EPIL
Pipeline Infrastructure Limited

Digitalization in Operations for Maximizing Efficiency and Safety

Subrata Banerjee & Bishnu Mishra

28th June 2024

Speakers Profile

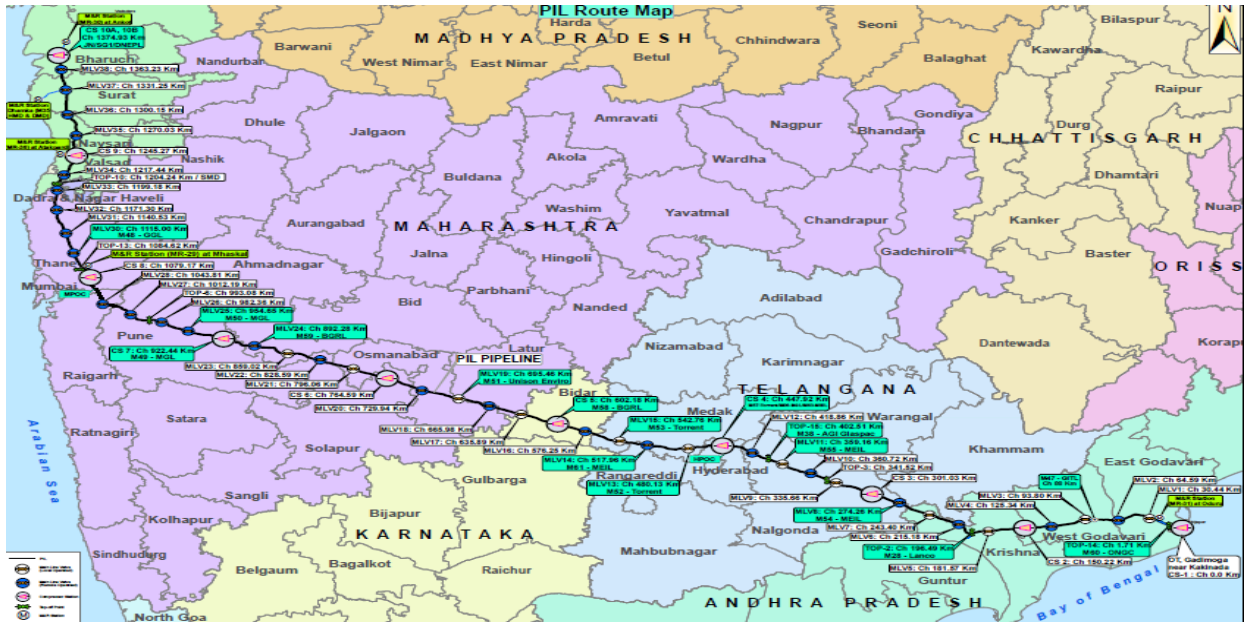
 **Subrata Banerjee** **PIL**	Head Pipeline Operations Centre, CGM - Pipeline Infrastructure Limited (PIL) BEE, BOE Experience for 17 Years in NG Pipeline Operations/measurements. 11 Years – Thermal and GT based Power Plant Operation
 **Bishnu Mishra** **PIL**	Lead MPOC Sr. GM - Pipeline Infrastructure Limited (PIL). BTech (Inst) Experience for 17 Years – NG/ Liquid Ethane Pipeline Operation and measurement.

Content

Pipeline Infrastructure Limited

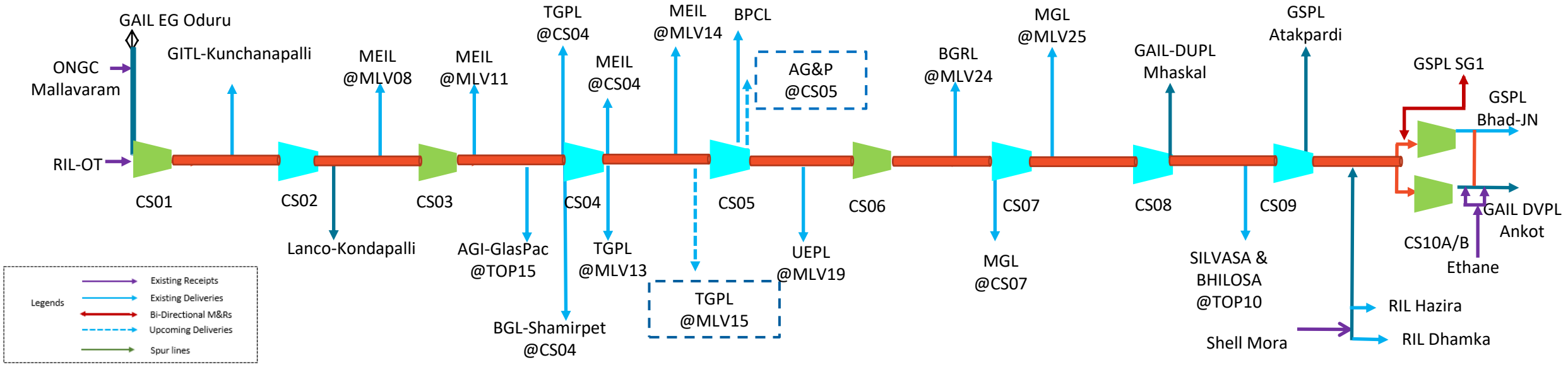
Brief on PIL Pipeline

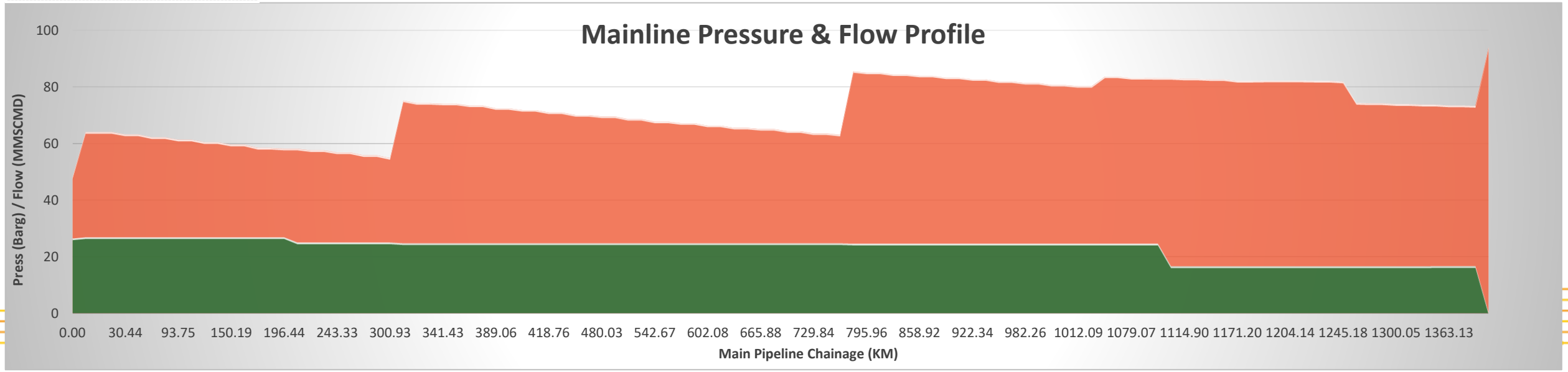
Description	Value
Trunk Pipeline Length	~1,375 KM
Trunk Pipeline Outside Diameter	DN 1200 (48 inch)
Cumulative Length of Interconnects	~ 108 KM
Diameter of Interconnects	20” to 30”
Design/Authorised Throughput	85 MMSCMD
Design Pressure	98 Barg
External Anti-Corrosion Coating	Three Layer Polyethylene
No. of Compressor Stations (CS)	11
No. of Mainline Block Valves and Tap-off stations	44
No. of Entry / Exit (CTM)	6 / 23



- 11 CS (compression power > 900 MW)
- State of the art features - low emission control, better operational efficiency
- 2 (24X7) Pipeline Operation Centers, at Navi Mumbai and Hyderabad
- Bidirectional and Remote gas flow operation capability
- SCADA system and dedicated OFC

Brief on PIL Pipeline





Requisite of PIL Pipeline Operations and Control

to maximize operational efficiency and safety.

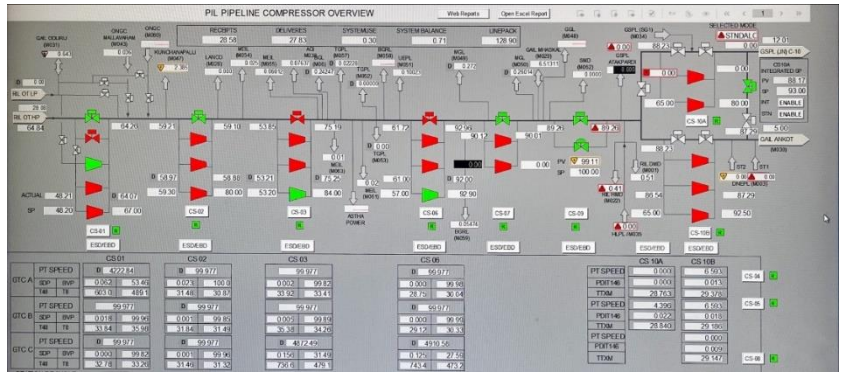
Pipeline Infrastructure Limited

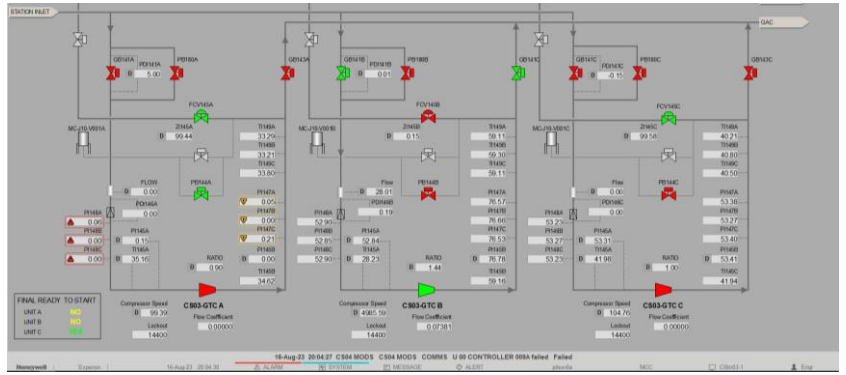
- Operations as whole Pipeline Perspective
- Optimized pipeline operations planning
- Uninterrupted receipt & delivery
- Enhanced Pipeline Integrity monitoring - PAS
- Timely detection of anomalies in Pipeline assets
- Handling emergency scenarios effectively
- Accurate Inventory assessment for identifying fugitive losses in pipeline
- Minimal impact on environment due to emissions
- Correctness in Gas measurement
- Timely Gas measurement validations & billing - RPA

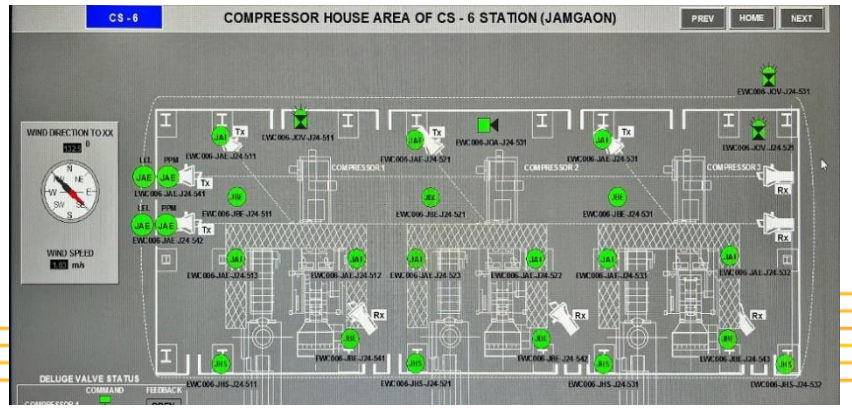
Digitalization enables to perform better & effective remote pipeline operations and control, thus ensures Safety, Reliability & Efficiency.

Operations and Control - as whole Pipeline Perspective

- State of the art SCADA with Remote and Local operation capability.
- SCADA comprises of RTU at Compressor station, servers at both Pipeline Operations Centers (POC).
- Start/stop of CS/GTC from POC
- Control of Gas Pressure, Flow through M&R
- RTU is connected to field instruments, third-party PLC i.e., MK-VI, CCC, F&G, GEG etc.
- Monitor essential parameters of Fire And Gas Detection system of all Above Ground Installations

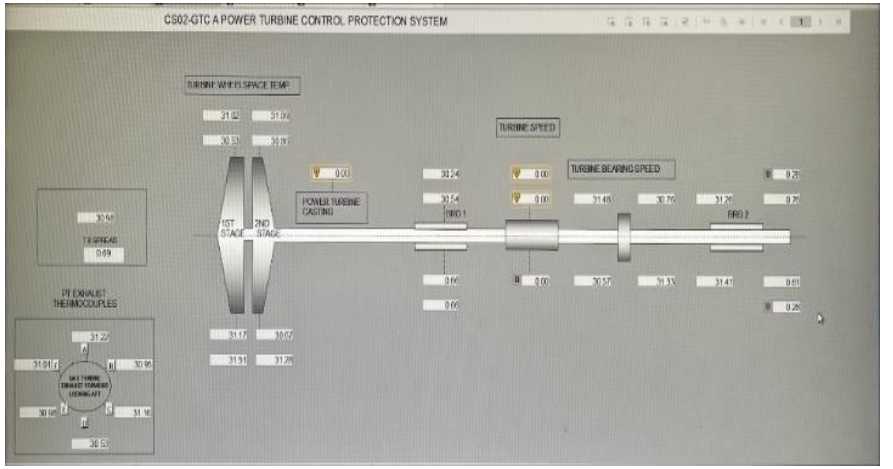


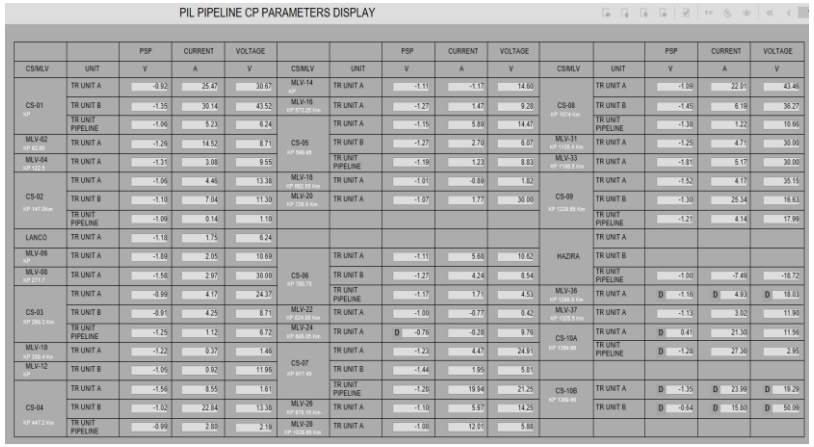


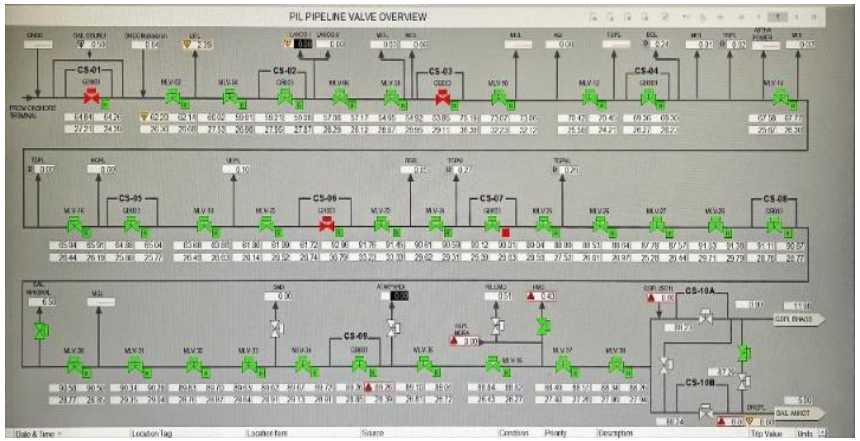


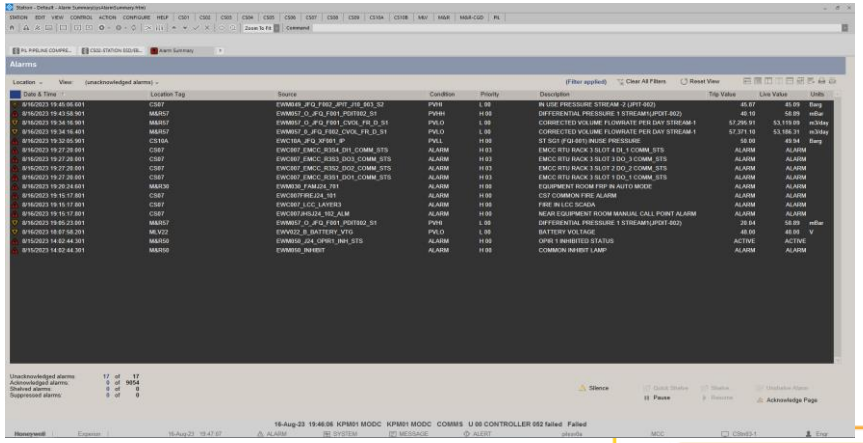
Operations and Control - as whole Pipeline Perspective

- Monitor CP Parameters and act.
- Monitor pipeline process parameters and open/close valves, regulators.
- Manage alarms with necessary action
- Monitor critical parameters through SCADA and act/notify thru SAP





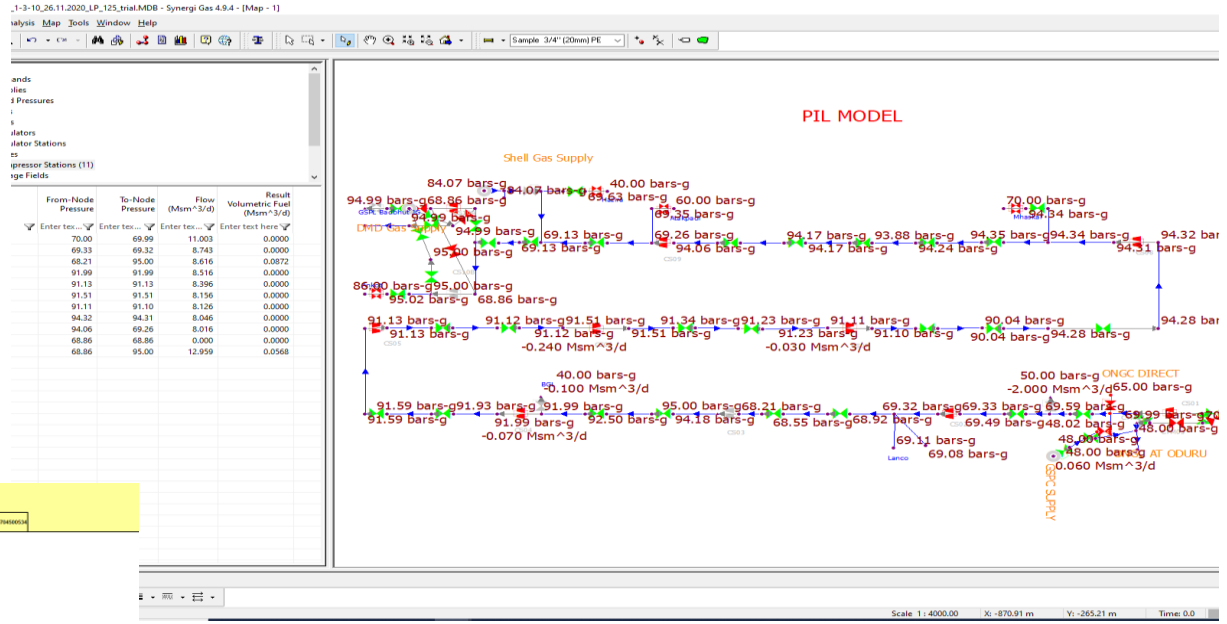


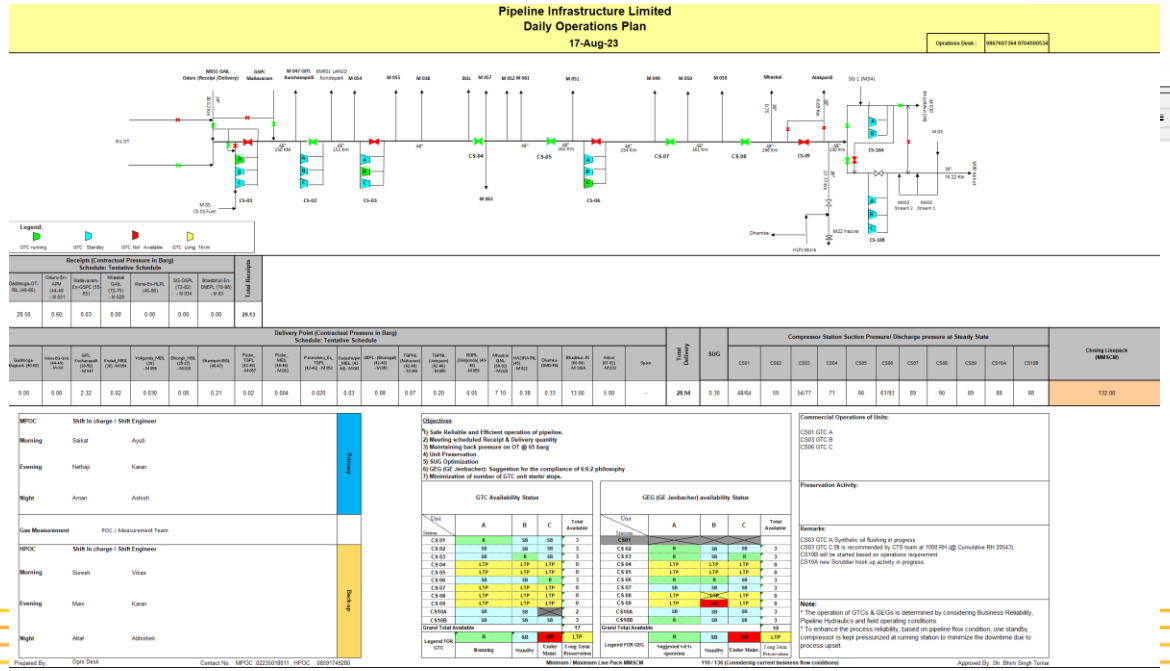


PAS Offline Module - Better Planning and analysis

PIL Pipeline / Asset data used in the Offline PAS models..

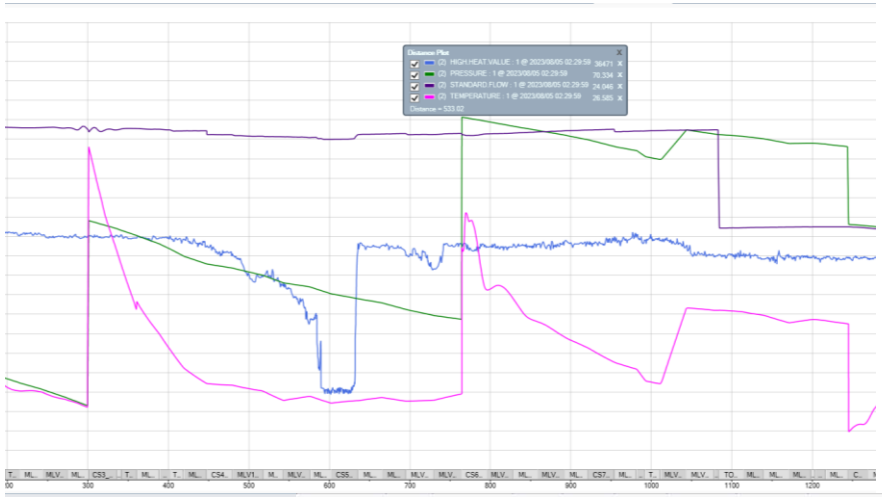
- Daily operations Planning
- Operation Budget – Monthly/Annual
- SUG Optimization
- PIL Capacity study for PNGRB submission

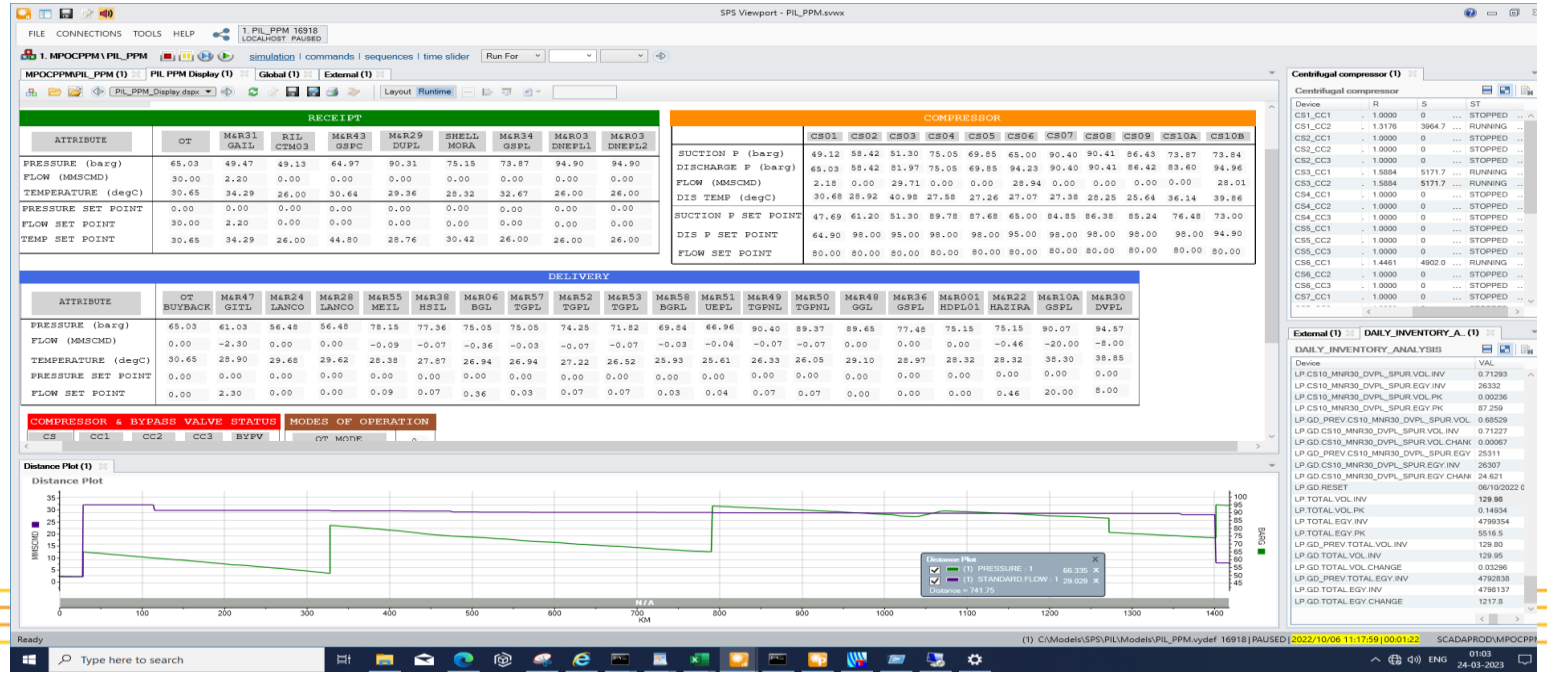




Enhanced Pipeline Integrity control with PAS

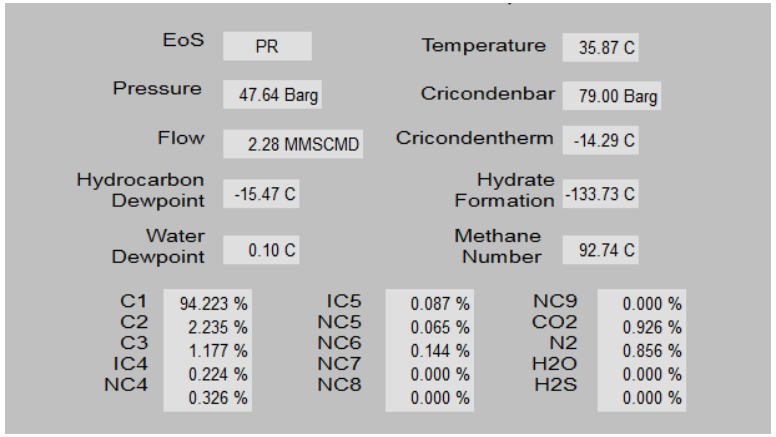
- Pipeline hydraulics monitoring and control
- Leak detection in pipeline and Predicting environmental impact.
- Gas composition tracking
- PIG tracking
- Planning Predictive Module

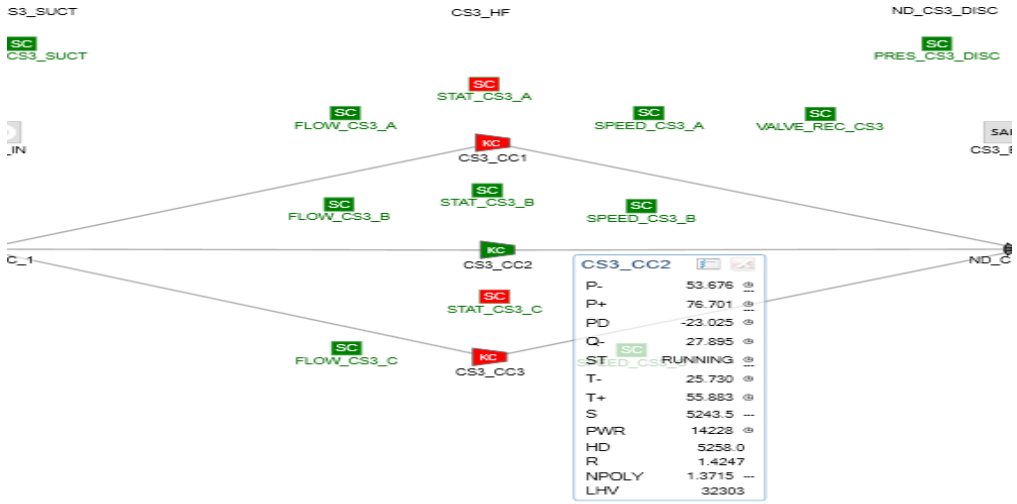


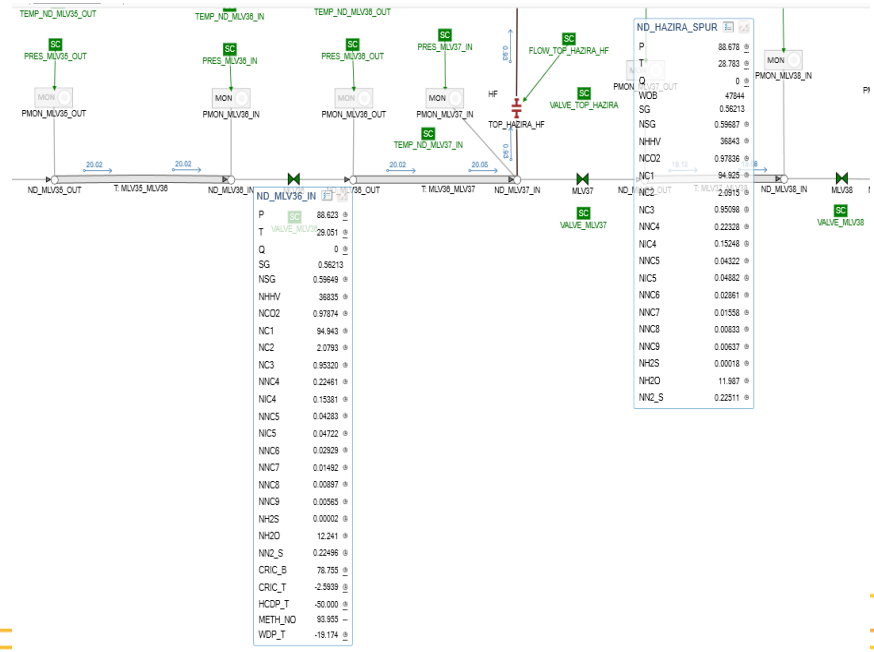


Enhanced Pipeline Integrity control with PAS

- Essential pipeline and asset parameters (derived by PAS) monitoring for better and effective asset operation and control.
- Online dew point temperature monitoring at all exit points.
- Calculation of offline dew point for any gas composition
- Record in historian for analysis



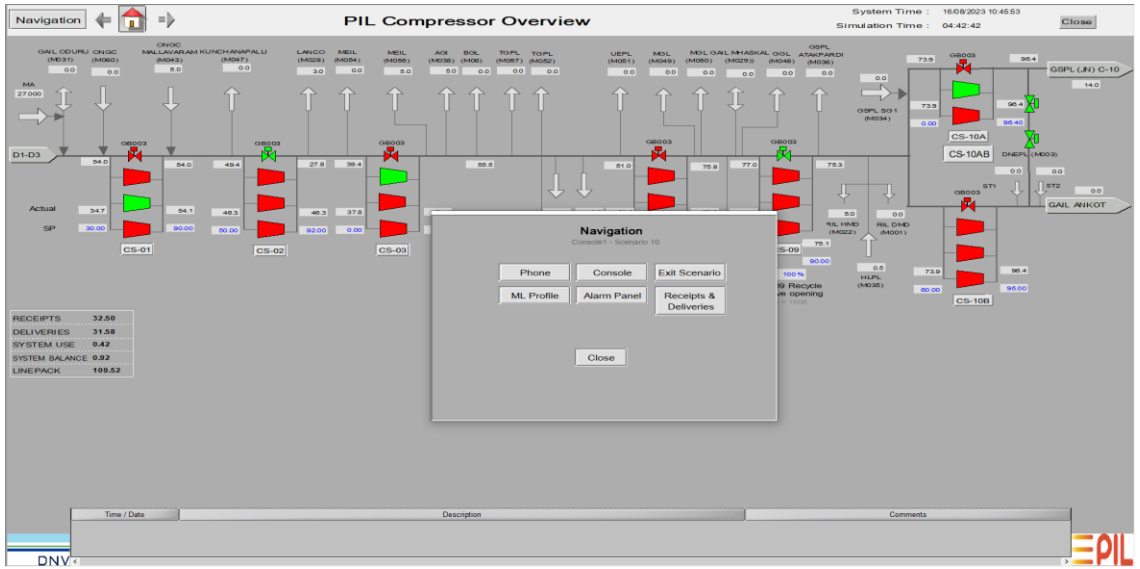


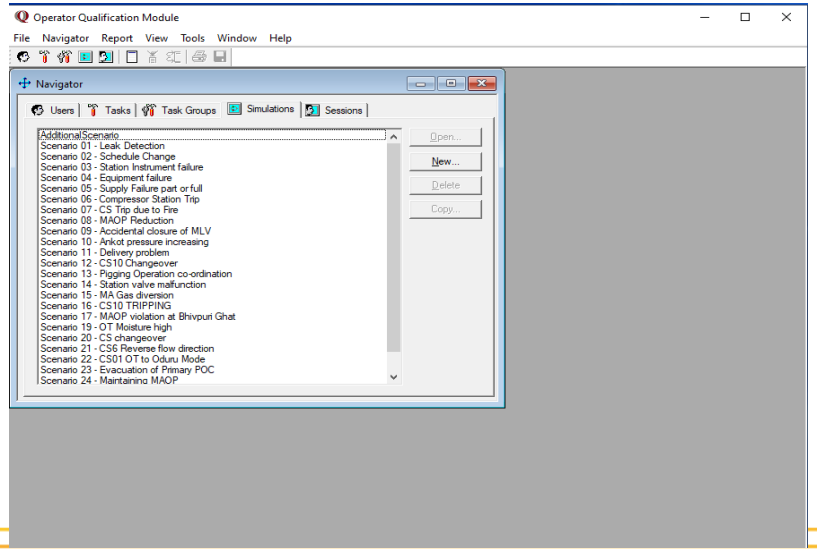


Simulator Training through PAS Trainer

POC Engineers training - Offline Trainer Module (Operator Qualification).

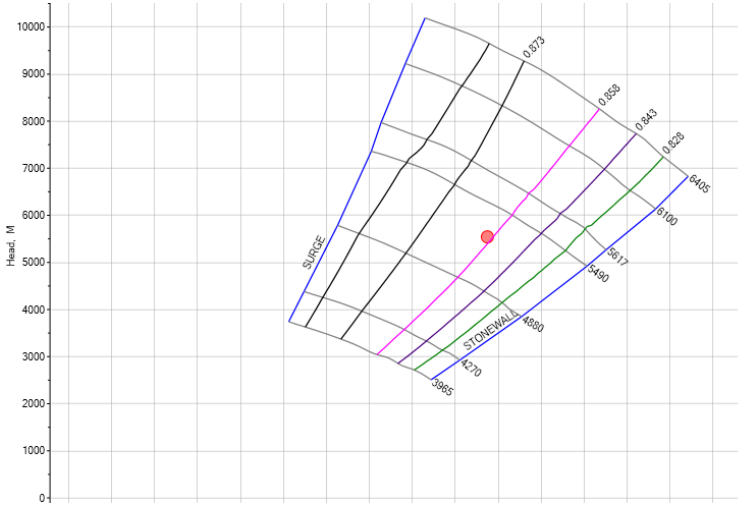
- Simulator for various process upset scenarios
- Look and feel like real time SCADA system
- Steps to be taken as per SOP
- Validation for qualification
- Certification

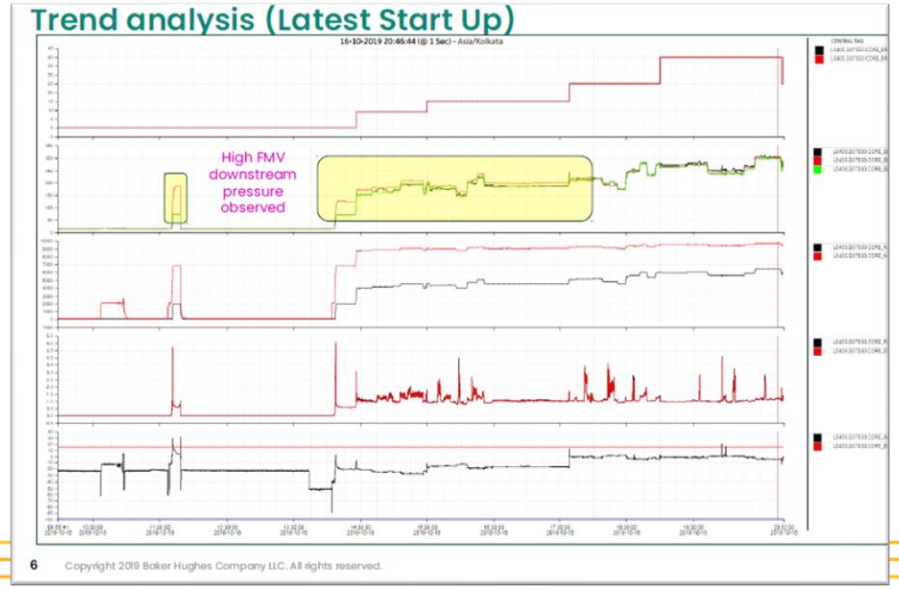


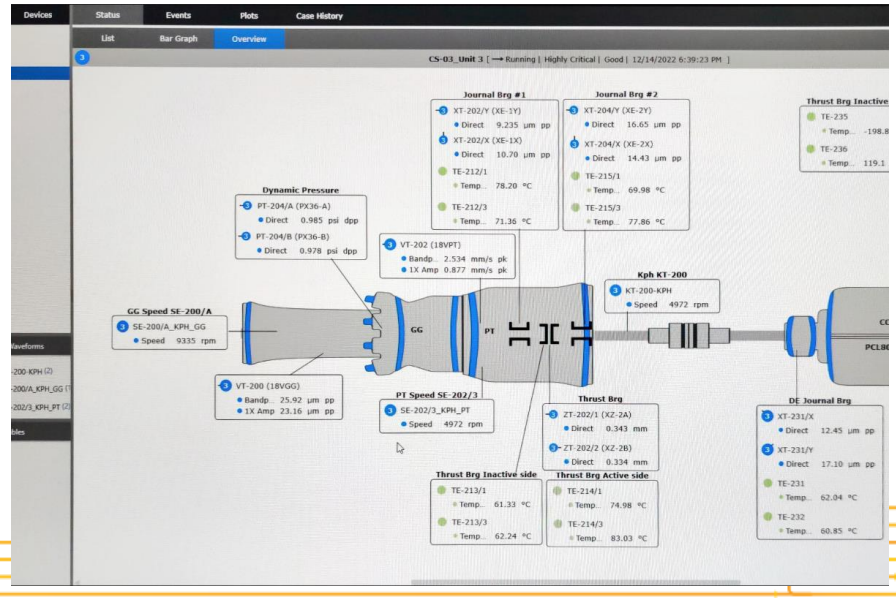


GTC Operations and control

- Asset performance Monitoring and Control through PAS.
- Monitoring critical parameters of all running GTC via System1.
- RMD services provides superior alternative of continuous monitoring by expert engineers and Notify POC over mail with detail report.

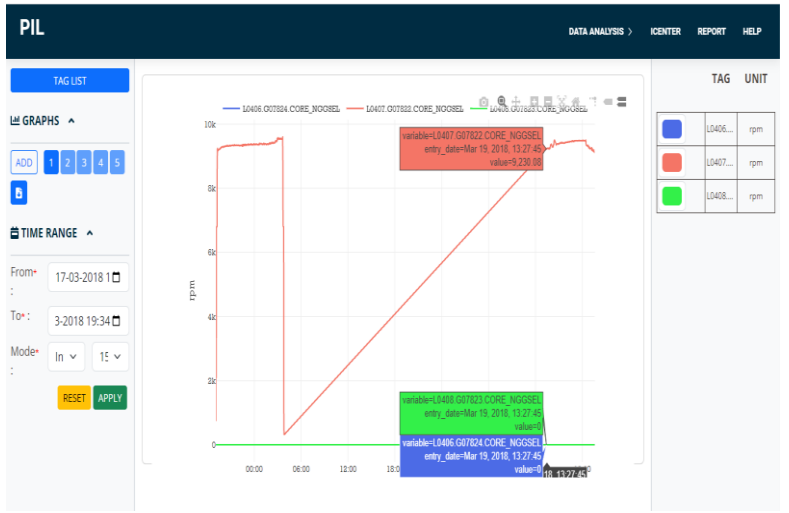


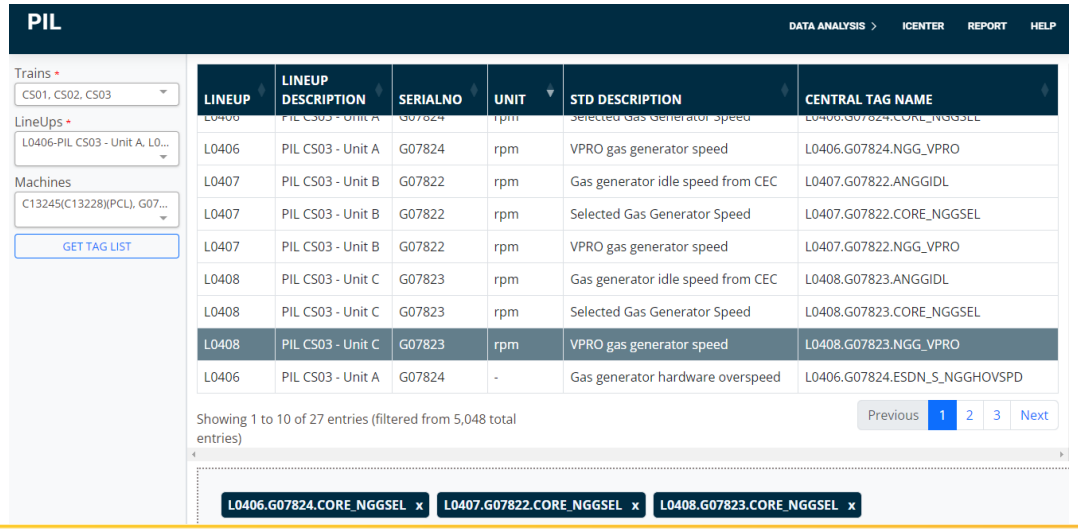




Technological Advancement in GTC Digital Data Processing

- Historical GTC data is collected from OEM Servers
- Artificial intelligence (AI) based – GTC Digital Data Processing being developed.
- Benefits - Behavioral fingerprint development, Predictive analysis

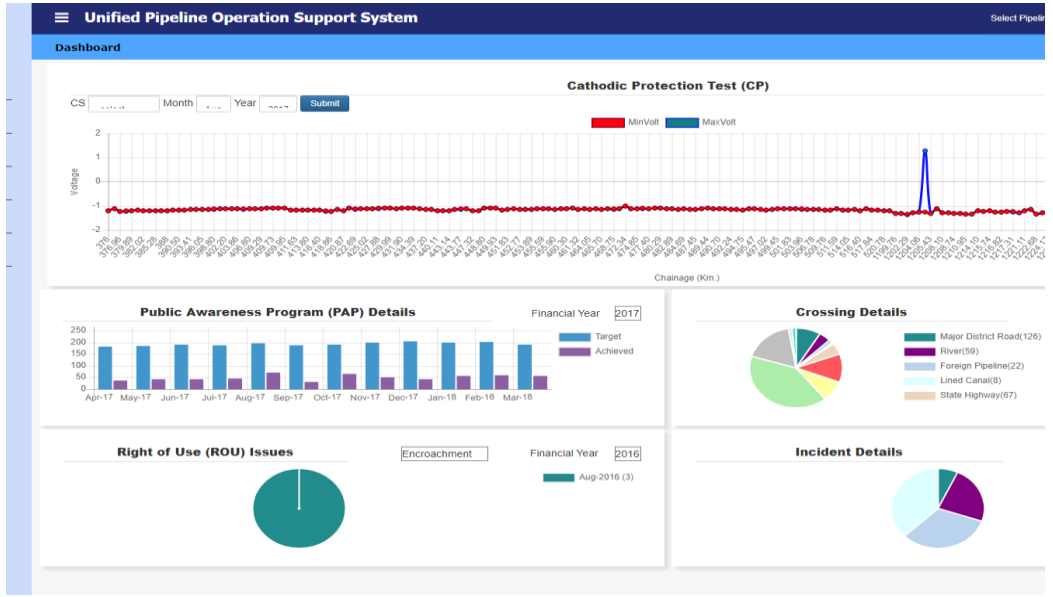


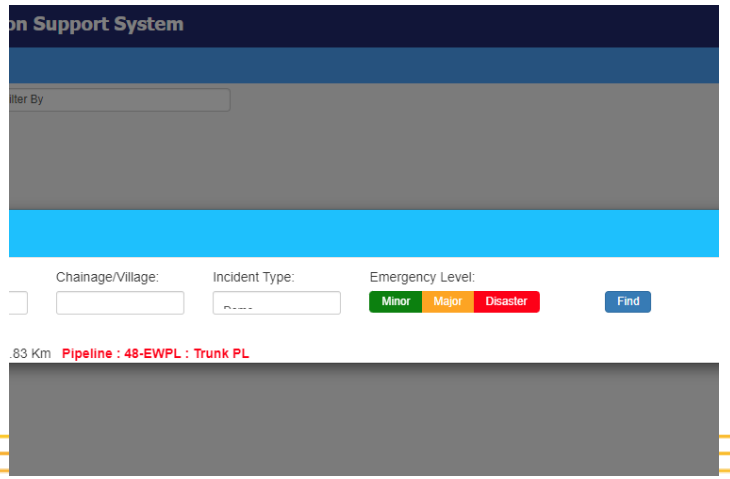


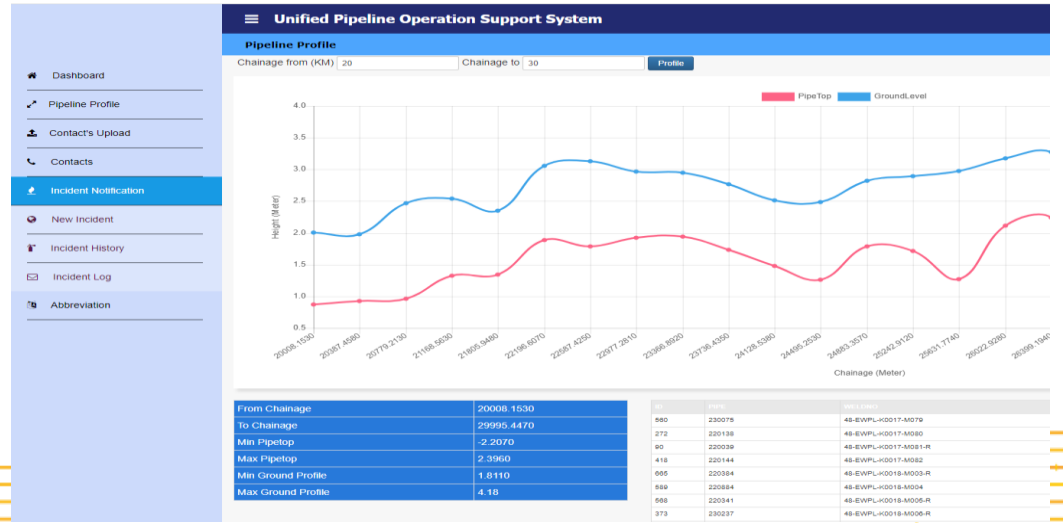
	entry_date	L0406.G07824.CORE_NGGSEL	L0407.G07822.CORE_NGGSEL	L0408.G07823.CORE_NGGSEL
0	17-03-2018 19:07	0	758.73	0
1	17-03-2018 19:07	0	1630.75	0
2	17-03-2018 19:08	0	2172.21	0
3	17-03-2018 19:08	0	2218.76	0
4	17-03-2018 19:08	0	2089.96	0
5	17-03-2018 19:08	0	2102.69	0
6	17-03-2018 19:09	0	2100.14	0
7	17-03-2018 19:09	0	2100.1	0
8	17-03-2018 19:09	0	2100.21	0
9	17-03-2018 19:09	0	2100.18	0
10	17-03-2018 19:10	0	2379.83	0
11	17-03-2018 19:10	0	3349.86	0
12	17-03-2018 19:10	0	4188.3	0
13	17-03-2018 19:10	0	5133.38	0
14	17-03-2018 19:11	0	6633.17	0

Effective Emergency Handling-ERSS / UOSS

- UOSS is a Web based application software.
- The entire loss prevention program for pipeline operating includes emergency preparedness as a key component.
- Essential for the efficient handling of any event to reduce damage to people, property, and the environment in and near compressor stations and pipeline ROU.
- In case of any emergency, POC initiates emergency in ERSS.
- All concerned persons are notified by e-mail and SMS through this portal

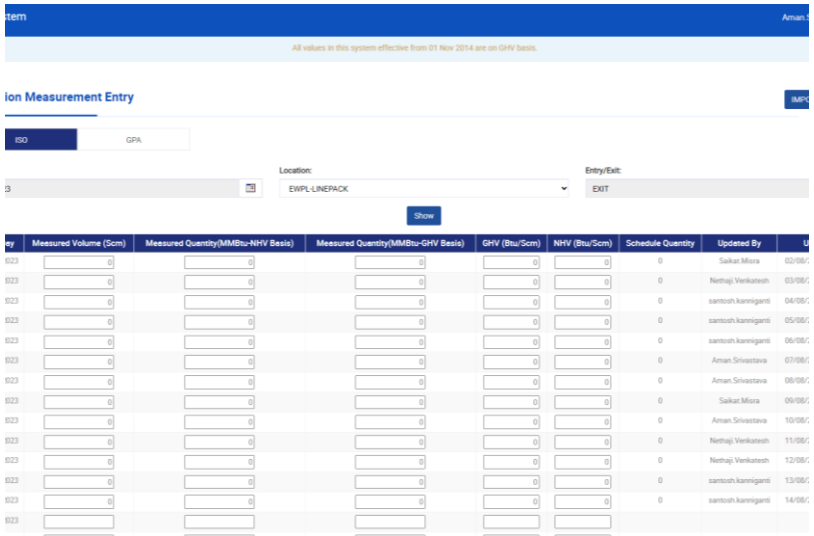


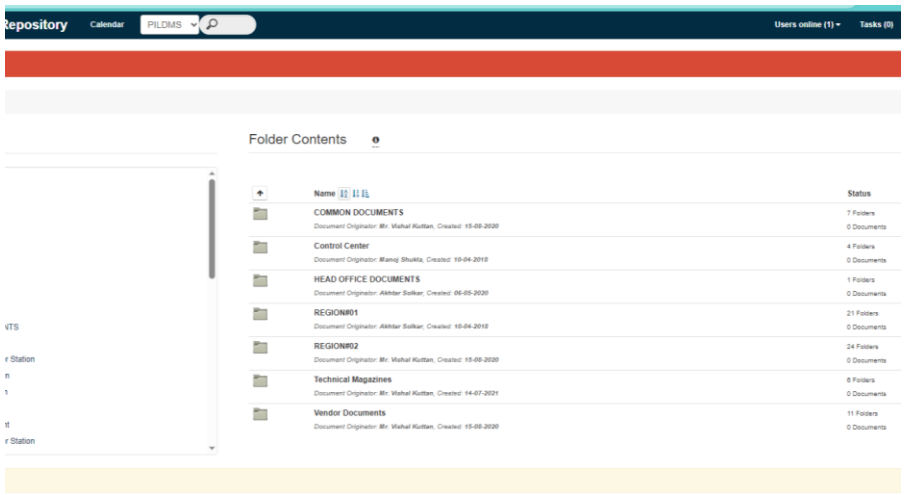


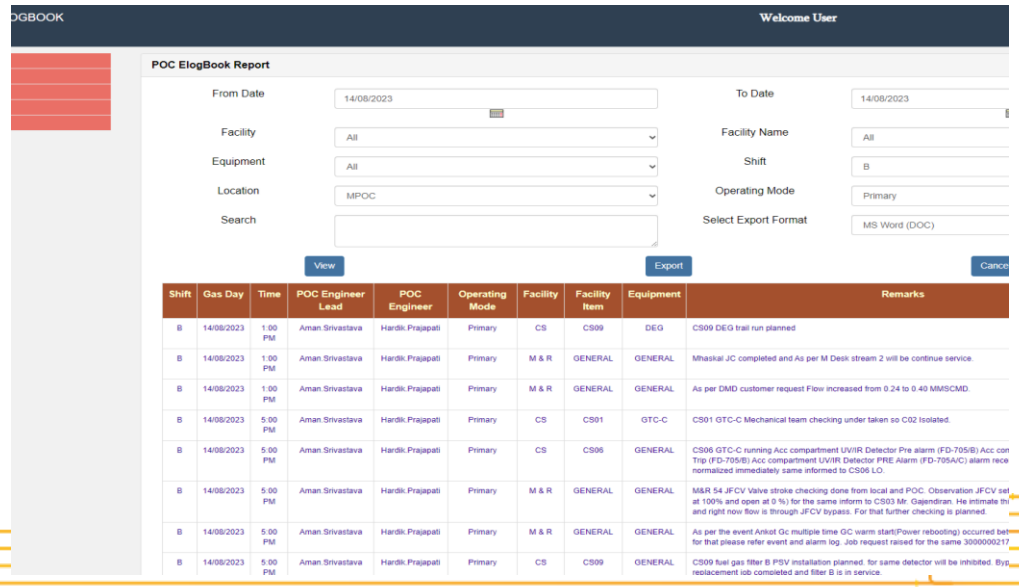


Supporting tools for POC

- PIL GAS TRANSPORTATION SYSTEM (PGTS)
- SAP
- POC E-LOG
- DOCUMENT MANAGEMENT SYSTEM (DMS)
- ALARM INFORMATION MANAGEMENT SYSTEM (AIMS)

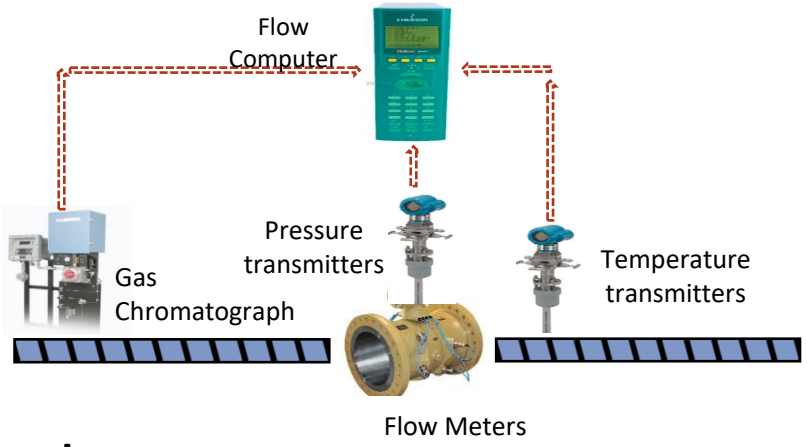




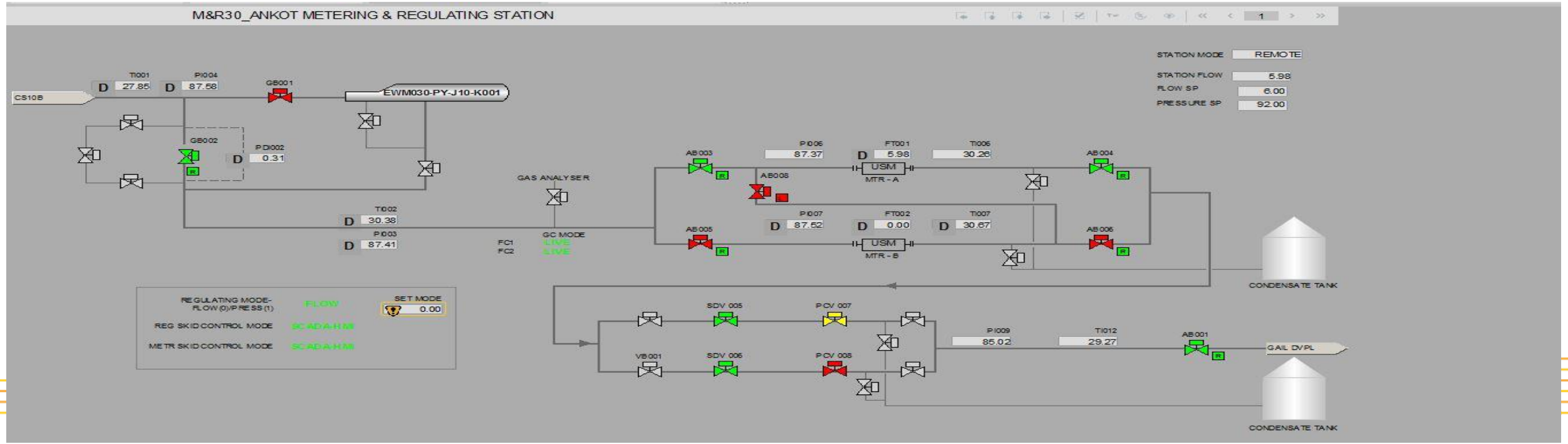


Custody Transfer Metering station Remote Operations

- Valves remote operation
- Flow data availability
- Flow meter healthiness
- Stream changeover
- Remote access to all field devices



24X7 Assurance to Uninterrupted Flow, Metered Gas & Correctness in fiscal measurement



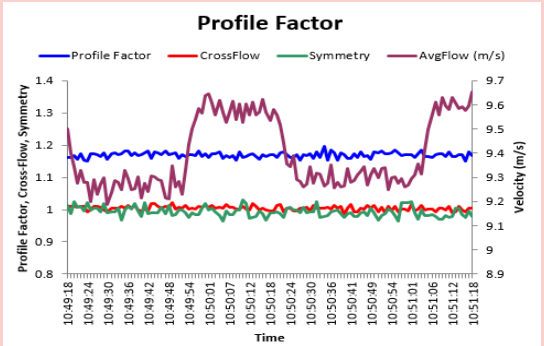
Gas Fiscal Measurement - Correctness

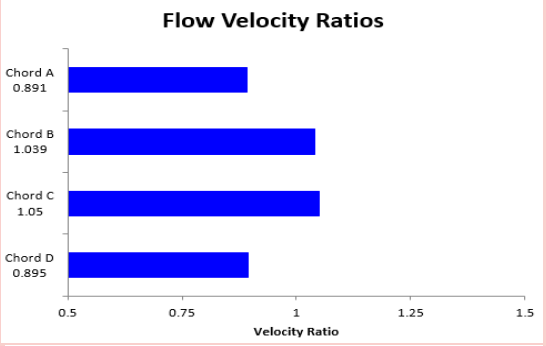
Pipeline Infrastructure Limited

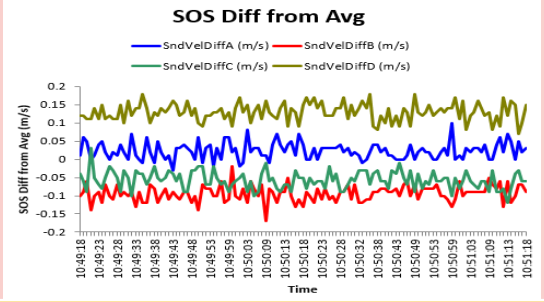
Reviewing & Tracking Metering Information & Diagnostics -

Flow meters, Gas Chromatographs, Pressure Transmitter, Temperature Transmitter, Flow Computers etc.

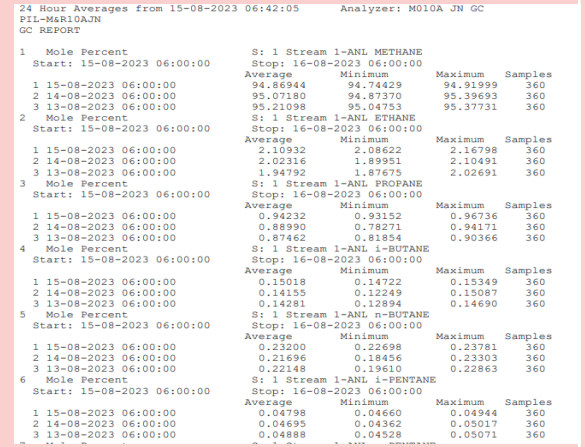
Flow meters (USM, Orifice)







Gas Chromatographs



```
24 Hour Averages from 15-08-2023 06:42:05        Analyzer: M010A JN GC
PIL-M&R10AJN
GC REPORT

1   Mole Percent                          S: 1 Stream 1-ANL METHANE
  Start: 15-08-2023 06:00:00              Stop: 16-08-2023 06:00:00
                                  Average      Minimum      Maximum    Samples
  1 15-08-2023 06:00:00          94.86944     94.74429     94.91999        360
  2 14-08-2023 06:00:00          95.07180     94.87370     95.39693        360
  3 13-08-2023 06:00:00          95.21098     95.04753     95.37731        360
2   Mole Percent                          S: 1 Stream 1-ANL ETHANE
  Start: 15-08-2023 06:00:00              Stop: 16-08-2023 06:00:00
                                  Average      Minimum      Maximum    Samples
  1 15-08-2023 06:00:00           2.10932      2.08622      2.16798        360
  2 14-08-2023 06:00:00           2.02316      1.89951      2.10491        360
  3 13-08-2023 06:00:00           1.94792      1.87675      2.02691        360
3   Mole Percent                          S: 1 Stream 1-ANL PROPANE
  Start: 15-08-2023 06:00:00              Stop: 16-08-2023 06:00:00
                                  Average      Minimum      Maximum    Samples
  1 15-08-2023 06:00:00           0.94232      0.93152      0.96736        360
  2 14-08-2023 06:00:00           0.88990      0.78271      0.94171        360
  3 13-08-2023 06:00:00           0.87462      0.81854      0.90366        360
4   Mole Percent                          S: 1 Stream 1-ANL i-BUTANE
  Start: 15-08-2023 06:00:00              Stop: 16-08-2023 06:00:00
                                  Average      Minimum      Maximum    Samples
  1 15-08-2023 06:00:00           0.15018      0.14722      0.15349        360
  2 14-08-2023 06:00:00           0.14155      0.12249      0.15087        360
  3 13-08-2023 06:00:00           0.14281      0.12894      0.14690        360
5   Mole Percent                          S: 1 Stream 1-ANL n-BUTANE
  Start: 15-08-2023 06:00:00              Stop: 16-08-2023 06:00:00
                                  Average      Minimum      Maximum    Samples
  1 15-08-2023 06:00:00           0.23200      0.22698      0.23781        360
  2 14-08-2023 06:00:00           0.21696      0.18456      0.23303        360
  3 13-08-2023 06:00:00           0.22148      0.19610      0.22863        360
6   Mole Percent                          S: 1 Stream 1-ANL i-PENTANE
  Start: 15-08-2023 06:00:00              Stop: 16-08-2023 06:00:00
                                  Average      Minimum      Maximum    Samples
  1 15-08-2023 06:00:00           0.04798      0.04660      0.04944        360
  2 14-08-2023 06:00:00           0.04695      0.04362      0.05017        360
  3 13-08-2023 06:00:00           0.04888      0.04528      0.05071        360
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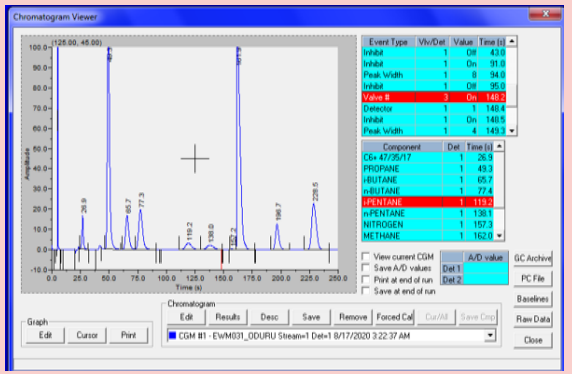


Pressure & Temperature Transmitter, Flow Computer


```
 152                DAILY REPORT (BASETIME  6:00)                08/09/2022 06:00:00
================================================================================
STREAM  1 NAME:   FQI-619 (PRIMARY)  REFERENCE CALC:ISO
LOCATION      :   PIL M&R 10A Bhadbhut JN
TOTAL ROLLOVER:   0     (0=NO,1=YES)

                          CUMULATIVE              PERIOD              FLOWRATE
NRM UVOL                     2160978               64722 m3          71059.03  m3/d
NRM CVOL                   200476985             5938147 SCM          6.4777  MMSCM/d
NRM MASS                      207807.65             4100.89 tonne     4473.52  t/d
NRM ENERGY  SUP          10822604.73           212510.39 MMBtu     232910.30  MMBtu/d
NRM ENERGY  INF           9748442.74           192290.09 MMBtu     209762.78  MMBtu/d

BASE TEMP(Tb)      :      15.00      Deg.C          GAS COMPOSITION
BASE PRESS(Pb)     :      1.01325    bara
Atm press          :      1.01325    bara           NITROGEN      0.208021
AVG METER TEMP(Tf) :      93.76      Deg.C          CO2           0.251912
AVG METER PRESS(Pf):      56.21      barg           METHANE      98.993278
AVG METER DENS     :      62.47595   kg/m3          ETHANE        0.270142
AVG BASE DENS      :      0.690601   kg/m3          PROPANE       0.184426
AVG GCV            :      37.9382    MJ/Sm3         I_BUTANE      0.045473
                   :      25955.75   BTU/SCM        N_PENTANE     0.008726
                   :      9060.70    Kcal/SCM       I_PENTANE     0.020382
AVG NCV            :      34.1650    MJ/Sm3         HEXANE        0.046146
                   :      32282.19   BTU/SCM        HEPTANE       0.000000
                   :      8160.17    Kcal/SCM       OCTANE        0.000000
AVG REAL RD (SG)   :      0.563881                  NONANE        0.000000
AVG UPSTR COMP(Zf) :      0.878178                  DECANE        0.000000
AVG BASE COMP(Zb)  :      0.997976                  ----------------------
AVG GAS VELOCITY   :      17.745     m/s            TOTAL       100.000000
AVG MEASURED VOS   :      443.262    m/s            ----------------------
AVG CALCULATED VOS :      442.906    m/s

DURATION      1377.66   minutes
================================================================================
STREAM  2 NAME:   FQI-611 (BACKUP)  REFERENCE CALC:ISO
LOCATION      :   PIL M&R 10A Bhadbhut JN
TOTAL ROLLOVER:   0     (0=NO,1=YES)

                          CUMULATIVE              PERIOD              FLOWRATE
NRM UVOL                     8581896               61661 m3          67757.63  m3/d
NRM CVOL                   875611799             5642707 SCM          6.1980  MMSCM/d
NRM MASS                      609949.63             3896.86 tonne     4282.77  t/d
NRM ENERGY  SUP          31716969.19           202887.54 MMBtu     221417.43  MMBtu/d
NRM ENERGY  INF          26571629.38           192723.03 MMBtu     199412.90  MMBtu/d
```

Gas Measurement – Timely Gas measurement validations & billing

Measurement correctness	Huge data	Stringent timelines	Manual updation and analysis	Business Expansion

Robotics Process Automation (RPA) - To reduce manual & repetitive works

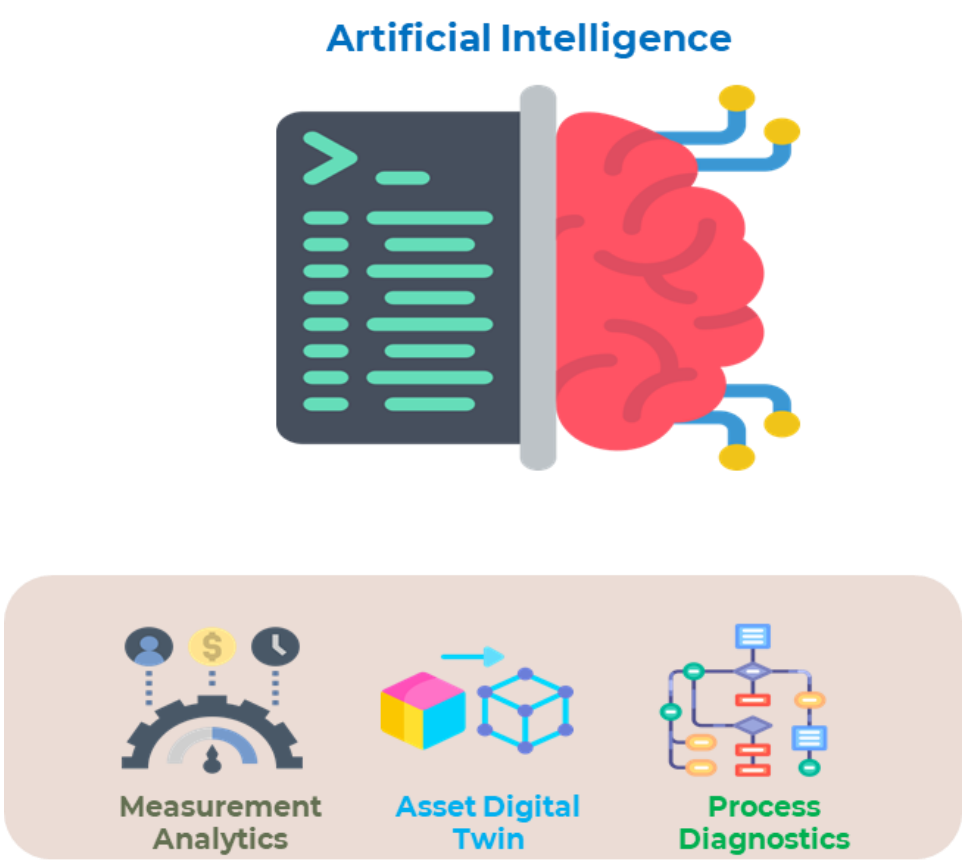
Scheduling for Reports downloading / Data fetching → Data tabulation / Validation → Report Preparation / E-Joint ticket emails

RPA Uniqueness	
• Extensive diagnostics (FC/USM/GC) – archiving & monitoring • Time & Manual efforts saving • CGD USM diagnostics	• FC & GC alarms • Update Gas Composition in keypad • Historical data retrieval • Handling Communication Failure

Technological Advancement in Gas Measurement

Pipeline Infrastructure Limited

Smart Measurement Application | Artificial Intelligence (AI) & Machine Learning (ML) based



Features / Deliverables	Benefits
• Data Analytics • AI Model development • Machine Learning – modules & algorithms • Digital Twin development • Energy reconciliation • Interactive Dashboards • E-Joint ticketing, Emailing & Portal entry	• Real time data capture and processing to identify anomalies of different flow meters. • Metering systems – Ultrasonic Flow meter (USM) / Gas Chromatograph (GC) / Flow Computer (FC) performance - Quantification and Qualification of anomalies • Predictive analysis • Alerts and Alarms. • Reconciliation, line pack calculations etc.

Synopsis:

- Digitalization is imperative to operate in a holistic manner – Whole Pipeline Perspective
- Improved operation and control by real-time monitoring
- Efficient operation of assets and pipeline
- Timely and accurate gas measurement validations
- Enhanced monitoring and timely detection of anomalies of GTC, USM, GC FC etc.
- Prompt action during emergencies
- Predictive maintenance and automated processes
- Better-organized and well-coordinated maintenance of critical assets thus reducing downtime