GUJARAT GAS

एनटीपीसी NTPC

Pilot Project on Green Hydrogen Blending in PNG Distribution Network

NTPC TOWNSHIP, KAWAS, HAZIRA, GUJARAT

Contents

1. Project status
2. Objective and features
3. Project description and scheme
4. Safety provisions and studies
5. Performance testing of the project
6. Gas and material assessments
7. Awareness session and perception survey

Project Status

- GGL, NTPC inked agreement on 5th Apr 2022.
- Approval obtained for 5% v/v of H2 blending from PNGRB on 19th Sep 2022.
- Commissioned India's first Green Hydrogen Blending Project on 2nd Jan 2023.
- A third-party agency, Gujarat Energy Research Management Institute (GERMI) was engaged to carryout various assessment in this project.
- Project status report & Third-party assessment report has submitted to PNGRB.
- Approval obtained for increasing H2 concentration to 8% v/v in Nov' 2023.
- System in operation with 8% v/v of H2 blending for more than three months.

Objectives and Features

India's 1st Green Hydrogen Blending with Natural Gas

Objectives

Technical validation

- System Design
- Execution and Operation

Safety requirements

- Standards & Regulations

Understands the Impact of hydrogen blending

- Gas assessment
- Material structure assessment

Understanding user's concerns and perception

NTPC Kawas Township, Surat, Gujarat

Features

- 5.5 TPA of CO_2 eq / year can be mitigated
- Import substitution of LNG
- Decentralized decarbonization of gas-based end-use application

Project description and scheme

PNG Network : Gujarat Gas Limited Surat GA

Blending Level : H_2 at 5-20% v/v

RE Power : Floating Solar (NTPC Kawas)

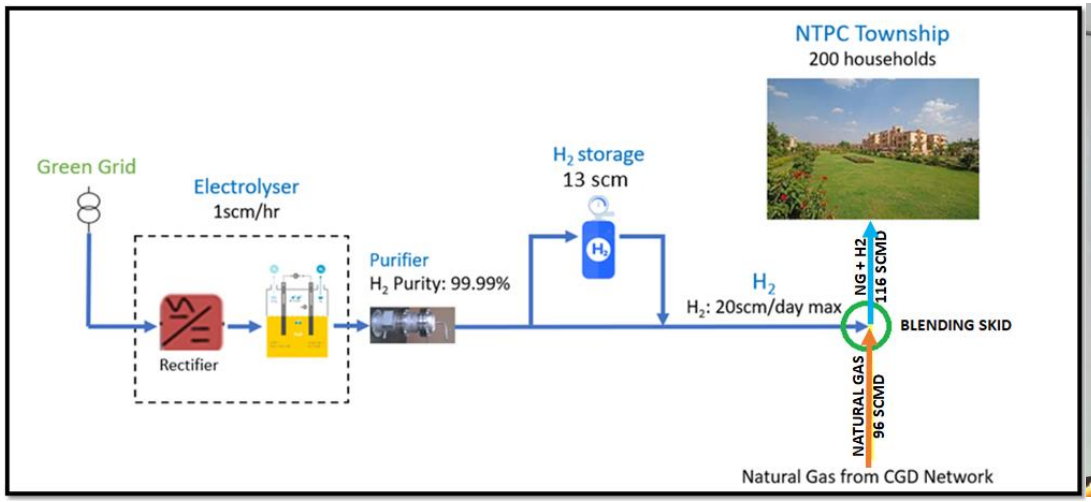
Household : 200 nos.

Electrolyzer : PEM (Min 1 nm^3/hr.)

H_2 storage : 13 nm^3 (640 WL) at 30 bar(g)

H_2 blending : Active & Monitor, PID c/v, H_2 Analyzer

Safety Studies : HAZOP, HAC, QRA, EMERA



Brief scheme of the project

Commissioned on 02nd Jan 2023

Safety Provisions

Standards Compliance	Piping Standards: OISD 118, ASME B31.12 and B31.3, PNGRB T4S Guidelines
	Electrical: IS 5571, IS 3043, IP Std Compliance
	Instrumentation & Control System : API RP, EN 334, EN 14382
	Storage Cylinder: PESO GCR 2016
	Safety Valves: ASME UV stamped
Safety System	Provision of Active and Monitor Pressure regulator
	Safe shutdown of system (in-case of power supply failure)
	Emergency Shutdown for overpressure protection and leakage detection
	Online analyser (H2, NG, and blended gas) for feedback control & protection
	Gas detectors for H2 and NG at strategic locations
	Safety devices (flame arrester) in all venting points

Safety Studies

A. Hydrogen Generation and Blending System

i. Hazard Operability (HAZOP) - *M/s Nachiket Enterprise*
ii. Quantitative Risk Assessment (QRA) - *M/s DNV*
iii. Hazardous Area Classification (HAC) - *M/s DNV*
iv. Escape Muster Evacuation and Rescue Analysis (EMERA) - *M/s DNV*

B. Gas Pipeline Network (upto 10% Hydrogen Blending)

i. Quantitative Risk Assessment (QRA) - M/s Bureau Veritas

Performance Testing

Performance Test of Hydrogen Generation System:

Assessments were carried out for following parameters:

1. Flow rate
2. Hydrogen purity
3. Maximum pressure

Performance Test of Blending Skid:

Assessments were carried out for following blended percentages:

1. 10% hydrogen blending
2. 15% Hydrogen Blending
3. 20%. Hydrogen Blending

During the performance testing the blending skid was isolated and PNG was supplied with 100% Natural Gas through by-pass system.

Performance test results were found satisfactory.

Gas Homogeneity and Burner Testing

Establishment of stagnant network and riser

1. A tapping was taken from low pressure PE line for around 70 meters to the nearest building (with no customer)
2. Test (dummy) riser of GI piping was installed on this 2-storey building.
3. Regulator was installed on this riser with two tapings
4. Burner is connected to this riser termination to observe the flame behavior to the blended mixture
5. Blended gas was allowed to line pack the tapping line and dummy riser and was isolated.
6. Samples of blended gas were collected from this stagnant line pack at defined interval of 24 hours and 48 hours from both top & bottom of the riser.
7. Each sample was tested for its gas composition to establish the gas homogeneity.

Gas Homogeneity and Odourant Dilution

Analysis Result at 5% v/v and 8% v/v Hydrogen blending with PNG

Gas Composition

Purpose : Composition (Homogeneity)

Frequency : Every Month

Samples : 3 Samples

(blending skid, highest, farthest)

No separation of hydrogen gas

Gas sampling

Odourant Dilution

Purpose : Dilution Effect

Frequency : Every blending level

Samples : 4 Samples

(once in a week)

No dilution in the odourant level

Odourant Testing

Material Testing (5% v/v)

Purpose : Composition (Homogeneity)

Frequency : Every 3 Month

Samples : Polyethylene, Galvanised pipe, Burner, Rubber seal

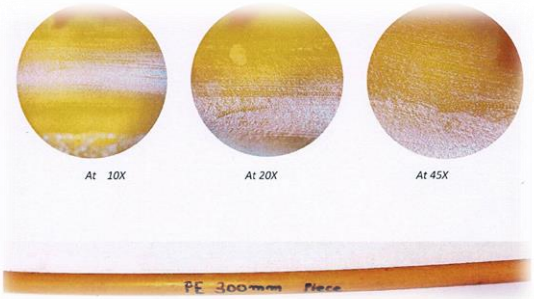
Material	Test / Analysis	Inference
Galvanised pipe	Composition	No variation
	Tensile test	No variation
	Corrosion mapping	No adverse effects
	Macro structure	No discontinuity
Rubber seal	Compatibility test	No adverse effects
Burner	Macro structure	No discontinuity
Polyethylene pipe	Corrosion mapping	No adverse effects
	Macrostructure	No discontinuity

Microscopic Examination

Galvanised pipe

Burner

Polyethylene



Awareness Sessions

Conducted for residents of NTPC township covering following key aspects:

- Natural Gas – Properties and its advantages
- Hydrogen Gas properties
- Project about H2 blending in Natural Gas
- Advantages of the blending project
- Hazards related to Natural Gas & Hydrogen
- Brief on Testing carried out for this project
- Flame behavior of NG & H2 at different blending %
- Do’s & Don’t for PNG connections
- Sharing of emergency contact details
- Customer Service-related information

Customer Perception Survey

Carried out with residents of the NTPC township:

Sample survey at 24 residential connections

The summarized results of survey along with corrective actions taken are:

- Knowledge about hydrogen gas or any additional requirement of training for Hydrogen gas – around 60% were found aware, awareness session conducted as part of corrective action.
- Heating performance w.r.t cooking – maximum were found satisfied
- Any gas flow sound during cooking – majority reported no sound
- Flame visibility in gas appliance – almost all found it normal (blue)
- Gas smell adequacy – all reported normal
- Actions in case of gas leakage – most of them responded with turn off gas supply, open door etc.
- Awareness of emergency contact details – around 50% found aware, checklist along with emergency contact details were shared

Performance at higher blending level

- Stagnation Sample of 48 hours in riser pipe: H2% in the blended mixture was also found within acceptable range (7.79% & 7.72% at bottom & top respectively)

Post increase in hydrogen concentration of 8% v/v.:

- Burner flame behaviour at domestic and commercial connection for any abnormality – *No abnormality observed*
- Gas composition at Domestic connections during peak hours of flow – *within range (7.96%)*
- Gas composition at Commercial connection during peak hours of flow – *within range (7.71%)*
- Odorant concentration/smell monitoring at network farthest end – *no change in effect on odorant smell/concentration*
- H2% concentration testing at top & bottom of testing riser for stagnant line pack (duration of 3 months) – *Planned in March 2024*
- Chimney stack monitoring at commercial connection (SOx, Nox, PM etc.) – *Done with 8% hydrogen concentration in Jan 2024, planning for similar monitoring with only NG combustion in March 2024 for comparison purpose.*
- Material testing for pipeline components exposed to the increased H2% as per defined frequency (post 3 months of exposure) – *Planned in March 2024*

Project - Photographs

THANKS