AAVANTIKA GAS LIMITED
(A JV Company of GAIL & HPCL)

अवंतिका गैस लिमिटेड
AAVANTIKA GAS LIMITED
(A JV Company of GAIL & HPCL)

Hydrogen Blending in CGD Network

27-28 June 2024
Mumbai

O&M Conference
Natural Gas Society

Preliminary

- The Finance Minister unveiled the National Hydrogen Energy Mission (NHEM) during the 2021 Union Budget.
- The Paris Climate Agreement, India pledged to slash its greenhouse gas emissions by 33-35% compared to 2005 levels. National Green Hydrogen mission will help India in accomplishing its emission goals.
- Hydrogen has the potential to play a key role in the de-carbonization of the energy industry, which is dominated by fossil fuels.
- To leverage the existing pipeline infrastructure , GAIL in consultation with MoPNG has commissioned a study in Aug'2021 for assessment of blending of H2 with natural gas in 5 CGD networks Viz. Delhi, Mumbai, Bangalore, Ahmedabad and Indore.
- Hydrogen injection through pilot project is being explored in GAIL's Jagoti-Indore-Pithampur Pipeline (JIPPL).

- As per study, Indore CGD network is suitable for blending of hydrogen in natural gas up to 3 – 5 vol%, considering the existing system components.
- City Gate Station (CGS) for Indore operated by GAIL and supplying gas to **Avantika Gas Limited (AGL)** is considered for undertaking the pilot project in CGD network.

Introduction

AAVANTIKA GAS LIMITED
(A JV Company of GAIL & HPCL)

Aavantika Gas Limited

Aavantika Gas Limited

Structure Outline & Areas of Operation

- JV of GAIL & HPCL
- Incorporated on 7th June 2006
- Authorized GA :
  - Indore GA
  - Gwalior GA

Areas of Operation

Indore

Pithampur

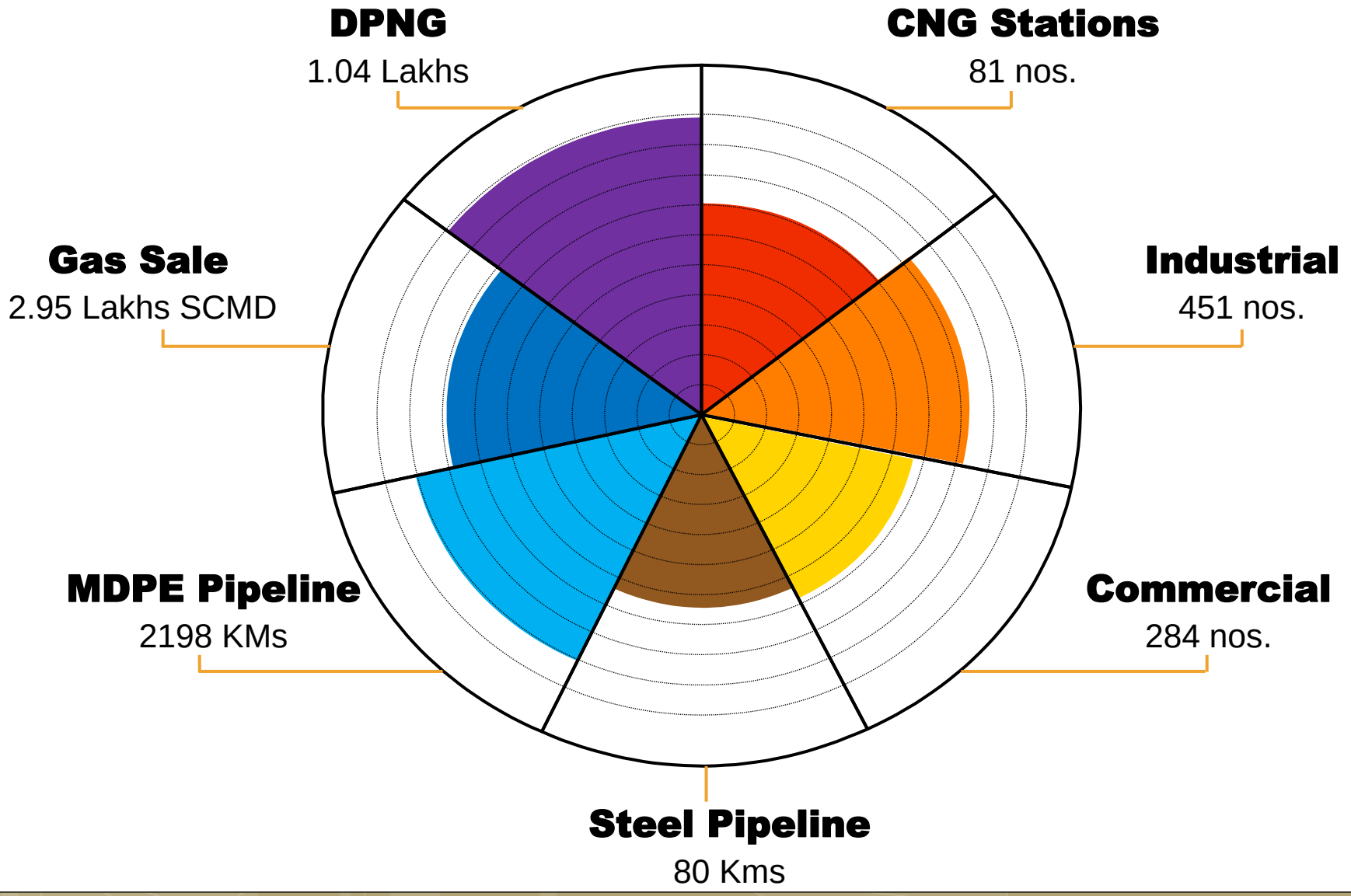
Ujjain

Gwalior

Aavantika Gas Limited

Physical Infrastructure – Indore GA

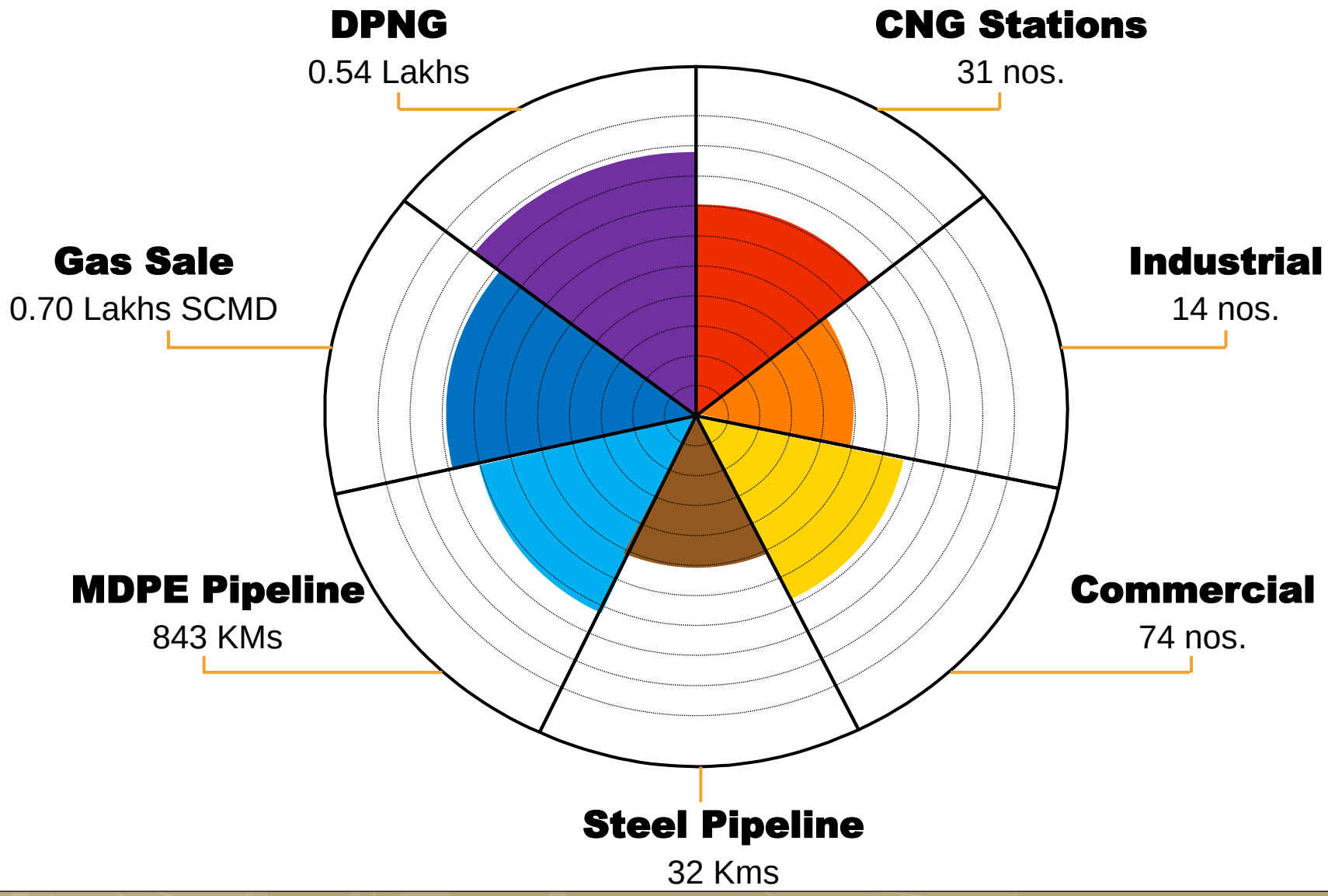
As on 31.03.2024



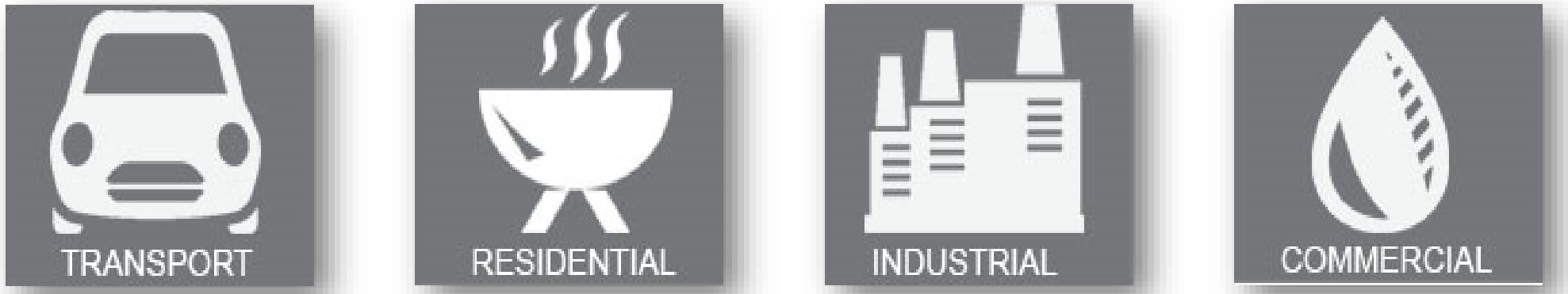
Aavantika Gas Limited

Physical Infrastructure – Gwalior GA

As on 31.03.2024



GAIL's Initiative for Blending of Hydrogen in Aavantika Gas Limited



BLENDING MILESTONES

GAIL conducted study through EIL for blending of hydrogen in CGD network.

GAIL decided to start the injection into CGD network of Indore from GAIL CGS.

Trail permission granted from PESO for 1.1 % to 2.0 % v/v progressively.

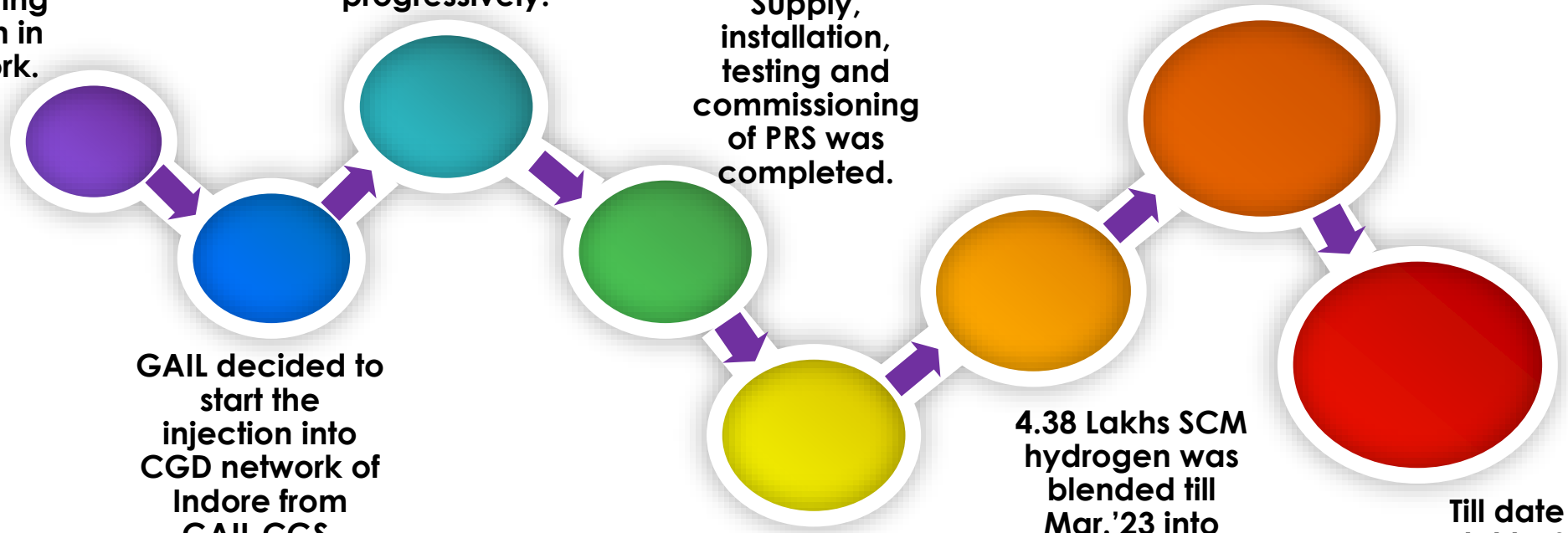
Supply, installation, testing and commissioning of PRS was completed.

Hydrogen blending started on 31.01.2022 into main grid steel network.

4.38 Lakhs SCM hydrogen was blended till Mar.'23 into main grid steel network. .

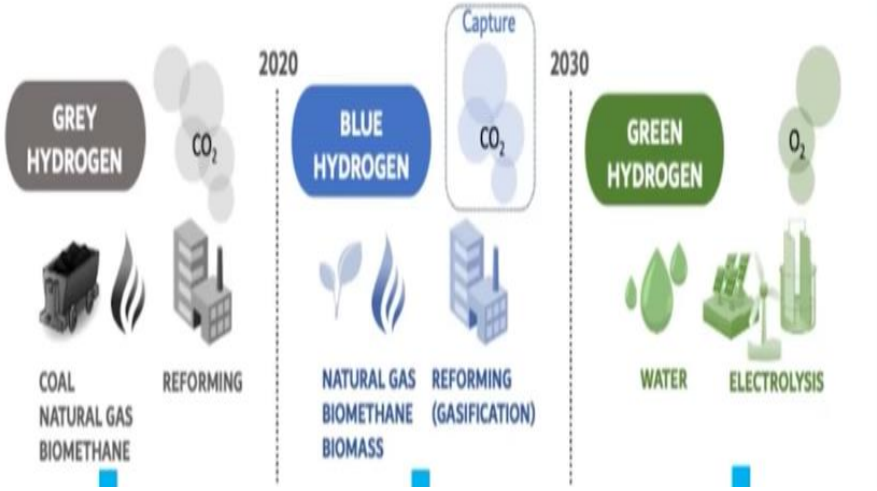
PNGRB permission for 5% injection into DRS on Oct. 22 & started injection from March'23

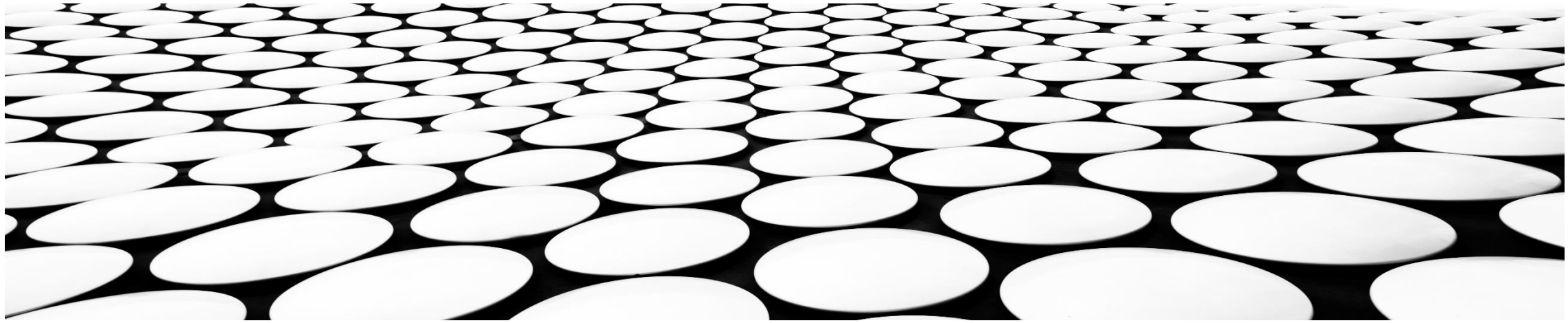
Till date 1.84 lakhs SCM injected in MDPE network.



Hydrogen:

- Hydro-Gen (Greek Name) meaning “Water-Former”.
- Colorless, Odorless, Tasteless, Non-toxic & Highly Combustible
- Explosive Limit : 4% - 74% by volume in the air.
- Autoignition Temperature : 500°C .
- Hydrogen when burned, the flame is nearly invisible.
- Calorific Value : 3050 Kcal/SCM.





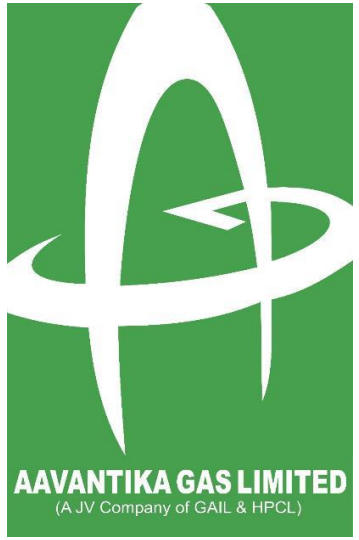
Advantages of Hydrogen Fuel

- Clean Energy
- Versatile Fuel
- Reducing Greenhouse Gases
- Energy Storage
- Technology Booster
- Quiet Operation
- Longer Range for Vehicles
- Hydrogen Economy

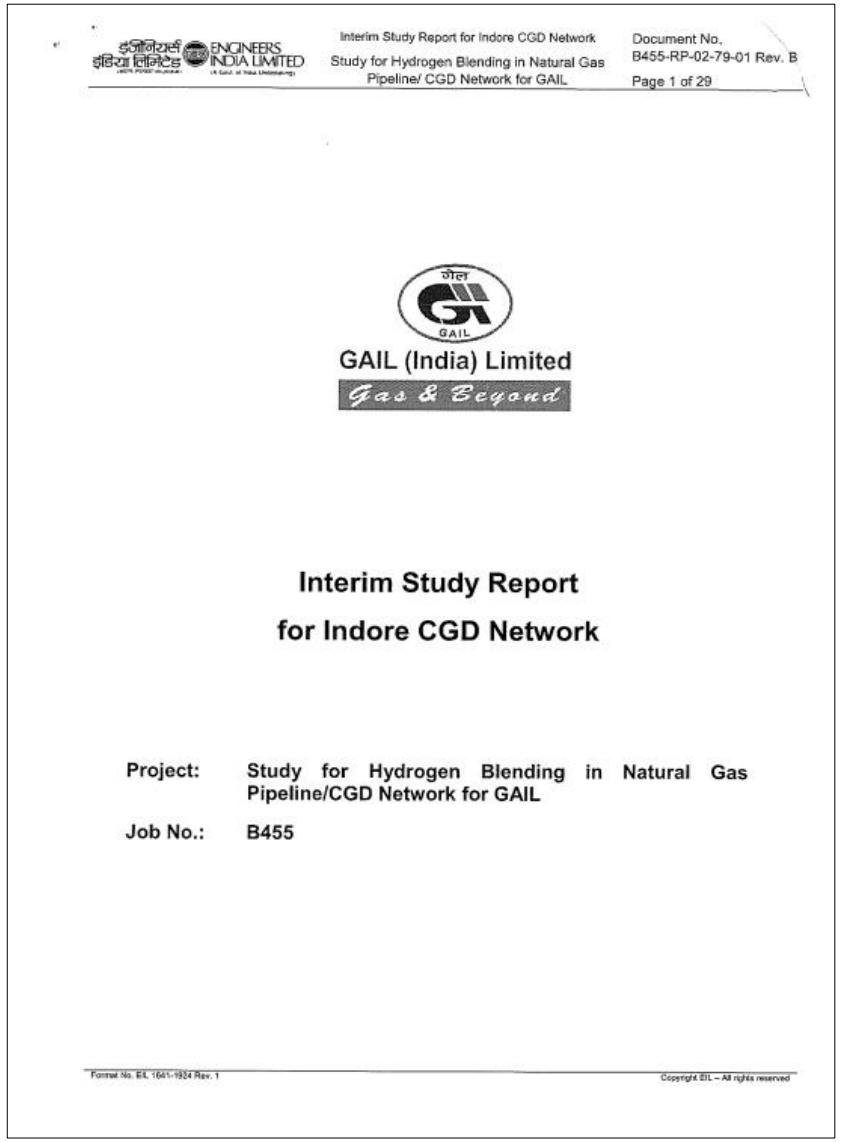
Disadvantages of Hydrogen Fuel

- Production Challenges
- Storage and Transport
- Costly Infrastructure
- Energy Loss
- Limited Availability
- Carbon Footprint (in Some Cases)
- Technological Challenges

India's Maiden Project of Blending Hydrogen into Natural Gas System



Assessment Study



इंजीनियर्स इंडिया लिमिटेड ENGINEERS INDIA LIMITED

Interim Study Report for Indore CGD Network
Study for Hydrogen Blending in Natural Gas Pipeline/ CGD Network for GAIL

Document No.
B455-RP-02-79-01 Rev. B
Page 1 of 29

GAIL (India) Limited
Gas & Beyond

Interim Study Report
for Indore CGD Network

Project: Study for Hydrogen Blending in Natural Gas Pipeline/CGD Network for GAIL

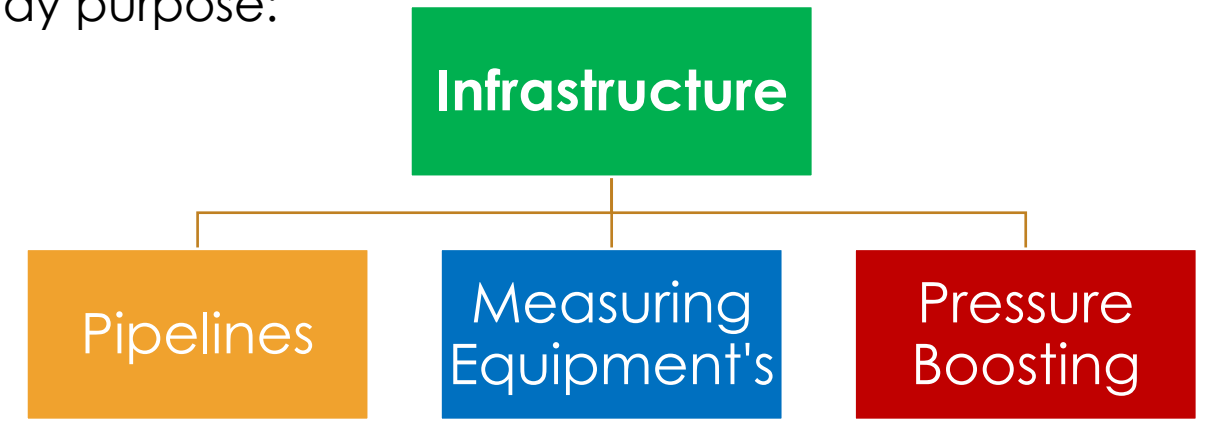
Job No.: B455

Format No. EIL 1641-1924 Rev. 1

EIL conducted the study for GAIL for assessment of blending of H2 with natural gas in CGD networks :

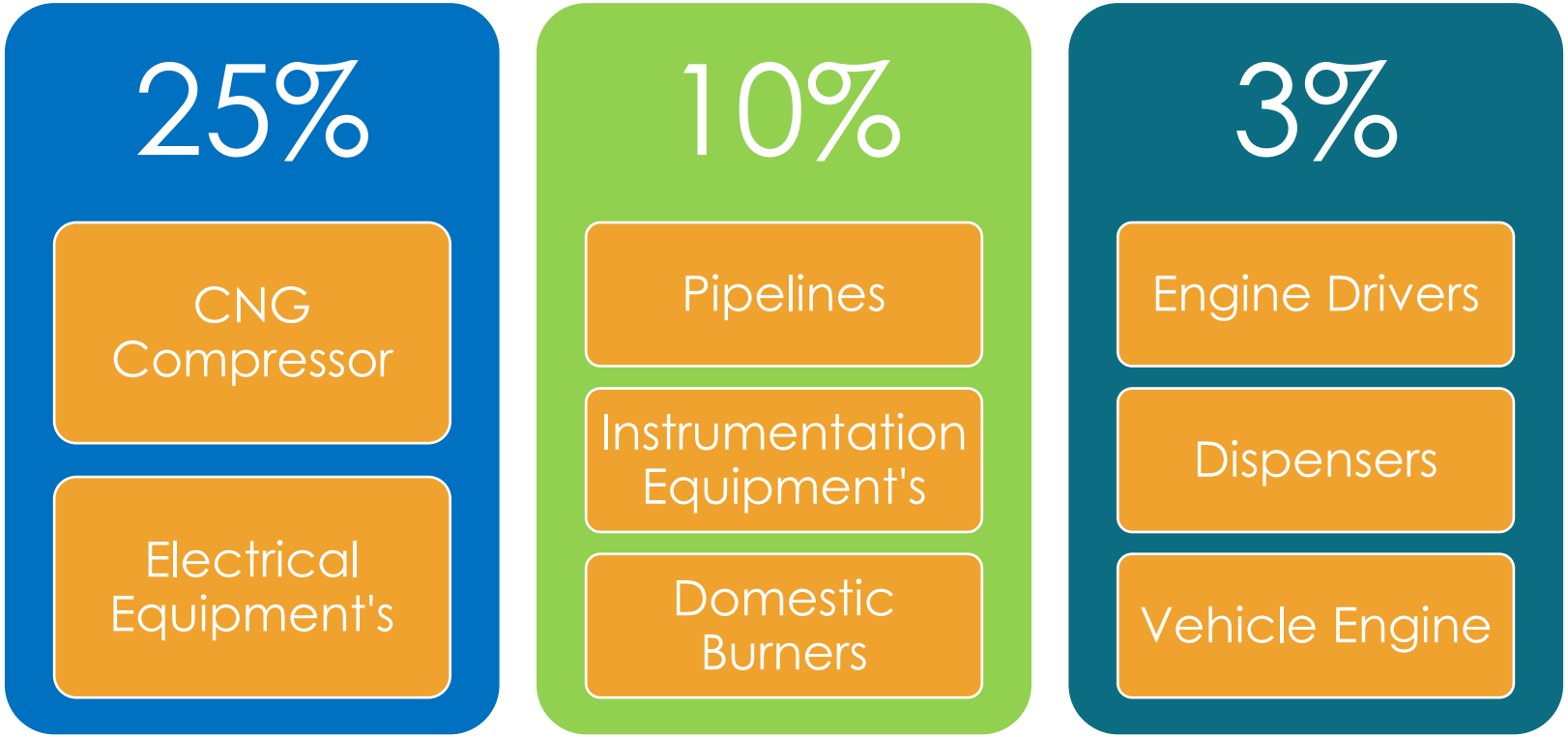
- To find out the maximum % of Hydrogen to be blended in the existing NG / CGD network without making any changes.
- To establish the maximum % of Hydrogen to be blended in existing NG / CGD with minor modifications (such as fitting, metering skids, etc.)

The infrastructure network is classified into following group for study purpose:



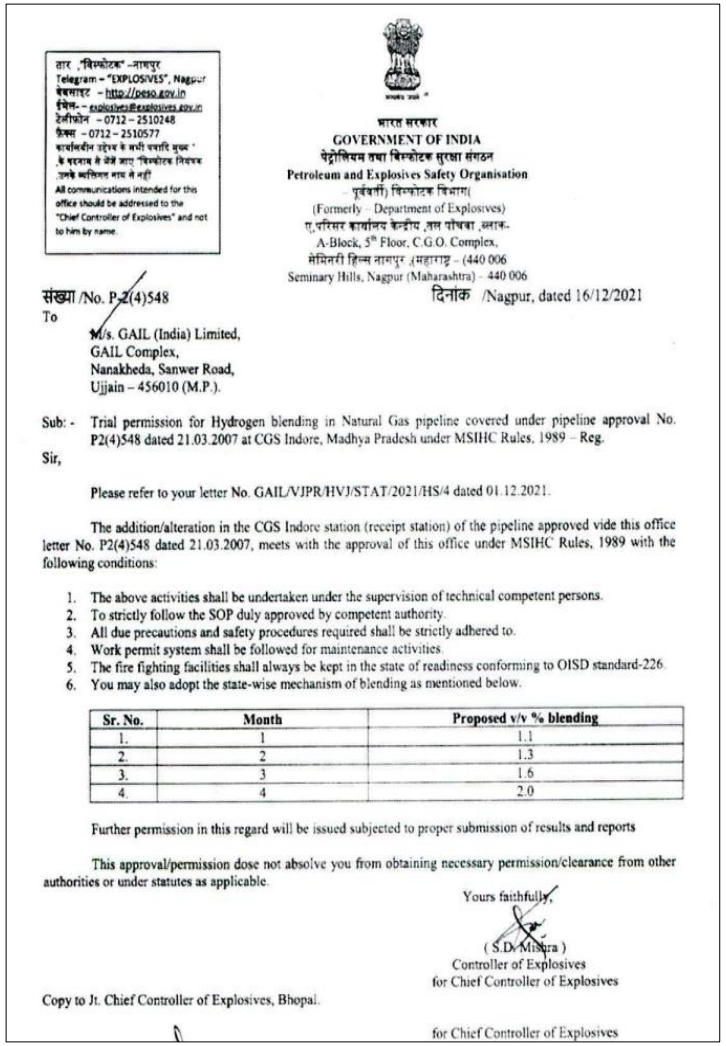
Study Findings

Based on the data collected for CGD network and end users, study of literatures & international standards, relevant regulations, discussion with vendors, existing practice/experience, preliminary limits for safe % of hydrogen blending in the CGD networks are as follows;



Aavantika Gas Limited

Permission for Injection



तार ,"विस्फोटक" –नागपुर
Telegram – "EXPLOSIVES", Nagpur
वेबसाइट – http://peso.gov.in
ईमेल- – explosives@explosives.gov.in
टेलीफोन – 0712 – 2510248
फैक्स – 0712 – 2510577
कार्यालयीन उद्देश्य के सभी पत्राचार मुख्य "
के पदनाम से भेजें जाए "विस्फोटक नियंत्रक
उनके व्यक्तिगत नाम से नहीं
All communications intended for this office should be addressed to the "Chief Controller of Explosives" and not to him by name.

भारत सरकार
GOVERNMENT OF INDIA
पेट्रोलियम तथा विस्फोटक सुरक्षा संगठन
Petroleum and Explosives Safety Organisation
– पूर्ववर्ती) विस्फोटक विभाग(
(Formerly – Department of Explosives)
ए,परिसर कार्यालय केन्द्रीय ,तल पाँचवा ,ब्लाक-
A-Block, 5th Floor, C.G.O. Complex,
सेमिनरी हिल्स नागपुर ,(महाराष्ट्र – (440 006
Seminary Hills, Nagpur (Maharashtra) – 440 006

संख्या /No. P-2(4)548 दिनांक /Nagpur, dated 16/12/2021

To
M/s. GAIL (India) Limited,
GAIL Complex,
Nanakheda, Sanwer Road,
Ujjain – 456010 (M.P.).

Sub: - Trial permission for Hydrogen blending in Natural Gas pipeline covered under pipeline approval No. P2(4)548 dated 21.03.2007 at CGS Indore, Madhya Pradesh under MSIHC Rules, 1989 – Reg.

Sir,

Please refer to your letter No. GAIL/VJPR/HVJ/STAT/2021/HS/4 dated 01.12.2021.

The addition/alteration in the CGS Indore station (receipt station) of the pipeline approved vide this office letter No. P2(4)548 dated 21.03.2007, meets with the approval of this office under MSIHC Rules, 1989 with the following conditions:

1. The above activities shall be undertaken under the supervision of technical competent persons.
2. To strictly follow the SOP duly approved by competent authority.
3. All due precautions and safety procedures required shall be strictly adhered to.
4. Work permit system shall be followed for maintenance activities.
5. The fire fighting facilities shall always be kept in the state of readiness conforming to OISD standard-226.
6. You may also adopt the state-wise mechanism of blending as mentioned below.

Sr. No.	Month	Proposed v/v % blending
1.	1	1.1
2.	2	1.3
3.	3	1.6
4.	4	2.0

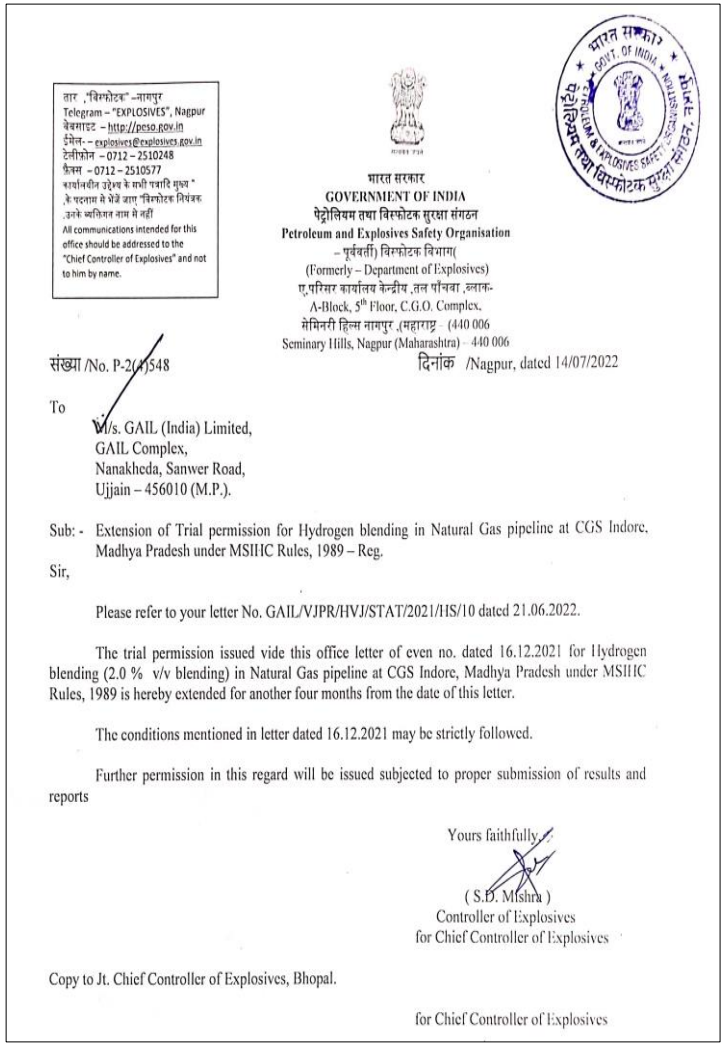
Further permission in this regard will be issued subjected to proper submission of results and reports

This approval/permission dose not absolve you from obtaining necessary permission/clearance from other authorities or under statutes as applicable.

Yours faithfully,
(S.D. Mishra)
Controller of Explosives
for Chief Controller of Explosives

Copy to Jt. Chief Controller of Explosives, Bhopal.

for Chief Controller of Explosives



तार ,"विस्फोटक" –नागपुर
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कार्यालयीन उद्देश्य के सभी पत्राचार मुख्य "
के पदनाम से भेजें जाए "विस्फोटक नियंत्रक
उनके व्यक्तिगत नाम से नहीं
All communications intended for this office should be addressed to the "Chief Controller of Explosives" and not to him by name.

भारत सरकार
GOVERNMENT OF INDIA
पेट्रोलियम तथा विस्फोटक सुरक्षा संगठन
Petroleum and Explosives Safety Organisation
– पूर्ववर्ती) विस्फोटक विभाग(
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A-Block, 5th Floor, C.G.O. Complex,
सेमिनरी हिल्स नागपुर ,(महाराष्ट्र – (440 006
Seminary Hills, Nagpur (Maharashtra) – 440 006

संख्या /No. P-2(4)548 दिनांक /Nagpur, dated 14/07/2022

To
M/s. GAIL (India) Limited,
GAIL Complex,
Nanakheda, Sanwer Road,
Ujjain – 456010 (M.P.).

Sub: - Extension of Trial permission for Hydrogen blending in Natural Gas pipeline at CGS Indore, Madhya Pradesh under MSIHC Rules, 1989 – Reg.

Sir,

Please refer to your letter No. GAIL/VJPR/HVJ/STAT/2021/HS/10 dated 21.06.2022.

The trial permission issued vide this office letter of even no. dated 16.12.2021 for Hydrogen blending (2.0 % v/v blending) in Natural Gas pipeline at CGS Indore, Madhya Pradesh under MSIHC Rules, 1989 is hereby extended for another four months from the date of this letter.

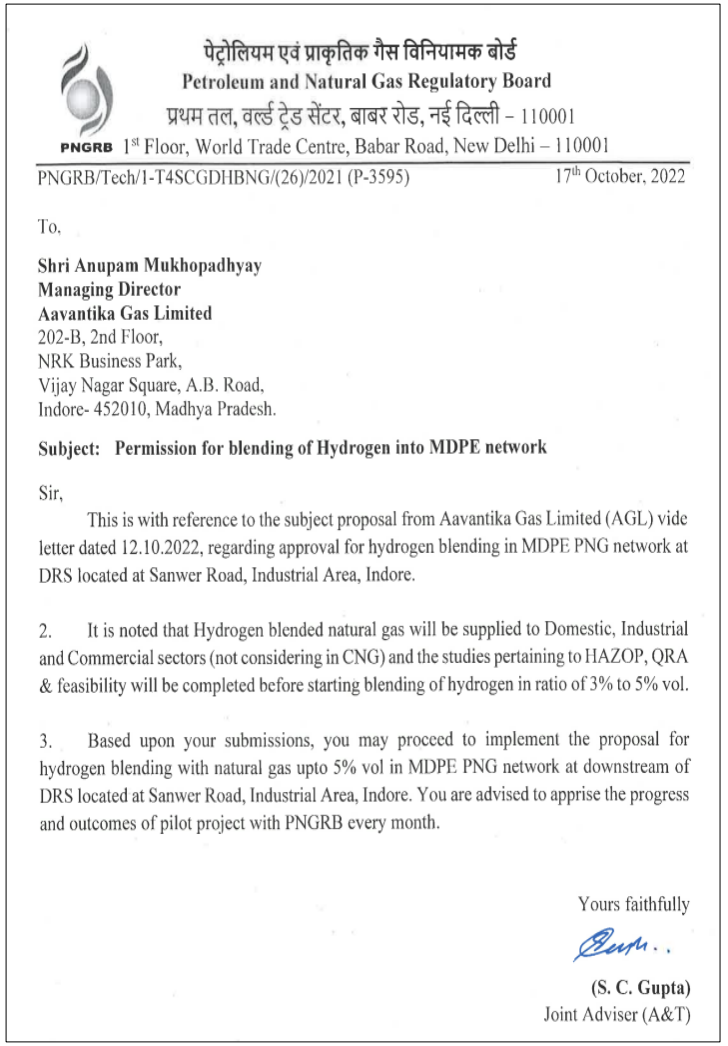
The conditions mentioned in letter dated 16.12.2021 may be strictly followed.

Further permission in this regard will be issued subjected to proper submission of results and reports

Yours faithfully,
(S.D. Mishra)
Controller of Explosives
for Chief Controller of Explosives

Copy to Jt. Chief Controller of Explosives, Bhopal.

for Chief Controller of Explosives



पेट्रोलियम एवं प्राकृतिक गैस विनियामक बोर्ड
Petroleum and Natural Gas Regulatory Board
प्रथम तल, वर्ल्ड ट्रेड सेंटर, बाबर रोड, नई दिल्ली – 110001
PNGRB 1st Floor, World Trade Centre, Babar Road, New Delhi – 110001

PNGRB/Tech/1-T4SCGDHBNG/(26)/2021 (P-3595) 17th October, 2022

To,

Shri Anupam Mukhopadhyay
Managing Director
Aavantika Gas Limited
202-B, 2nd Floor,
NRK Business Park,
Vijay Nagar Square, A.B. Road,
Indore- 452010, Madhya Pradesh.

Subject: Permission for blending of Hydrogen into MDPE network

Sir,

This is with reference to the subject proposal from Aavantika Gas Limited (AGL) vide letter dated 12.10.2022, regarding approval for hydrogen blending in MDPE PNG network at DRS located at Sanwer Road, Industrial Area, Indore.

2. It is noted that Hydrogen blended natural gas will be supplied to Domestic, Industrial and Commercial sectors (not considering in CNG) and the studies pertaining to HAZOP, QRA & feasibility will be completed before starting blending of hydrogen in ratio of 3% to 5% vol.

3. Based upon your submissions, you may proceed to implement the proposal for hydrogen blending with natural gas upto 5% vol in MDPE PNG network at downstream of DRS located at Sanwer Road, Industrial Area, Indore. You are advised to apprise the progress and outcomes of pilot project with PNGRB every month.

Yours faithfully

(S. C. Gupta)
Joint Adviser (A&T)

PESO permission for blending H2 1.1% to 2% v/v in high pressure pipeline network

PNGRB permission for blending H2 5% v/v in low pressure pipeline network

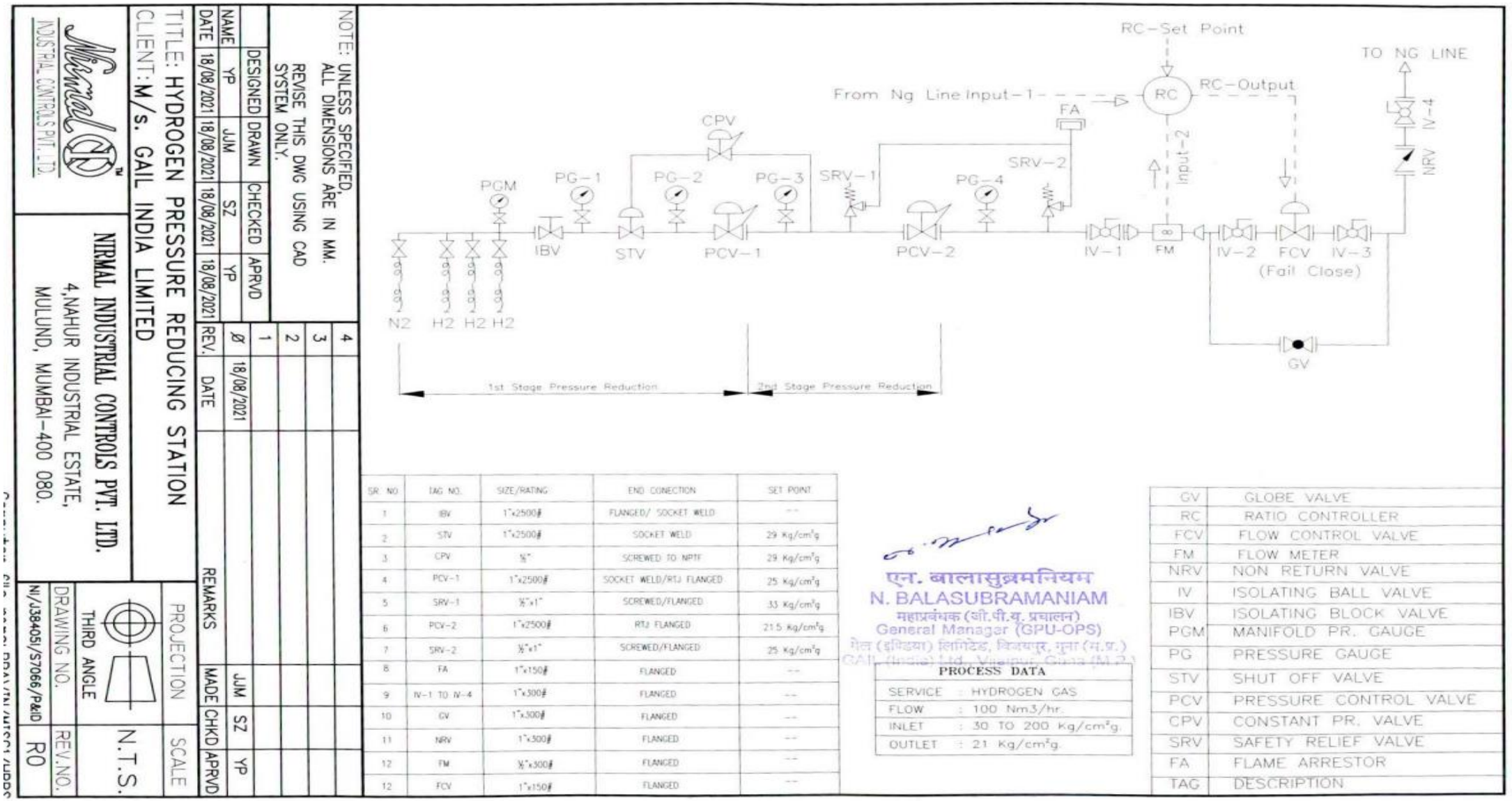
GAIL CGS Indore

Hydrogen Dispatch Unit Set-Up

- Phase I – Injection of Hydrogen up to 02 % v/v into AGL main grid steel pipeline network at GAIL CGS Indore
- Phase II - Injection of Hydrogen up to 05 % v/v into DRS downstream MDPE network

Hydrogen PRS

Aavantika Gas Limited



SR. NO	TAG NO.	SIZE/RATING	END CONECTION	SET POINT
1	IBV	1"x2500#	FLANGED/ SOCKET WELD	--
2	STV	1"x2500#	SOCKET WELD	29 Kg/cm²g
3	CPV	½"	SCREWED TO NPTF	29 Kg/cm²g
4	PCV-1	1"x2500#	SOCKET WELD/RTJ FLANGED	25 Kg/cm²g
5	SRV-1	½"x1"	SCREWED/FLANGED	33 Kg/cm²g
6	PCV-2	1"x2500#	RTJ FLANGED	21.5 Kg/cm²g
7	SRV-2	½"x1"	SCREWED/FLANGED	25 Kg/cm²g
8	FA	1"x150#	FLANGED	--
9	IV-1 TO IV-4	1"x300#	FLANGED	--
10	GV	1"x300#	FLANGED	--
11	NRV	1"x300#	FLANGED	--
12	FM	½"x300#	FLANGED	--
12	FCV	1"x150#	FLANGED	--

एन. बालासुब्रमनियम
N. BALASUBRAMANIAM
महाप्रबंधक (जी.पी.यू. प्रचालन)
General Manager (GPU-OPS)
गेल (इंडिया) लिमिटेड, विंध्याचल, मुंबा (म.प्र.)
GAIL (India) Ltd., Vindhyachal, Distt. (M.P.)

PROCESS DATA

SERVICE	:	HYDROGEN GAS
FLOW	:	100 Nm3/hr.
INLET	:	30 TO 200 Kg/cm²g.
OUTLET	:	21 Kg/cm²g.

TAG	DESCRIPTION
GV	GLOBE VALVE
RC	RATIO CONTROLLER
FCV	FLOW CONTROL VALVE
FM	FLOW METER
NRV	NON RETURN VALVE
IV	ISOLATING BALL VALVE
IBV	ISOLATING BLOCK VALVE
PGM	MANIFOLD PR. GAUGE
PG	PRESSURE GAUGE
STV	SHUT OFF VALVE
PCV	PRESSURE CONTROL VALVE
CPV	CONSTANT PR. VALVE
SRV	SAFETY RELIEF VALVE
FA	FLAME ARRESTOR

NOTE: UNLESS SPECIFIED, ALL DIMENSIONS ARE IN MM.
REVISE THIS DWG USING CAD SYSTEM ONLY.

	DESIGNED	DRAWN	CHECKED	APRVD
NAME	YP	JJM	SZ	YP
DATE	18/08/2021	18/08/2021	18/08/2021	18/08/2021

REV.	DATE	REMARKS	MADE	CHK'D	APRV'D
Ø	18/08/2021		JJM	SZ	YP
1					
2					
3					
4					

TITLE: HYDROGEN PRESSURE REDUCING STATION
CLIENT: M/s. GAIL INDIA LIMITED

NIRMAL INDUSTRIAL CONTROLS PVT. LTD.
4,NAHUR INDUSTRIAL ESTATE,
MULUND, MUMBAI-400 080.

PROJECTION: THIRD ANGLE
SCALE: N.T.S.
DRAWING NO.: NI/J38405I/S7066/P&ID
REV.NO.: R0

SS316L Smart H2 Dispatch Station

Instruments/Equipments

- PLC Control Actuator
- Pressure Control Valve
- 1st Stage Regulator
- 2nd Stage Regulator
- Slam Shut Off Valve
- SRV
- Flame Arrester, H2 GD, FD
- Flow Control valve
- NRV
- Water Bath

Interlocks & Safety System

H2 Blending MRS with H2 Specific GD

PLC Panel & Ratio Controller

Ratio Controller

- Measure NG flow and accordingly inject Hydrogen at 5%
- Flow control valve shall operate accordingly.

Smart Safety Features

Human Body Static Dissipater
provides a simple display indication if the resistance is above or below the value set in the unit

Earthing Integrity monitoring system for Cascade which is connected with PLC to ensure continuity

Hydrogen Cascade

H2 Mobile Cascade:

- Total nos. of Cylinders – 148
- Total Capacity – 23680 litres
- Manufacturer – EKC
- Working Pressure – 200 bar
- Gas filled in single cascade – 4230 SCM

Aavantika Gas Limited

GAIL CGS to AGL Mother Station

During Phase II for blending of hydrogen 05% v/v into MDPE network.

Sample Collection – PNG Customers

Sample were collected from several Industrial & Commercial customers including CNG vehicle during Phase I & Phase II blending process.

The sample were tested by GAIL Vijaipur lab & results were shared.

Aavantika Gas Limited

Test Report of Collected Samples.

QUALITY CONTROL LABORATORY
GAIL (India) Ltd.
Vijaipur Dist: Guna (MP) - 473112
PHONE: (07544) 274444

Test Report of Hydrogen Blending in City Gas (H-CNG)

Report No: GAIL/H-CNG/VIJ/QAL/2022/05 DATE:20.05.2022
Source of Sample: INDORE -CGD
Sample collected on: 19.05.2022 at 15:00 hrs.
Sample received on: 19.05.2022
Sample Analyzed on: 20.05.2022
Reporting Date: 20.05.2022

Sr. No	Parameters	Unit	Result
1	Hydrogen	Mole %	2.0013
2	Nitrogen	Mole %	0.1499
3	Methane	Mole %	90.6702
4	CO2	Mole %	0.0071
5	Ethane	Mole %	6.0774
6	Propane	Mole %	0.7608
7	I-Butane	Mole %	0.1287
8	N- Butane	Mole %	0.1898
9	I-Pentane	Mole %	0.011
10	n-Pentane	Mole %	0.0038
11	Gross calorific value (GCV)	Kcal/SM3	9473
12	Net Calorific value (NCV)	Kcal/SM3	8545
13	Sulphur content	PPM	NIL

Remarks (if any): NIL

M Subramani (Senior Manager-lab)
(Analyzed By)

Dr A.K. Sen Gupta
CM-lab
(Authorized Signatory)

एन. बालासुब्रमनियम
N. BALASUBRAMANIAM
महाप्रबंधक (जी.पी.यू. प्रचालन)
Manager (GPU-OPS)

डॉ. ए.के. सेन गुप्ता
Dr. A.K. SEN GUPTA
मुख्य प्रबंधक (प्रयोगशाला)
Chief Manager (Lab)
गेल (इंडिया) लिमिटेड, विजयपुर-गुना (म.प्र.)
GAIL (India) Limited, Vijaipur-Guna (M.P.)

High pressure & low pressure samples were collected for CNG & PNG segment.

Customer Feedback :

- Industrial Customers
- Commercial Customers
- DPNG Customers
- CNG Customers

Covering:

- Flame size (full mode / sim mode)
- Flame colour & pattern
- Cooking time
- Furnace temperature
- Mileage of vehicle
- Pick up of vehicle
- Cranking observation
- Change in exhaust

I&C Customers – Feedback Forms

Aavantika Gas Limited

Commercial Customer feedback on Hydrogen blended CNG/PNG

Customer name : Asha Confectionery canteen Date : 13/05/22

Address : 13 1/3 c" Sector Sanwer Road Industrial Area Indore (452015)

Customer Phone number : 9039146555

Sr. No.	Description	Observation	Remarks
1	Any change in flame pattern/stability at burner	Yes / No ✓	
2	Change observed in cooking time	Increased / Decreased / No change ✓	
3	Change observed in flame colour	Yes / No ✓	
4	Change observed in flame size in SIM mode	Yes / No ✓	
5	Change observed in flame size in Full mode	Yes / No ✓	
6	Any leakage observed (If Yes, Specify point of leakage)	Yes / No ✓	
7	Any signficant change in bill as compared to last bill	Yes / No ✓	
8	Any other observation		

Customer Signature

एन. बालासुब्रमनियम
N. BALASUBRAMANIAM
महाप्रबंधक (जी.पी.यू. प्रचालन)
General Manager (GPU-OPS)
गेल (इण्डिया) लिमिटेड, विजयपुर, गुना (म.प्र.)
GAIL (India) Ltd., Vijaipur, Guna (M.P.)

GAIL Representative Signature

PRASHANTH VASARI

Industrial Customer feedback on Hydrogen blended CNG/PNG

Customer name : MCW Health care pvt ltd Date : 13/05/22

Address : 286, Sector-E Industrial Area

Customer Phone number : 9981545127

Sr. No.	Description	Observation	Remarks
1	Observations in flame pattern/stability	Yes / No ✓	N/A
2	Flow requirement at burner for the same heat duty	Increased / Decreased / No change ✓	
3	Pressure requirement at burner for the same heat duty	Increased / Decreased / No change ✓	
4	Furnace temperature	Increased / Decreased / No change ✓	
5	Metal Temperatures inside furnace	Increased / Decreased / No change	N/A
6	Change in combustion air requirement	Increased / Decreased / No change	N/A
7	Any other observation		

Customer Signature

13/05/2022

एन. बालासुब्रमनियम
N. BALASUBRAMANIAM
महाप्रबंधक (जी.पी.यू. प्रचालन)
General Manager (GPU-OPS)
गेल (इण्डिया) लिमिटेड, विजयपुर, गुना (म.प्र.)
GAIL (India) Ltd., Vijaipur, Guna (M.P.)

GAIL Representative Signature

PRASHANTH VASARI

CNG & DPNG Customers – Feedback Forms

Aavantika Gas Limited

Domestic Customer feedback on Hydrogen blended CNG/PNG

Customer name : Pushpa Kale Date : 13/05/22

Address : B-231 Bassa Kalimdi gold Imalore

Customer Phone number : 9589999524

Sr. No.	Description	Observation	Remarks
1	Any change in flame pattern/stability at burner	Yes / No ✓	
2	Change observed in cooking time	Increased / Decreased / No change ✓	
3	Change observed in flame colour	Yes / No ✓	
4	Change observed in flame size in SIM mode	Yes / No ✓	
5	Change observed in flame size in Full mode	Yes / No ✓	
6	Any leakage observed (If Yes, Specify point of leakage)	Yes / No ✓	
7	Any signficant change in bill as compared to last bill	Yes / No ✓	
8	Any other observation		

Customer Signature

एन. बालासुब्रमनियम
N. BALASUBRAMANIAM
महाप्रबंधक (जी.पी.यू. प्रचालन)
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GAIL (India) Ltd., Vidisha, Guna (M.P.)

GAIL Representative Signature

PRASHANTH VASARI

Vehicle Customer feedback on Hydrogen blended CNG/PNG

Vehicle description : C.N.G. Vehicle Cascade Date : 13/05/2022

Make / Model : Tata - 1109G

Vehicle registration No : MP09-GH 7078

Customer Phone number : 8889402657

Sr. No.	Description	Observation	Remarks
1	Mileage of vehicle	Increased / Decreased / No change ✓	
2	Pickup of vehicle (anysignificant change in torque of vehicle)	Increased / Decreased / No change ✓	
3	Engine temperature as compared to earlier	Increased / Decreased / No change ✓	
4	Any problem observed during start (cranking of vehicle)	Yes / No ✓	
5	Any significant change in exhaust	No change	
8	Any other observation	No	

Customer Name / Signature

एन. बालासुब्रमनियम
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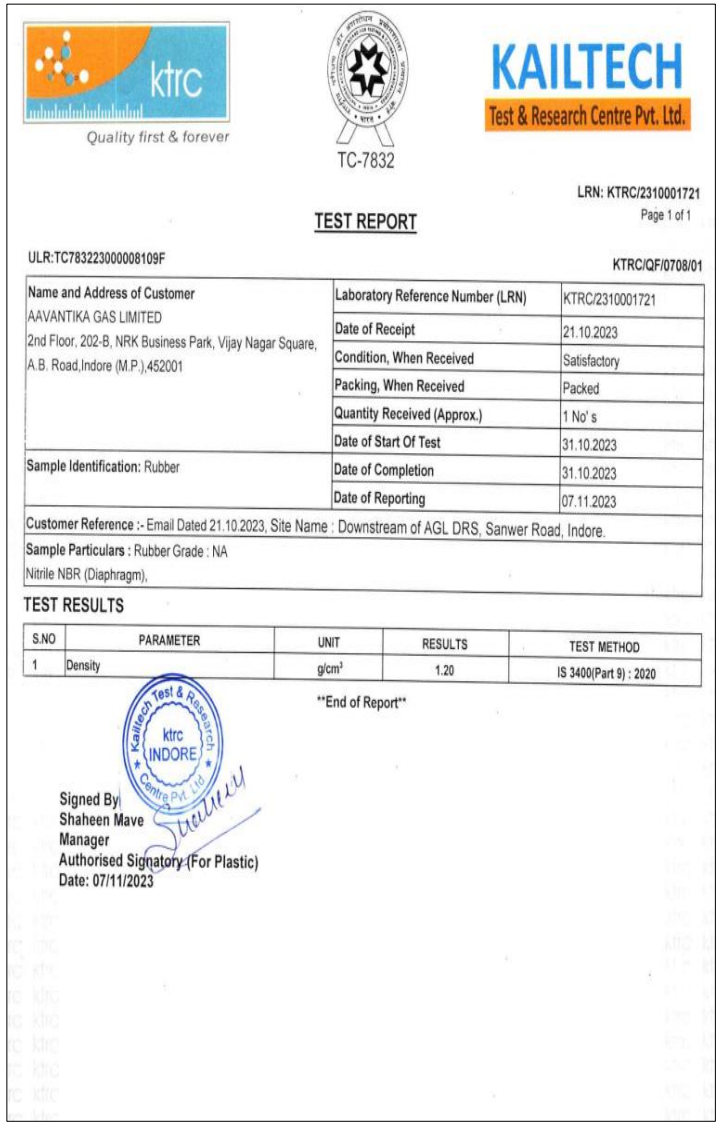
GAIL (India) Ltd., Vidisha, Guna (M.P.)

GAIL Representative Signature

PRASHANTH VASARI

Testing of Material – Density & Chemical Composition



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TC-7832

KAILTECH
Test & Research Centre Pvt. Ltd.

LRN: KTRC/2310001721
Page 1 of 1

TEST REPORT

ULR:TC783223000008109F
KTRC/QF/0708/01

Name and Address of Customer	Laboratory Reference Number (LRN)	KTRC/2310001721
AAVANTIKA GAS LIMITED 2nd Floor, 202-B, NRK Business Park, Vijay Nagar Square, A.B. Road,Indore (M.P.),452001	Date of Receipt	21.10.2023
	Condition, When Received	Satisfactory
	Packing, When Received	Packed
	Quantity Received (Approx.)	1 No' s
	Date of Start Of Test	31.10.2023
Sample Identification: Rubber	Date of Completion	31.10.2023
	Date of Reporting	07.11.2023

Customer Reference :- Email Dated 21.10.2023, Site Name : Downstream of AGL DRS, Sanwer Road, Indore.

Sample Particulars : Rubber Grade : NA
Nitrile NBR (Diaphragm),

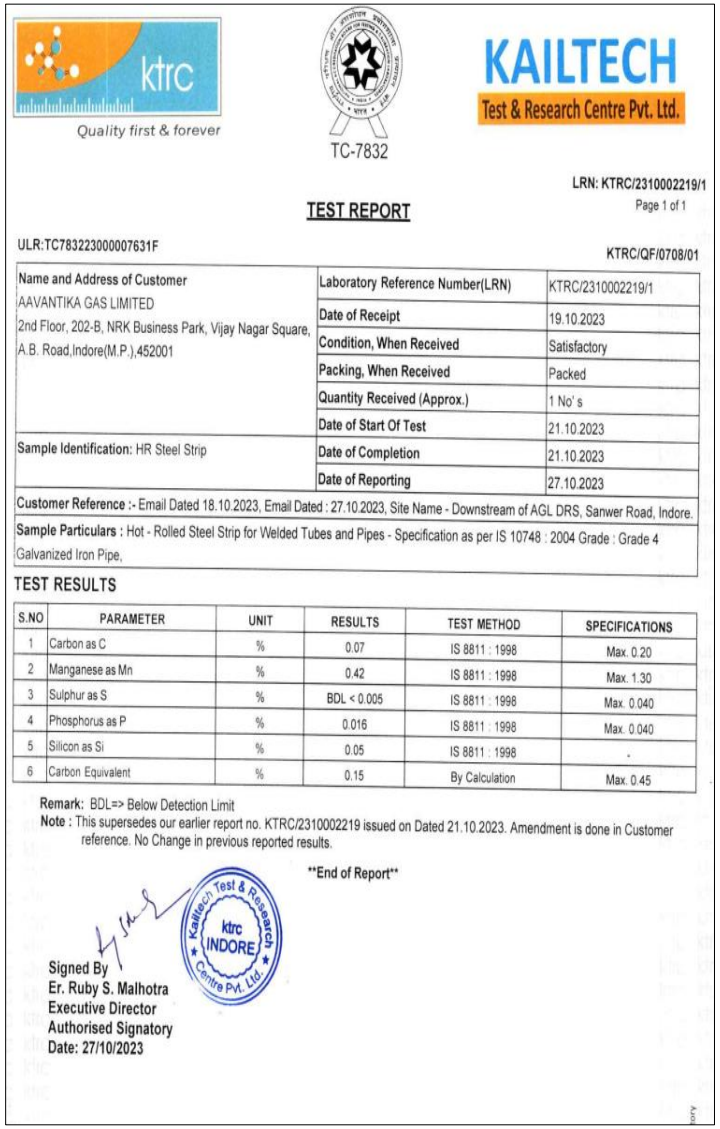
TEST RESULTS

S.NO	PARAMETER	UNIT	RESULTS	TEST METHOD
1	Density	g/cm³	1.20	IS 3400(Part 9) : 2020

End of Report

Kailtech Test & Research Centre Pvt. Ltd. ktrc INDORE

Signed By
Shaheen Mave
Manager
Authorised Signatory (For Plastic)
Date: 07/11/2023



ktrc
Quality first & forever

TC-7832

KAILTECH
Test & Research Centre Pvt. Ltd.

LRN: KTRC/2310002219/1
Page 1 of 1

TEST REPORT

ULR:TC783223000007631F
KTRC/QF/0708/01

Name and Address of Customer	Laboratory Reference Number(LRN)	KTRC/2310002219/1
AAVANTIKA GAS LIMITED 2nd Floor, 202-B, NRK Business Park, Vijay Nagar Square, A.B. Road,Indore(M.P.),452001	Date of Receipt	19.10.2023
	Condition, When Received	Satisfactory
	Packing, When Received	Packed
	Quantity Received (Approx.)	1 No' s
	Date of Start Of Test	21.10.2023
Sample Identification: HR Steel Strip	Date of Completion	21.10.2023
	Date of Reporting	27.10.2023

Customer Reference :- Email Dated 18.10.2023, Email Dated : 27.10.2023, Site Name - Downstream of AGL DRS, Sanwer Road, Indore.

Sample Particulars : Hot - Rolled Steel Strip for Welded Tubes and Pipes - Specification as per IS 10748 : 2004 Grade : Grade 4 Galvanized Iron Pipe,

TEST RESULTS

S.NO	PARAMETER	UNIT	RESULTS	TEST METHOD	SPECIFICATIONS
1	Carbon as C	%	0.07	IS 8811 : 1998	Max. 0.20
2	Manganese as Mn	%	0.42	IS 8811 : 1998	Max. 1.30
3	Sulphur as S	%	BDL < 0.005	IS 8811 : 1998	Max. 0.040
4	Phosphorus as P	%	0.016	IS 8811 : 1998	Max. 0.040
5	Silicon as Si	%	0.05	IS 8811 : 1998	-
6	Carbon Equivalent	%	0.15	By Calculation	Max. 0.45

Remark: BDL=> Below Detection Limit
Note : This supersedes our earlier report no. KTRC/2310002219 issued on Dated 21.10.2023. Amendment is done in Customer reference. No Change in previous reported results.

End of Report

Kailtech Test & Research Centre Pvt. Ltd. ktrc INDORE

Signed By
Er. Ruby S. Malhotra
Executive Director
Authorised Signatory
Date: 27/10/2023

Impact of 5% v/v Hydrogen Blended Natural Gas on Material

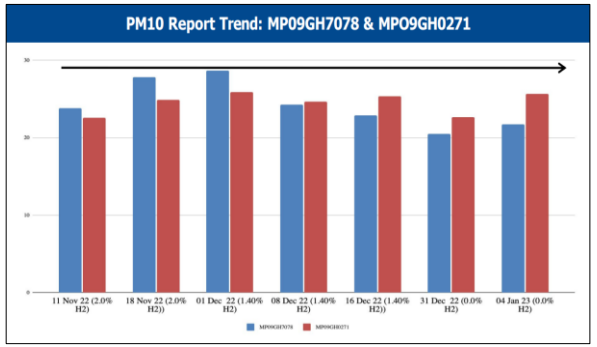
- Density test result of MDPE pipe & regulator diaphragm found within the acceptable range.
- Chemical composition test result for GI pipe & regulator body found within acceptable limit.
- No adverse effect on chemical composition and mechanical properties of material.

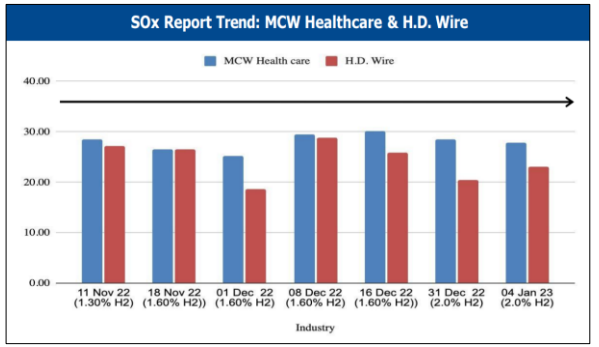
GAIL has conducted surveys on monthly basis for collecting blended gas sample & also captured feedback from PNG & CNG customers during 2% & 5% blending separately .

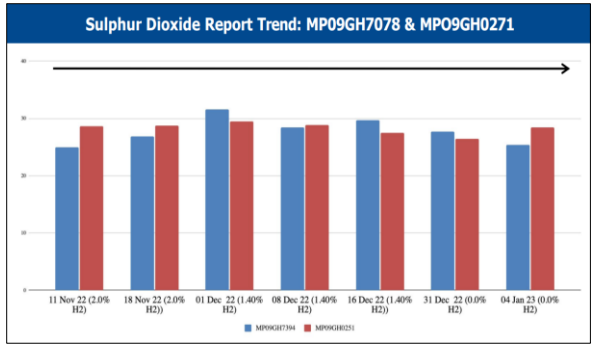
Survey study focus on:

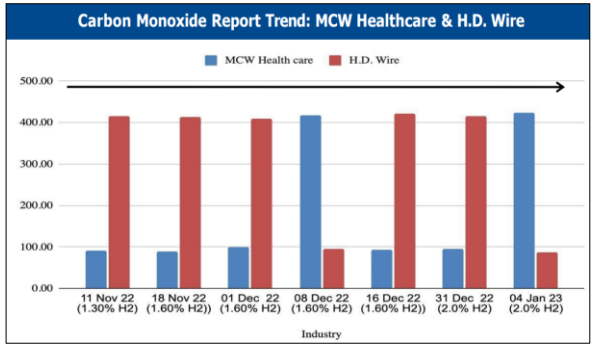
Vehicular Exhaust & Industry Emission Monitoring

- Particulate Matter PM 10
- Sulphur dioxide SO2
- Hydro carbon HC
- Carbon Monoxide CO
- Carbon dioxide CO2
- Oxygen









02% to 05% Hydrogen Blending in Natural Gas has shown a Neutral to Positive Improvement in PM10, SOx, CO, CO2, and HC Emissions

HYDROGEN BLENDING JOURNEY

2022

1. January'22 – 1% Blending Started from GAIL CGS to AGL network.
2. March'22 - Blending % increased to 1.3 % as no abnormality was noted.
3. April'22 - further blending % increased up to 1.6 %
4. May'22 - achieved 2% Blending, started taking feedback from customers

Till date 6.23 Lakhs SCM hydrogen blended in the network

2023

1. March'23 – Permission received from PNGRB, started blending at 5% v/v at Mother Station DRS.
2. Started collecting samples from I&C customers. Network – 180 KMs, I&C – 85 nos., DPNG – 2600 nos.
3. No abnormal observation found in event of Hydrogen blending up to 5 % v/v
4. From Mar.'23 to till date 1.84 lakhs SCM hydrogen was blended in MDPE network.

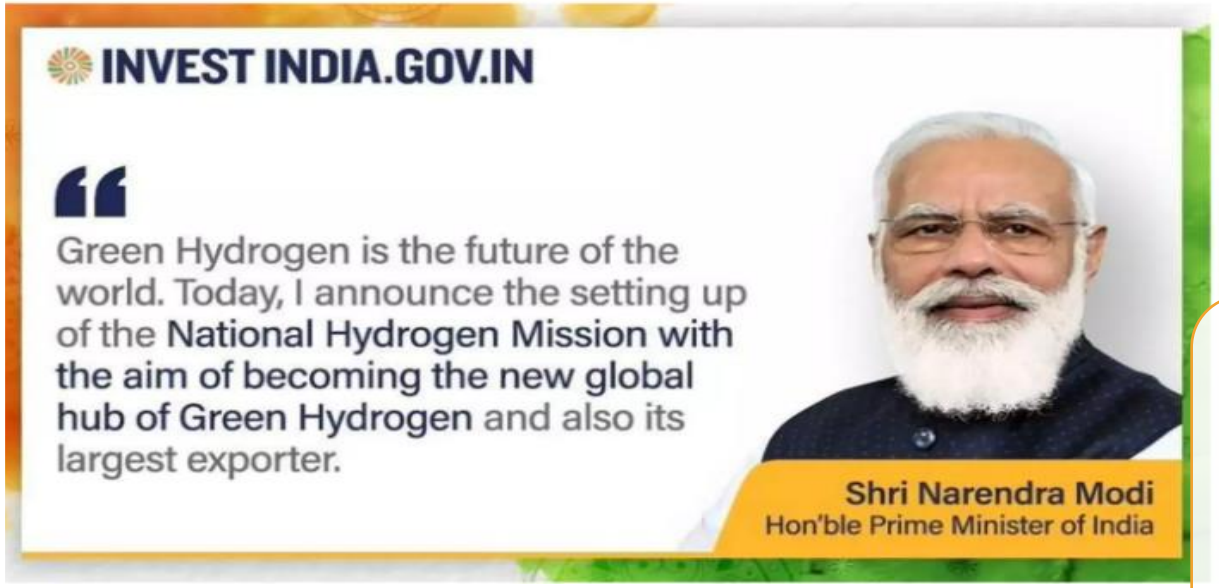
2024

Journey Continues.....

Conclusion

- Blending integrates concentrations of hydrogen into existing natural gas pipelines and reduces carbon intensity in methane.
- India has committed to achieving net-zero carbon emission by 2070 and hydrogen together with renewable energy is seen as a key to achieving that goal.
- It is expected that this pilot project would help in creation of a robust standard and regulatory framework in India to cover the aspects of injecting hydrogen in natural gas.
- M/s DNV is being engaged for impact assessment of blending of Hydrogen into Natural Gas.

National Hydrogen Energy Mission



National Hydrogen Energy Mission: Reason for Implementation

- Energy Independence
- Clean Energy Transition
- Diversification of Energy Sources
- Reducing Emission
- Economic Growth and Innovation
- Meeting International Commitments

Thank You