Sharing of GAIL Experience- H_2 Blending in CGD Network on Pilot Basis

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GAIL India Limited

Presentation by:- GAIL (India) Limited

JOURNEY OF GAIL (INDIA) LIMITED

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1984	1987	1990	1994	1997	1999	2004	2006	2007-08
Formation of GAIL	HVJ Pipeline	Entry into LPG	Entry into CGD	Navratna	Entry into Petrochem	First LNG Import	First SPOT LNG at Dahej	BCPL Incorporated	Pata expansion 410 KTA / GAIL Gas

…SUPPORTING INDIAN ECONOMY

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DVPL-II
(610 Kms)

LNG deals (US, Russia)

Maharatna

Cove Point, USA

PM Urja Ganga P/L KKBMPL/ MNJPL

VAPL P/L Project

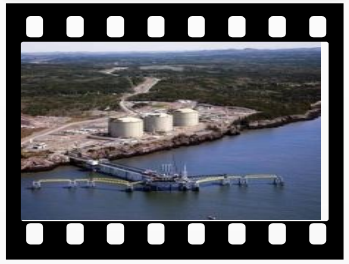
2008-11 | **2011-13** | **2013-24**

CJH P/L
(450 Kms)

USA Shale Asset

Vijaipur-Dadri-Bawana Nangal (1260 Kms)

Dhabol LNG comissioned



Dabhol Bangalore (1000 KMS)

Pata –II (810 KTA); BCPL (280 KTA) PDHPP (500 KTA)

Green Hydrogen Projects

INDIA'S NATIONAL HYDROGEN ENERGY MISSION

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Hon'ble Prime Minister launched the National Hydrogen Energy Mission (NHEM).

The Mission aims to meet GOI's climate targets and making India a green hydrogen hub.

The Objectives of the Mission include:

- 5 MMT Green Hydrogen production per annum by 2030
- Replacing Grey Hydrogen with Green Hydrogen by 2035
- Progressively blending Green Hydrogen in CGD systems up to 15% by 2030
- Shift heavy duty long-haul mobility to vehicles powered by Green Hydrogen by 2040
- Shift steel production to low-carbon routes using Green Hydrogen by 2040
- Build/retrofit two Indian ships powered by Green Hydrogen or its derivative fuels by 2027
- Emerging as a Hub for Green Hydrogen & Green Ammonia

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H2 BLENDING IN CGD NETWORK

H2 BLENDING IN CGD NETWORK

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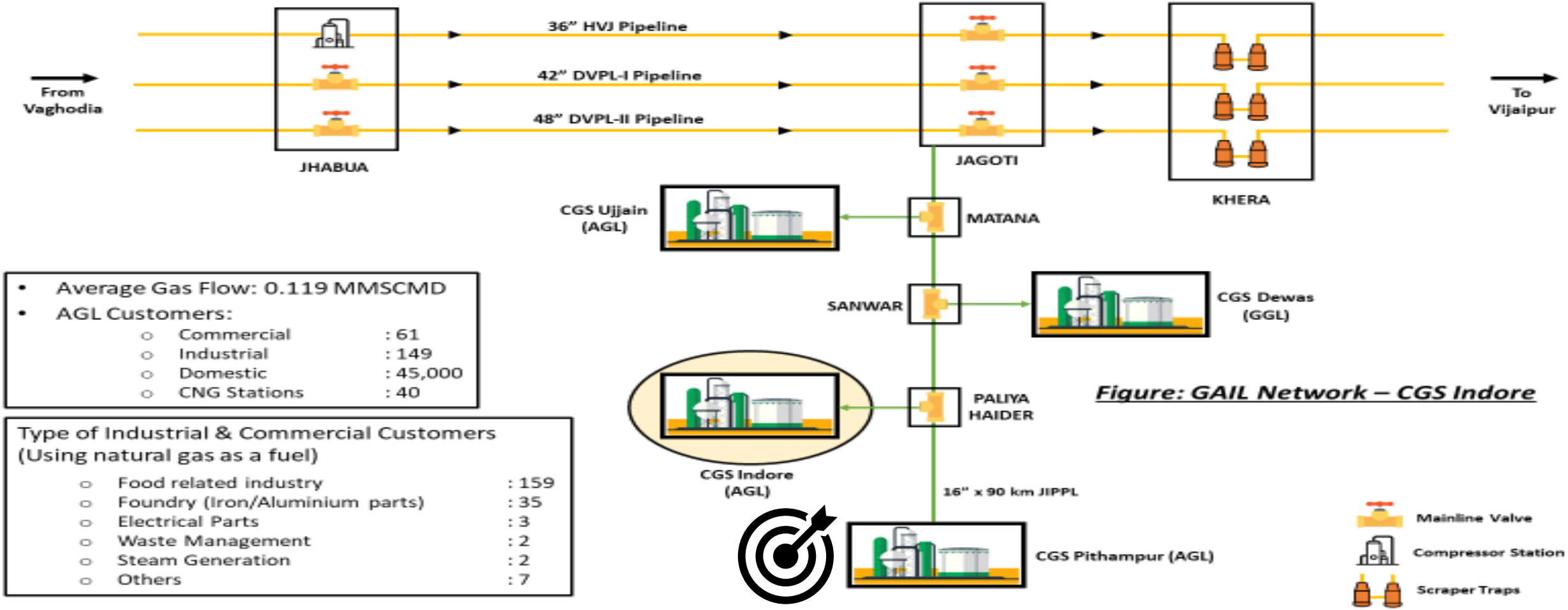

Figure: GAIL Network – CGS Indore

- Average Gas Flow: 0.119 MMSCMD
- AGL Customers:
  - Commercial : 61
  - Industrial : 149
  - Domestic : 45,000
  - CNG Stations : 40

Type of Industrial & Commercial Customers (Using natural gas as a fuel)

- Food related industry : 159
- Foundry (Iron/Aluminium parts) : 35
- Electrical Parts : 3
- Waste Management : 2
- Steam Generation : 2
- Others : 7

CGS Indore GA operated by AGL

CHRONOLOGY OF EVENTS

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March 2021

Concept Study by Technip India Limited

Apr 2021

Intimation to PNGRB regarding blending

May 2021

Investment Approval for GAIL's entry into for blending of H2 in Natural gas

June 2021

PNGRB confirmation for implementation of Project

Jul 2021 to Nov 2021

Procurement and execution of Project at site

Dec 2021

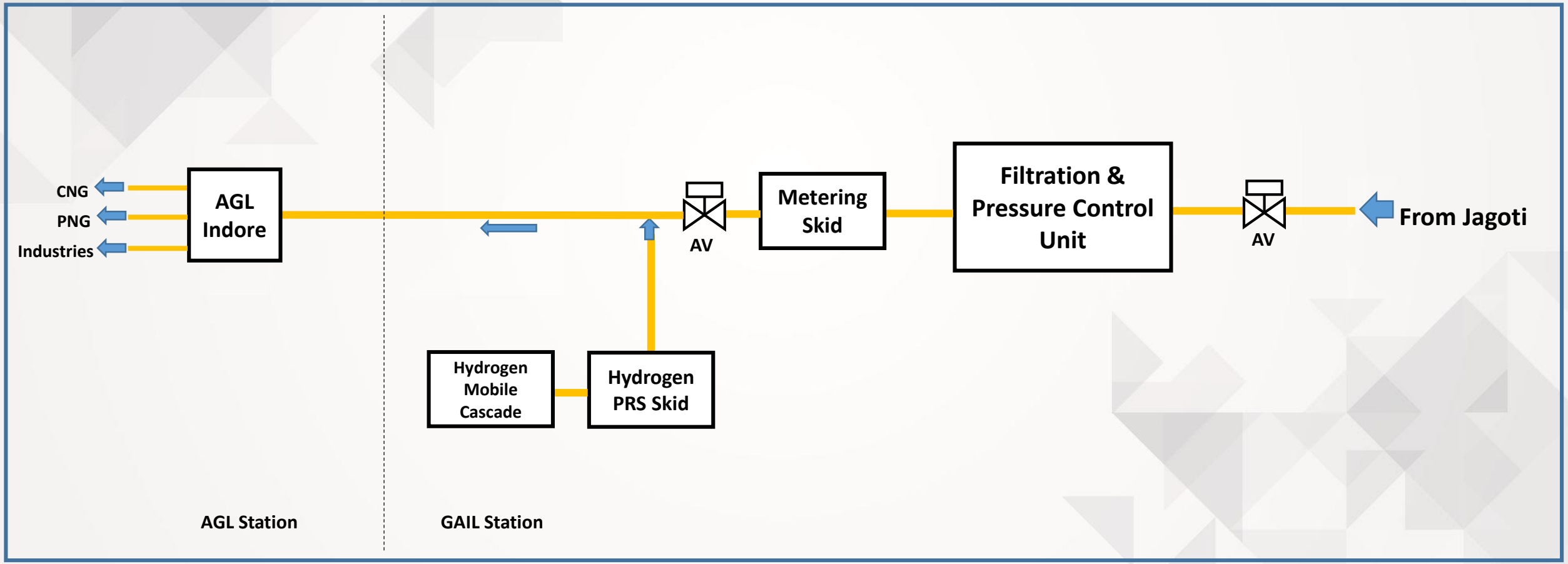
PESO-Nagpur approval for Hydrogen blending in NG

Jan 2022

Testing and commissioning of project

H2 BLENDING IN CGD NETWORK

Schematic of H2 Blending in CGD Network



H2 BLENDING IN CGD NETWORK

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PRS skid

PRS skid and Cascade

PLC Panel and Ratio Controller

H2 BLENDING IN CGD NETWORK

Interlocks & safety System of H2 blending MRS

AV operated inlet valve, stage-wise pressure reduction with PSV

H2 BLENDING IN CGD NETWORK

RESULTS

- Periodic monitoring of blended Natural Gas composition is being done on fortnightly basis.
- 2% Hydrogen blending in Natural Gas has shown no impact on the Metallurgy of Pipeline (API 5L-X42)
- 2% Hydrogen blending in Natural Gas has shown no impact on exhaust parameters of Vehicles and industry which are using blended gas as fuel.
- There was a positive to neutral feedback from PNG users.

WAY FORWARD

- Go ahead for permission from PNGRB for 5% Hydrogen Blending in CGD to ascertain the Further impact on Downstream consumers as well Pipeline Infrastructure.
- **Modifications for 5% H2 blending into DRS of AGL Indore:** Mechanical modification is being done to blend directly into DRS AGL Indore network.

H2 BLENDING IN CGD NETWORK

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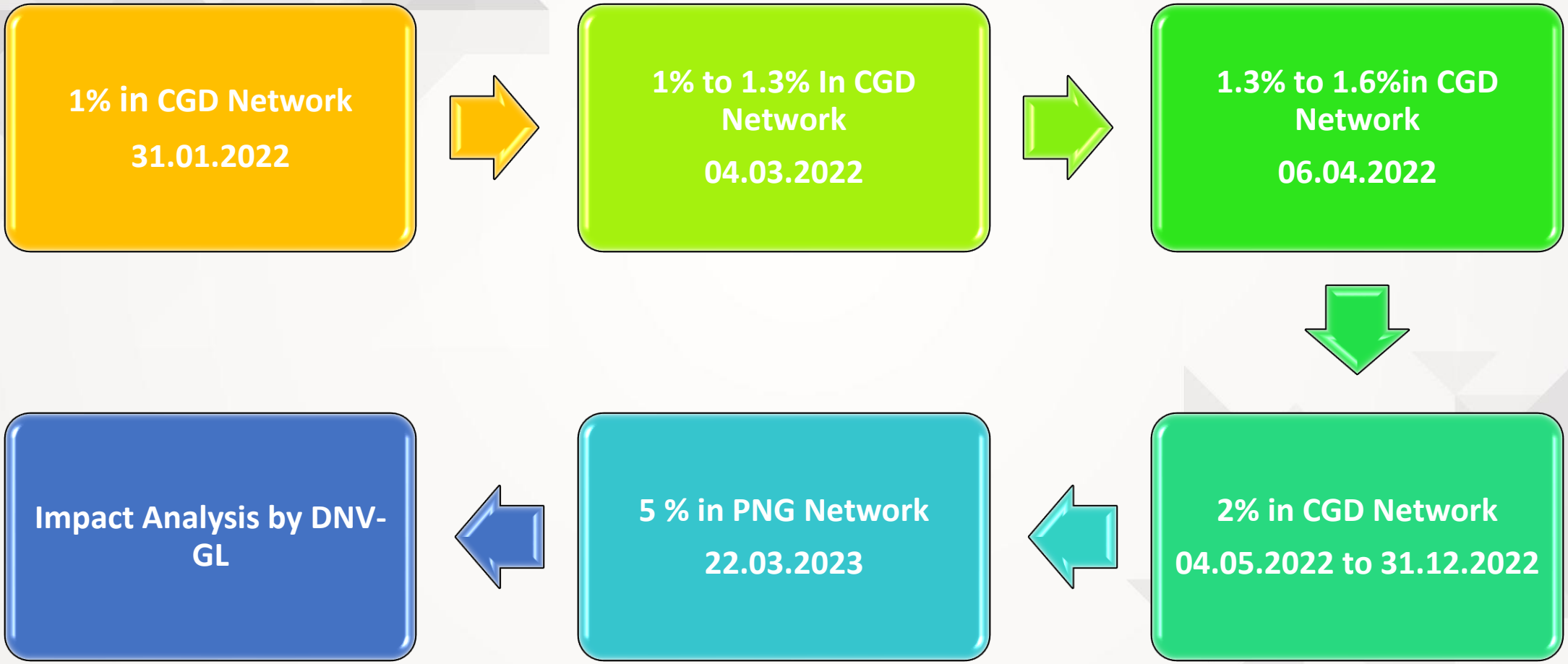
Chronological Order of blending of Hydrogen into Natural Gas



H2 BLENDING IN CGD NETWORK

DNV Study Scope – Part A
(2% Hydrogen blending in CNG & PNG networks)

1.INTEGRITY SCOPE

1. Hydrogen skid
2. Unloading equipment
3. Metering skid materials
4. Injection point materials
5. CS line pipe (API 5L X42)
6. CNG comp, cylinder, dispenser
7. Materials aspects of CNG fuelled vehicle
8. DRS system
9. MDPE pipe, Isolation Valves, meters & hoses

2.END USER SCOPE

1. Effect on CNG vehicle
2. Small commercial consumer
3. Large commercial consumer
4. Domestic consumers
5. Exhaust emissions from CNG vehicle
6. Exhaust emissions from commercial consumers (Up to 6 Typical Consumers)

H2 BLENDING IN CGD NETWORK

DNV Study Scope – Part A
(5 % Hydrogen blending in PNG networks)

1.INTEGRITY SCOPE

1. Interim connections – Regulators
2. DRS system
3. MDPE pipe
4. isolation valves,
5. meters and flexible hoses

2.END USER SCOPE

1. Small commercial consumer
2. Domestic consumers
3. Impact of hydrogen on Commercial customers
4. Exhaust emissions from commercial consumers

H2 BLENDING IN CGD NETWORK

Methodology

Part A & B: Review of collected data during trials & performance by DNV:

Gap Analysis

To determine if the data is sufficient to evaluate trial

Comparing the materials

For expected performance predicted by IS (e.g. ASME B31.12) & trials in UK and Europe

Issue Report

Trail Results & conclusion

Any Additional Measurements

Any additional measurements recommended

Comparing the Results

Results from emissions data to those in UK and European trials

Part C:

1. Compare & contrast the impact assessment performed in UK & European projects .
2. It will cover integrity & end user impacts
3. Identification of planned way forward building on both GAIL & International trials and allow GAIL to optimise future blending plans.

H2 BLENDING IN CGD NETWORK

Recommendations

- The effects of 2% and 5% blended Hydrogen on the NG assets (API 5l X42) have been evaluated by doing inspection tests such as UT, RT, and MPI.
- PAUT and TFM test on the Girth welds of CGS and Cas customers terminals to find the possible cracks and defects and monitor the effects of Hydrogen blending.
- The NDT results were deemed acceptable for the continuation of blending in CGD assets and the impact of 5% Hydrogen Blending in Natural Gas on piping (API-5l-X42) was found to be negligible.

- **Hydrogen Impact on stainless steel assets:**

The austenitic stainless-steel materials (SS 304 and SS 316) in the 300 series, demonstrate superior resistance to hydrogen embrittlement compared to other stainless steels. A higher nickel content in them has been increased their resistance to hydrogen embrittlement. Consequently, data suggest that austenitic stainless steels are preferable for applications involving hydrogen gas service.

H2 BLENDING IN CGD NETWORK

Recommendations

Hydrogen Impact on carbon steel assets:

No damage has been observed in the Girth welds of joints (API 5l X42) , the risk of HE is low for carbon steel materials.

Hydrogen Impact on non-metallic assets:

it's unlikely to affect the functionality of these components, especially at low pressures and with a 5% blend

Hydrogen Impact on high-strength steel assets:

Regarding steel CNG tanks and their material (High Strength steel (>950 MPa UTS)), UN ECE limits hydrogen content to 2% in Natural Gas. However, ISO design and compatibility standards allow 5 MPa hydrogen in cylinders with >950 MPa UTS. The main concern for CNG type 1 tank is hydrogen assisted fatigue cracking.

Hydrogen Impact on cast iron assets:

Cast Iron material is available in crankcase and cylinders. There is a lack of data and studies on cast iron. However, both the US standard ASME B31.12 and ISO/TR 15916 explicitly prohibit the use of grey, ductile, or malleable cast iron for pressure-containing parts in hydrogen service. It should be noted that assessment of compressors is mostly related to their functionality of compressors in Hydrogen Blend. Thus, the functionality of compressors in Hydrogen/NG blend should be assessed by manufacturer.

Conclusion:

As the blending ration in GAIL Indore CGS is below 5% the impact of hydrogen is negligible on API 5L42X and MDPE pipeline. Also, stainless steel hydrogen PRS assets are not susceptible to HE.

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