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Abstract: Indraprastha Gas Limited (IGL), New Delhi is supplying piped natural gas to approx. 7.5 lakh domestic consumers, 9.5 Lakh vehicles through more than 420 CNG outlets and more than 2600 Industrial and commercial customers in Delhi and NCR. Daily approximate purchase and sale of gas is 40 lakh SCMD. Gas reconciliation in any CGD sector is the biggest challenge because of wide range of customers, 21mBar to 2 Bar delivery pressure, and MDPE pipe network of approx. 10,600 KM spread in the streets of Delhi – NCR. Generally, over the world in CGD sector 2% benchmarking has been considered for LUAG .During the FY 14-15 IGL gas reconciliation shoot up to 3.23%. In order to achieve the best reconciliation and mitigate the cause of high gas loss, many strategic gas reconciliation measures have been taken and LUAG for FY 16-17 reduced to 0.97%. In this paper authors presented the novel methodologies applied to achieve the best gas reconciliation.

Key words:

Gas reconciliation, Pressure regulator, LUAG (loss due to unaccounted gas).

1.0 INTRODUCTION

Indraprastha Gas Limited (IGL) was incorporated in 1998, IGL took over Delhi City Gas Distribution Project in 1999 from GAIL (India) Limited (Formerly Gas Authority of India Limited). The project was started to lay the network for the distribution of natural gas in the National Capital Territory of Delhi to consumers in the domestic,

transport, and commercial sectors. With the backing of strong promoters – GAIL (India) Ltd. and Bharat Petroleum Corporation Ltd. (BPCL) – IGL plans to provide natural gas in the entire capital region.

The transport sector uses natural gas as Compressed Natural Gas (CNG), the domestic and commercial sectors use it as Piped Natural Gas (PNG) and R-LNG is being supplied to industrial establishments.

IGL continued to augment its infrastructure so as to meet the increasing demand of CNG arising out of growing number of CNG vehicles in Delhi. The growth drivers for increase in demand of CNG are - car manufacturers coming up with CNG variants and Delhi Government's directive making it mandatory for all LCVs operating in Delhi to run on CNG. The company is in the process of enhancing its compression capacity by adding new stations. On the PNG front, IGL has expand its business activities in Delhi and its neighboring towns like Noida, Greater Noida and Ghaziabad. Industrial and commercial segments are the focus areas for the organization. Following is the brief about the present infrastructure of IGL :-

- Network of ~800 Kms of steel & ~10600 Kms of MDPE Pipeline
- More than 420 CNG outlets
- 1798 Commercial customers
- 839 Industrial customers
- Catering~7.5 lac domestic customers and ~9.5 lac vehicles
- Average daily sale 4.0 mmscmd

2.0) PROBLEM:

IGL was facing issue of high gas loss in their operations and it was having a very high impact on their balance sheet. It was observed that gas loss in IGL increased to 5.2% in a particular month. In order to reduce gas loss data analysis from 2009-2013 of all the operations units has been done. In detail four types of data analytics has been performed

- Descriptive Analysis: To check what has happened in the past that resulted in high gas loss.
- Diagnostic Analysis: To check why high gas loss happened.
- Predictive Analysis: To check what may happen in future due to present and past trends.
- Prescriptive Analysis: To check what plan of action required to be taken to control LUAG.

Based on the above, gas loss analytics findings following measures have been taken to check gas loss.

3.0) Initiatives taken to reduce unaccounted gas loss

3.1) Removal of Negative metering: Negative metering is a phenomenon in which multiple customers avail gas from the downstream of Custody transfer meter. Billing to IGL was done by subtracting the sum of readings of all other downstream customers meter with the reading of custody transfer meter. On analysis of consumption pattern of negative metering (GAIL Consumers), we noted following:

- On 14 April 2014, Out of 4 consumer one consumer M/s Maruti Udyog Limited got separated from steel Network, and on 22 June 2014 all

consumers connected at Bawana terminal got separated. These separations have resulted in decreasing trend of gross drawl by IGL and simultaneously reduction in unaccounted loss. But this reduction could not sustain as there were other reasons of unaccounted loss and these will be in later part of this document.

3.2) FRS wise loops broken: FRS (Field regulating stations) perform the reduction of pressure from 19bar to 4bar, to monitor and control gas loss in the downstream of FRS ,area wise FRS were grouped .

PNG customers (Domestic, Industrial, and Commercial) are connected via Field Regulating Systems (FRS) in the IGL city gas distribution system. However, few customers are connected directly to the steel pipelines. FRS level reconciliation was carried out .

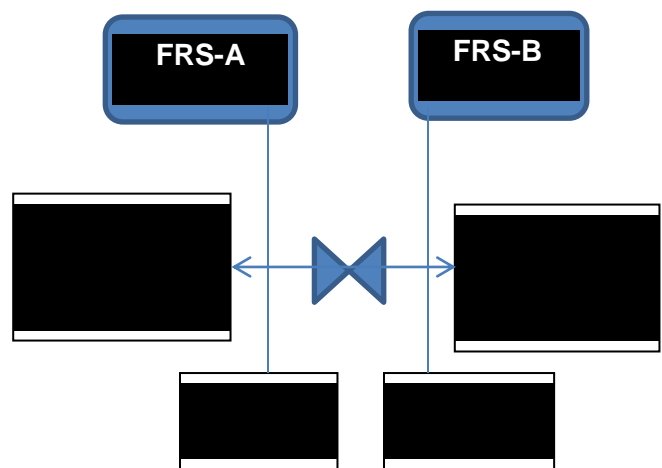


Fig 1-FRS loop

Based on the data obtained, month-wise FRS downstream reconciliation was carried out, where

varied loss of 2% to 14% was noted in different FRS loops.

Measures taken to bring the FRS downstream gas loss below 1% were as following.

- Flow computer hourly data logs downloaded to study the capacity of the meter to check whether meter is capable to read minimum and maximum flow. Hourly data logs indicated that 77 meters of customers are oversized and hourly flow of the customers is nearly Q_{min} of the meters.
- FRS meters during late night hours indicate zero flow although many of the customers were found drawing gas at that time.
- Turbine Flow Meters (TFM) have been replaced with RPD meters which has very high turndown ratio i.e. capacity to measure wide range of gas flow. 105 no of such overly designed meters were replaced by correct size RPD meters.

3.3) Analysis of CNG metering skid inlet Meters : 22 no of oversized mass flow meters are also replaced by correctly sized meters in the inlet metering skids of CNG stations

3.4) Daily over all IGL gas reconciliation. Daily gas reconciliation started to identify abnormal trend of gas consumption/ drawl based on the FRS and CNG inlet measurements w.r.t gas sourced from various CGS of GAIL.

On daily basis started reconciliation of IGL to check and monitor the over all trends. Gas purchased from Gail vs Gas Consumed were monitored. Since Daily downstream PNG consumption was not available so PNG I/L is assumed as its approximate downstream consumption to get a bigger over all picture of gas reconciliation . Transportation loss

between Gas purchased from gail and Gas entered in IGL system is also calculated by subtracting Gas in from GAIL vs sum of CNG gas inlet and PNG FRS inlet.

Please refer annexure-i for the format.

3.5) Surprise visits carried out at I&C customers. All the industrial and commercial customers were visited to check their set pressure, condition of Meter & regulator etc.

- 7 meters found stopped & 4 meter found not moving on low load. New meters of correct size were installed.
- In 96 cases (commercial) & 34 cases (Industrial) running pressure found higher (> 10%) than set / contract pressure. Pressure set right.
- Pressure regulating valve seals found broken in 51 commercial customers and in a few cases no seal was found. New seals installed.
- Meters found tampered /damaged: We have found tampering of meter index at various customers in the industrial and commercial segment.



Fig 2- Meter tampered (Blocking of transfer gear assembly)



Fig 3-Inside of Gear Assembly

3.6) Gas reconciliation in Industrial Hubs

By installing master meters in the main line entering industrial areas, we found huge difference in the gas quantity measured by the Master meter and sum of all the meters installed in the premises of customers.

On analysis of the difference it has been found that there was gas theft by customers incorporating a “T” before meter .Customer thus by passed the meter and added illegal pipeline till its appliances.

Some of the pics are as attached



Fig 4- Illegal pipeline connection using T



Fig 5- By passed meter pipeline concealed under wall

3.7) Review of I&C bills with respect to supply pressure and the pressure correction factor applied in the bills. :

Eight Commercials were found under billed due to wrong correction factor. Bills are revised

3.8) Problems found in MDPE Network:

Gas loss Trends of past few years (Yr 2012 to 2015) analyzed and found gas loss increased in winter every year which indicated that there is a common cause due to that quantity of un-accounted gas (gas loss) increases in winters. Control rooms complaint logs books shown frequent complaint of gas leakages from domestic regulators during winter. Please refer Annexure-ii

Leakages in Domestic regulators:

- Total Regulators: 193060
- Checked: 410919 (with repetitive cycles)
- Leakages found & rectified: 32000 cases.



Fig 6 - Leakage point. (regulator reduces pressure from 4 bar to 21 mbar)

Based on the inputs from IGL, design modifications has been done in the regulator by OEM that includes:
Modification in the design of slam shut valve (two “o” rings and one plastic ring) which addressed leakage during winters.

3.9) Enhance MDPE and Transition Fitting leakage testing :

FRS downstream reconciliation shown high un-accounted gas. Comprehensive testing of MDPE network was carried out. Incidences of MDPE damage/ punctured by third parties, rat bites and leakages from fusion points as well from transition fittings (TFs) were found

Table 1: No. of leakages observed

Segment	Leakages found and rectified
MDPE	120
TF	650



Fig 7- MDPE Rat Bite

3.10) Odorization

To detect early gas leakages odorization dosing rate increased to 41ml/SCM.

3.11) Smart phone based metering started for Domestic customers :

An app based solution introduced for domestic meter readers. Using the app meter reader take the picture of meter with counter reading (index) and directly download in IGL server for verification billing from the customer premises itself. This image carries date and time stamp generated automatically while clicking the picture. This has avoided chances of fake reading given by the meter readers without visiting customer houses.

3.12) Other actions taken to improve un-accounted gas :

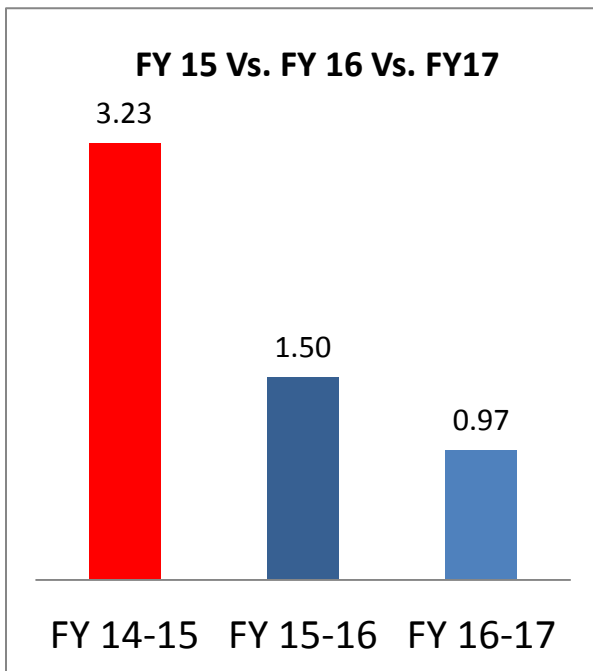
- Optimized PNG network operating pressure from 4 bar to ~2.8 bar to control gas loss due to leakage. (*where ever possible*)
- Implementation of AMR for I&C customer & FRS.
- Isolation of gas supply of the I&C customers from outside of their premises in case of permanent disconnection is made mandatory.

- Special drive launched to identify low consumption domestic meters for their replacement
- Minimum charges policy implemented for PNG domestic customers (4.0 SCM/ billing cycle).
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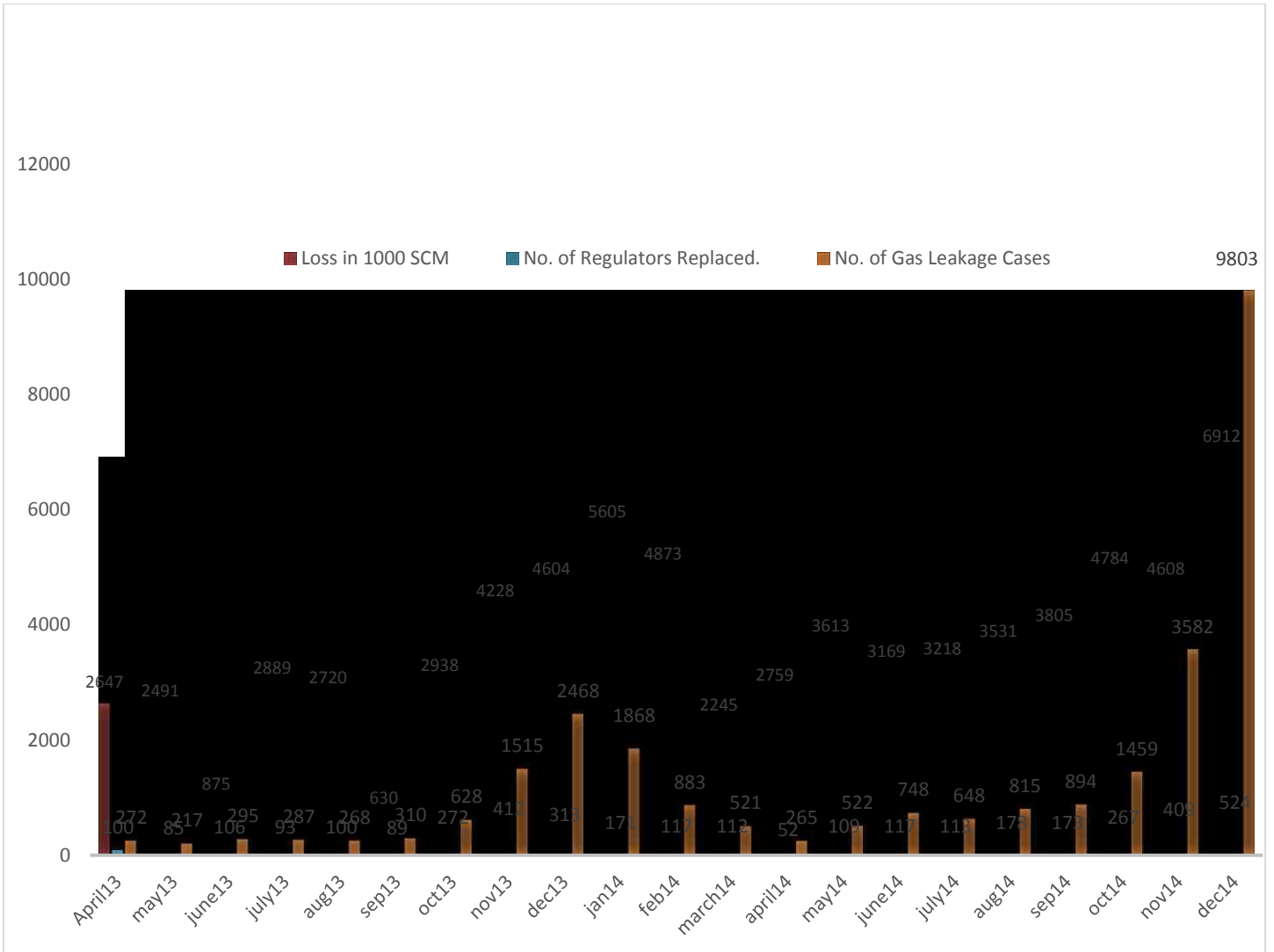
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4.0) Conclusion:

At present gas loss (un- accounted gas) of IGL is under control as following for FY 16-17 in comparison to FY15-16 and FY 14-15



Annexure ii) – Complaint of Gas Leakages





Presenting author Biodata

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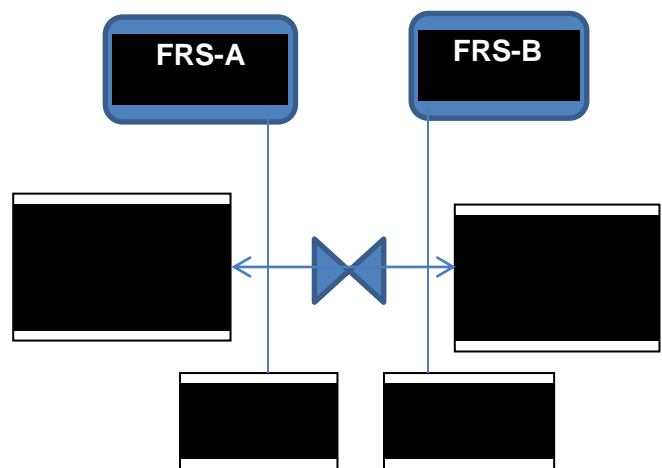


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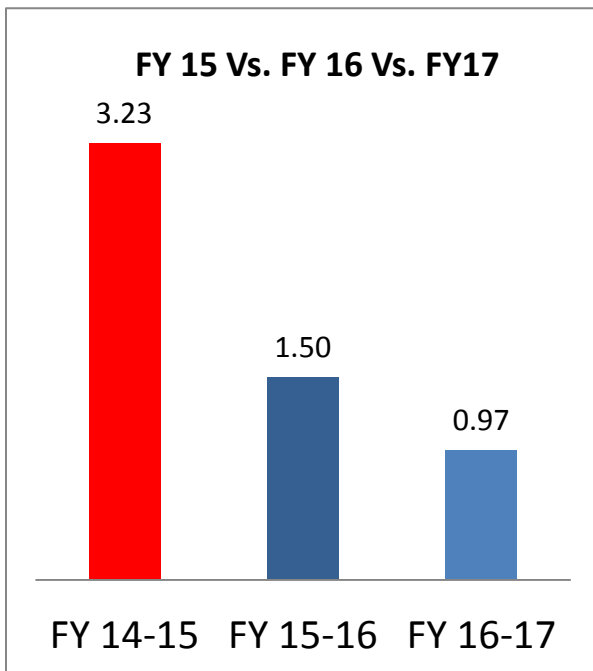
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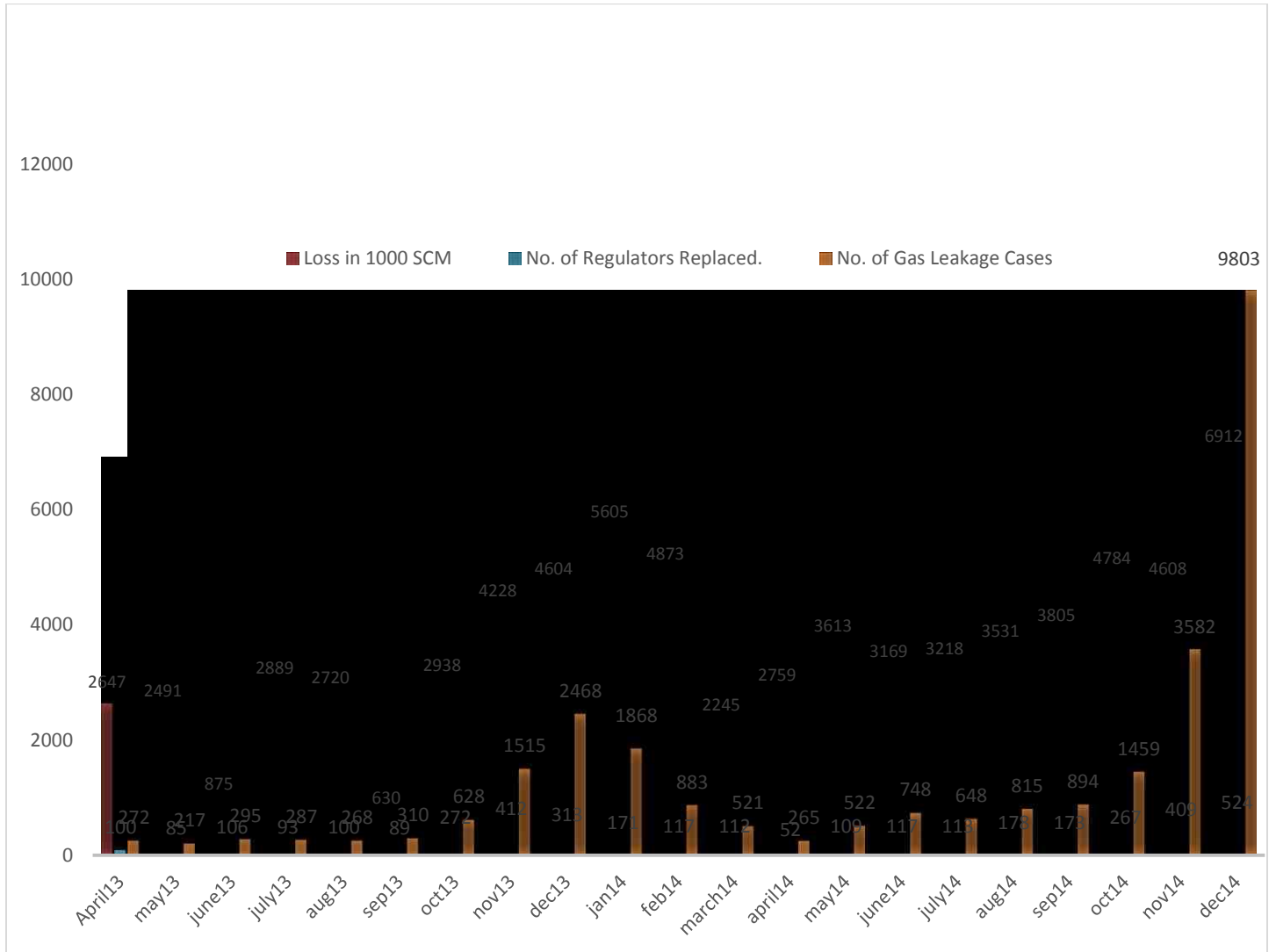
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In his previous assignments he has also been deputed to Gail Gas Agra and Firozabad for Audit, carried out inspections of gas measurement systems at gas terminals, customer ends and suggested various procedures for accurate gas measurement and gas loss control. He is the key strategist in preparing various innovative ways for controlling IGL Unaccounted gas loss.

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