanced Process Control / Pinch-analysis software / Monitoring and targeting tools / Statistical analysis / Process simulators / Heat-exchanger design / simulation tools / Dynamic training simulators / Utility reconciliation tools.

These tools can help organizations optimize utility systems, forecast demand, improve production planning, identify retrofit opportunities and reduce both operating and capital costs.

Advanced Heat Integration / Pinch Analysis

A dedicated section focused on advanced heat integration using pinch analysis. The methodology involves energy targeting, identification of improvement opportunities, feasibility assessment, total-site pinch analysis, heat-exchanger-network design, retrofit planning and evaluation of capital-versus-energy trade-offs. This approach can identify opportunities for improved heat recovery and reduced utility consumption across complex industrial facilities**.**

Total Employee Involvement

The presentation emphasized that energy management cannot be sustained solely through specialist teams. Employee involvement, Kaizen, energy-conservation campaigns, awareness programmes and capability development are essential. The proposed framework includes training in pinch analysis, utility modelling, ISO 50001, energy auditing, Six Sigma and energy-conservation initiatives.

Energy Conservation vs. Energy Efficiency: The presentation clearly distinguished the following concepts

- **Energy conservation: reducing energy use through behavioural or operational changes.**
- **Energy efficiency: using improved technology to perform the same function with less energy.**

This distinction is important because sustainable operational excellence requires both behavioural conservation and technology-driven efficiency improvements.

Sustainability and Operational Excellence

The presentation linked energy management with broader sustainability objectives such as:

- **Reduction of carbon footprint.**
- **Reduction of water footprint.**
- **Net Zero pathways.**
- **Sustainable manufacturing.**
- **Green certification.**
- **ISO 50001 adoption.**
- **Capability development.**

The presentation also highlighted practical experience in energy and water audits, energy-conservation schemes, ISO 50001 implementation and sustainability programmes

IInd Presentation Topic: **Innovations for Integrity, Reliability & Safety Management of Steel & MDPE Pipeline Networks**

Speaker: Sachin Kumar, Indraprastha Gas Limited (IGL)

The presentation by **Shri Sachin Kumar** provided a comprehensive overview of **Pipeline Integrity Management for steel and MDPE networks**, with particular relevance to City Gas Distribution (CGD) systems operating in densely populated urban areas. It emphasized that effective integrity management requires systematic identification of threats, risk assessment, condition monitoring, preventive maintenance and learning from incidents to ensure safe, reliable and sustainable pipeline operations.

The presentation outlined IGL's extensive CGD infrastructure and highlighted the differing integrity requirements of steel and MDPE pipelines. While steel pipelines are capable of operating at higher pressures, they require protection against corrosion through coatings and cathodic protection. MDPE pipelines offer flexibility and corrosion resistance but remain vulnerable to threats such as improper installation, third-party excavation and adverse operating conditions.

Pipeline integrity was defined as the ability of a pipeline to safely contain the transported product under specified operating conditions. Effective integrity management begins at the planning and design stage and continues throughout the pipeline lifecycle through proper material selection, quality construction, efficient operation and maintenance.

The **Pipeline Integrity Management Plan** presented a systematic approach involving:

- Identification of potential threats;
- Collection and integration of relevant data;
- Risk assessment;
- Pipeline integrity assessment; and
- Continuous monitoring and maintenance.

Pipeline threats were broadly classified as **time-dependent, time-independent and stable threats**. Time-dependent threats include external and internal corrosion and Stress Corrosion Cracking (SCC), while time-independent threats include third-party damage, vandalism, operational errors and natural events. Stable threats arise from manufacturing defects, welding and fabrication issues, equipment defects and other construction-related anomalies.

The presentation referred to the **ASME B31.8S framework** and emphasized risk-based decision-making based on:

Risk = Probability of Failure × Consequence of Failure

Higher-risk threats require stronger controls and more extensive integrity-management measures.

A major technical focus was the assessment of **non-piggable steel pipelines**, where conventional intelligent pigging may not be feasible. The methods discussed included **Hydrotesting, Ultrasonic In-Line Inspection, Magnetic Tomography Method (MTM), and Direct Assessment (DA)**. Advanced free-swimming immersed ultrasonic inspection was highlighted as an innovative solution for difficult-to-inspect pipelines, providing information on wall loss, pipeline geometry, remaining strength and fitness for continued service.

The presentation also discussed **Direct Assessment**, including ECDA, ICDA and SCCDA, involving pre-assessment, indirect inspection, direct examination, evaluation and post-assessment activities. The **Magnetic Tomography Method** was presented as a non-intrusive technique for detecting metal loss, crack-like defects, weld anomalies, deformation and mechanical damage. Electrical Resistance Probe Monitoring was also discussed for continuous assessment of corrosion rates.

Despite advances in technology, the presentation stressed the continued importance of conventional integrity practices such as **cathodic protection monitoring, coating surveys, CIPL/DCVG surveys, thickness monitoring, valve testing, pipeline patrolling, GIS mapping and Pipeline Integrity Management Systems**.

An important concern discussed was **AC interference from nearby high-voltage transmission lines**, which can create safety hazards and accelerate corrosion. Appropriate modelling, DC decouplers and zinc ribbon grounding systems were identified as possible mitigation measures.

The presentation also emphasized **incident-based learning**, demonstrating how third-party construction activities and interaction with other underground utilities can lead to pipeline failures. These incidents reinforced the importance of coordination, surveillance and preventive measures.

For **MDPE pipeline networks**, major threats identified included third-party excavation, improper installation, poor fusion joints, excessive pressure, UV exposure and ground settlement. Recommended preventive measures included regular patrolling, leak surveys, pressure testing, GIS mapping, accurate pipeline records, adequate burial depth, warning mats and competent execution of electrofusion joints.

Third-party damage prevention was identified as a critical aspect of CGD integrity management. The presentation highlighted proactive coordination with government agencies, contractors and excavation agencies, joint inspections, emergency communication systems and initiatives such as **"Dial IGL Before Dig."** Public awareness and training of contractors, equipment operators and local communities were also emphasized.

Emergency management measures included **ERDMP-based Emergency Action Plans, leak complaint monitoring, mock drills, incident investigation, corrective actions and internal safety audits**. The focus was not only on responding quickly to incidents but also on converting lessons learned into preventive improvements.

Key Takeaways

The presentation demonstrated that pipeline integrity management is a **continuous lifecycle activity rather than a one-time inspection exercise**. The key messages were:

1. Identify and systematically assess pipeline threats at an early stage.
2. Adopt a risk-based approach based on probability and consequences of failure.
3. Select appropriate inspection technologies according to pipeline characteristics.
4. Combine advanced technologies with strong conventional maintenance practices.
5. Give special attention to non-piggable pipelines and emerging inspection technologies.
6. Prevent third-party damage through coordination, surveillance and public awareness.
7. Ensure proper installation, adequate protection and preventive maintenance of MDPE networks.
8. Use GIS and accurate asset records for effective integrity and emergency management.
9. Address AC interference and other external threats proactively.
10. Make incident investigation and lessons learned an integral part of the Integrity Management System.

Overall Conclusion

Shri Sachin Kumar's presentation provided a practical and technology-oriented framework for ensuring the **integrity, reliability and safety of steel and MDPE CGD pipeline networks**. Its central message was that effective integrity management should move beyond responding to failures towards **anticipating threats, assessing risks, monitoring pipeline health and taking timely preventive action**.

The presentation effectively demonstrated that a combination of **risk-based management, advanced inspection technologies, disciplined maintenance, digital asset information and proactive stakeholder engagement** is essential for safe and sustainable pipeline operations. Ultimately, effective pipeline integrity management is an investment in asset protection, operational reliability, safety and long-term cost savings.

IIIrd Presentation Topic **River-Crossing Pipeline Failures: Lessons Learned, Reinstallation Innovations & Asset Integrity Enhancement**

Speaker: Nitin Singhal & Pradeep Kumar Gupta (GAIL India Limited)

The presentation focused on the critical importance of river crossings in natural gas transmission networks, examining major pipeline failure incidents, their root causes, rehabilitation approaches and emerging technologies for improving long-term asset integrity. River crossings were identified as some of the most vulnerable sections of pipeline systems due to changing river morphology, flooding, scour, erosion and the difficulty of inspection and maintenance.

Importance and Vulnerability of River Crossings

River crossings are essential for uninterrupted gas transportation but are exposed to significant hydraulic and geotechnical hazards, including riverbed scour, bank erosion, channel migration, high-velocity flows, sediment movement and flood-induced loading. Failure of a river-crossing pipeline can result in supply disruption, environmental consequences and serious public-safety risks.

Major Failure Case Studies

The presentation discussed four major pipeline failures:

- Yamuna River Crossing – 20-inch Pipeline: Flash floods, erosion and scour exposed an HDD punch-in section, resulting in excessive bending and hydrodynamic stresses and eventual rupture.
- Song River Crossing – 8-inch Pipeline: Extreme rainfall and changes in the river course caused erosion and ROW washout, leading to excessive loading on the pipeline.
- Ramganga River Crossing – 12-inch Pipeline: A cloudburst and flash floods caused loss of burial cover, exposing the pipeline to buoyancy, vibration, debris impact and hydrodynamic forces, ultimately resulting in rupture.
- Narmada River Crossing – 30-inch Pipeline: Severe flooding and bank erosion caused extensive washout, leaving the pipeline unsupported and resulting in flotation and fractures at multiple girth welds.

These incidents demonstrated a common pattern in which scour and erosion lead to pipeline exposure, unsupported spans, increased hydrodynamic and bending stresses, and ultimately pipeline failure.

Failure Mechanisms and Root Causes

The typical failure sequence was described as:

Extreme rainfall/cloudburst → Flooding and high flow velocity → River migra on → Erosion and scour → Loss of cover → Pipeline exposure → Unsupported spans and excessive stresses → Rupture and leakage.

The root causes were broadly categorized as:

- Environmental: Cloudbursts, flash floods, climate change and river migration.
- Geotechnical: Bank erosion, scour, loss of cover and settlement.
- Design: Inadequate burial depth, short HDD crossings and insufficient consideration of changing river conditions.
- Integrity: Unsupported spans, fatigue, bending and hydrodynamic stresses.
- Operational: Delayed mitigation and inadequate monitoring and response systems.

The presentation emphasized that sustainable rehabilitation requires addressing all contributing causes rather than only repairing the immediate failure.

Key Lessons Learned

<u>The major lessons highlighted were:</u>

1. Increasing flood intensity and climate-related risks must be incorporated into pipeline design.
2. River migration and channel changes should be considered during route selection.
3. Temporary protection measures should not be treated as permanent solutions.
4. Open-cut crossings may have lower resilience in vulnerable river systems.
5. Timely HDD-based rehabilitation is important to prevent repeat failures.
6. Continuous monitoring and inspection are essential for maintaining integrity.

River-Crossing Methods and Protection

The presentation compared open-cut crossings, pipe bridges, directional boring, HDD and micro-tunnelling. For major and high-consequence rivers, HDD and micro-tunnelling were identified as preferred methods because they provide greater burial depth and reduce exposure to scour and flood forces.

Selection of the crossing method should consider river characteristics, soil conditions, pipeline diameter, environmental sensitivity, cost and long-term integrity requirements. Recommended design and protection measures included detailed hydrological and geotechnical studies, adequate burial depth based on maximum scour, appropriate alignment and robust protection of crossing sections. Where required, anti-buoyancy measures, concrete weight coating, anchors and additional soil cover can further improve pipeline stability.

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Monitoring and Rehabilitation

For existing river crossings, the presentation recommended:

- Monitoring riverbank erosion and channel migration;
- Bank and riverbed protection;
- Re-routing or extending HDD crossings where required;
- Geo-tagging and RFID-based identification;
- Satellite and drone surveillance;
- Pre- and post-monsoon depth-of-cover surveys;
- Enhanced monitoring during monsoon periods;
- Coordination with government and emergency-response agencies; and
- Robust emergency-response planning.

Advanced Inspection and Future Technologies

Advanced technologies such as ROVs, LiDAR, multibeam sonar and GIS were highlighted for improving inspection and risk assessment. These technologies can support underwater inspection, identification of scour and pipeline exposure, high-resolution terrain mapping and integration of inspection information into risk-based maintenance plans.

The future technology roadmap included digital twins, satellite monitoring, AI-based flood prediction, machine-learning-based predictive maintenance, fibre-optic sensing, autonomous underwater inspection systems and integration of SCADA and ILI data.

Overall Assessment

The presentation demonstrated that river-crossing integrity management must evolve from reactive rehabilitation to predictive and climate-resilient asset management. Failures should be used as opportunities to improve design practices, engineering standards and asset-management strategies.

The key message was that safe and reliable river crossings require a combination of robust design, adequate burial and protection, timely rehabilitation, continuous monitoring and advanced inspection technologies. The adoption of trenchless technologies, remote sensing, digital tools and risk-based maintenance can significantly enhance the long-term integrity and reliability of natural gas transmission pipelines.

IVth Presentation Topic: **Gas Meter Tampering & Pilferage Detection (Industrial & Commercial Segment)**

Speaker: Mahesh Nagnure (General Manager - O&M, Mahanagar Gas Limited (MGL)

The presentation highlighted the growing challenge of **gas meter tampering and pilferage in the Industrial & Commercial (I&C) segment** and presented an integrated approach covering prevention, detection, technical validation, enforcement and digital monitoring.

Gas pilferage was identified as a **multidimensional business risk**, resulting in revenue loss, incorrect billing, unaccounted gas, abnormal consumption patterns, safety hazards, unreliable data and potential customer disruption. The I&C portfolio comprises around **6,094 customers**, using diverse metering technologies and multiple OEMs, making meter integrity management particularly challenging.

The presentation covered **RPD, thermal and diaphragm meters** and highlighted common tampering practices such as removal of seals and latching pins, alteration/reversal of readings, cutting of pulse cables, damage to sensor boxes, drilling of meter counters, removal of indexes and internal modification of meter mechanisms.

Detection and Investigation

A **four-source detection framework** was proposed:

- Consumption analysis to identify abnormal usage.
- Digital alerts from EVCs, MIUs and thermal meters.
- Surprise and targeted field inspections.
- Inputs from meter readers and field personnel.

The field investigation process follows **"Intimate → Inspect → Record → No fy → Act"**, with proper photographic and video documentation. Technical validation involves checking **physical integrity, signal integrity and, where required, independent OEM revalidation** before enforcement action.

The presentation also highlighted field challenges such as customer resistance, political interference, mob situations, safety concerns, restricted access and preservation of evidence, emphasizing the need for trained personnel, defined SOPs, management support and security arrangements.

Prevention and Digitalization

The proposed prevention strategy combines **Secure Access + Targeted Inspection + Technology Shift + Customer Awareness**. Key measures include secured meter cabinets, tamper-proof seals, surprise inspections, regular checks of zero/abnormal-consumption customers, replacement of conventional diaphragm meters with thermal meters having AMR, MIU-based remote alarms and customer awareness initiatives.

Digital initiatives included a **Seal Tracking Application** for real-time seal tracking, inventory control, SAP integration, photographic verification and audit trails. Remote monitoring and an **Integrated Command & Control Centre** can enable real-time consumption analysis, automated alerts, targeted verification and centralized 24×7 monitoring.

Integrated Revenue-Protection Framework

The presentation proposed a closed-loop framework:

Detect → Inspect → Validate → Monitor → Enforce → Improve

This approach integrates meter integrity, revenue protection and operational monitoring rather than treating pilferage detection as an isolated activity.

Way Forward

The presentation recommended development of **tamper-proof metering technologies**, appropriate legal/regulatory provisions to address meter tampering, and formation of a **CGD industry-level committee** to address common metering and revenue-protection challenges.

Overall Assessment

The presentation established that gas pilferage is not merely a **revenue concern**, but also a safety, operational, data-integrity and customer-service issue. The shift towards **digital monitoring, remote alarms, risk-based inspections and closed-loop enforcement** provides a practical and technology-enabled approach to strengthening meter integrity and revenue assurance in CGD operations.

A memento as a token of gratitude was presented to the session chair & all the speakers. Also a Certificate for appreciation was presented to all the speakers:

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The valedictory Session:

The valedictory speech was delivered by Dr V K Gupta, GC Member, NGS. He said "The two-day conclave emphasized innovation, strong foundations, customer focus and operational excellence as essential for building world-class gas organizations. Key priorities included achieving the 15% gas economy target, strengthening pipeline integrity, reducing leakages and pilferage, improving compressor reliability, digitalization and smart metering, and adopting future fuels such as CBG, LNG and hydrogen. Speakers stressed benchmarking against global best practices, robust planning, SOPs, PDCA, 5S, Kaizen and zero-defect philosophy, with targets of zero leakage, breakdowns, failures and accidents".

A memento as a token of gratitude was also presented to Dr V K Gupta

Vote of thanks:

The vote of thanks was proposed by Shri R P Singh. He thanked everyone, he said "On behalf of National Gas Society, we sincerely thank you all, our distinguished speakers, dignitaries, sponsors, delegates, partners, associates, and organizing team for making this event a grand success. We wish you all a safe journey home and look forward to. Meeting you again in future NGS event."

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