STAKEHOLDERS INTERACTION ON PATHWAYS FOR TRANSMISSION OF HYDROGEN IN NATURAL GAS PIPELINES

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PESO INITIATIVES - HYDROGEN SAFETY AND REGULATIONS

- PESO has reviewed the 55 codes and 22 standards as recommended by WG-II for inclusion in the amendment of Static and Mobile Pressure Vessel(Unfired) Rules,2016 and Gas Cylinder Rules,2016.
- PESO is coordinating with MED-16 committee, BIS for Harmonization of ISO19880 for Gaseous Hydrogen Fueling stations design, installation, commissioning, operation, inspection and maintenance requirements.
- The draft of the ISO19880 for Indian environment conditions to be studied by the all hydrogen experts/ stake holders for review of safety distances.
- Green Hydrogen definition to be inserted in SMPV(U) Rules 2016 and Gas cylinder Rules,2016.
- Gas cylinder for Hydrogen Type-III and Type-IV standards and proto type test standards to be reviewed by BIS and stake holders for inclusion in the Gas cylinder rules.
- NFPA-2, NFPA55 etc. are adopting for Site location and layout, safety distances, Hazardous zone classifications etc., for Gaseous Hydrogen dispensing station as well as Cryogenic Liquid Hydrogen.
- Preparing SOP and approval conditions for Green Hydrogen Storage, Transportation and dispensation.

PESO INITIATIVES - HYDROGEN SAFETY AND REGULATIONS

- Category : Standards that can be adopted as it is
  - Product Standards : Total 12 standards
  - Out of 12 standards 3 standards were already existing in the Gas cylinder Rules and the SMPV(U) Rules,2016. Remaining 9 standards will be adopted in consultation with BIS and stake holders for any amendments in the standards are required for suitability to Indian atmospheric conditions and density of population ,etc.
  - Code of Project : Total 5 standards
  - These standards are related to the cryogenic liquid hydrogen at -253 degC, and process safety management in industries .Therefore deliberations with cryogenic & Process Industries , BIS,OISD and other stake holders for any amendments in the standards are required for suitability to Indian atmospheric and process conditions.

PESO INITIATIVES - HYDROGEN SAFETY AND REGULATIONS

Action Taken Report

- Standards with amendments : Total 2
  - 1. NFPA-2 Hydrogen Technologies code-
    - PESO reviewed this code, will adopt this code in consultation with BIS and stake holders for any amendments in the standards are required for suitability to Indian atmospheric conditions . The code is very exhaustive in nature contains 16 chapters , approx. 380 pages and PESO requested to all the stake holders and working group to specify the subject matter which has to be included in the rules.
  - 2. Gas Cylinder Rules,2016
    - PESO has completed the work related to DRAFT amendment of Gas Cylinder Rules,2016 for inclusion of above mentioned codes and standards. PESO will incorporate/adopt all the codes and standards after duly notified by BIS and the inputs from working group as well as stake holders to avoid any duplicity in codes which may leads to compliance burden to the stake holders.
    - Example: Hydrogen dispensing stations referred in NFPA-2 and ISO 19880 also. In this regard detail study is required to decide which safety distances to be considered for Hydrogen fuelling stations in line with Indian atmospheric conditions

PESO INITIATIVES - HYDROGEN SAFETY AND REGULATIONS

- Trial permissions issued by PESO as a part of pilot studies

1. PESO has issued trial permission for storage and dispensing of hydrogen at :
   - M/s Indian Oil Corporation Ltd, R&D Centre, Faridabad
   - M/s Indian Oil Corporation Ltd, Gujarat Refinery
   - Solar Energy Centre, Gwalpahari, Gurgaon, Haryana
   - M/s Reliance Industries Limited , Jamnagar , Gujarat
   - M/s TATA Motors, Pune, Maharashtra
2. Dispensing of hydrogen in fuel cells fitted to vehicles of Hyundai, Toyota and Tata.
3. Trial permission for import of Tube Trailers for storing of Hydrogen Gas.
4. Electrical components of Hydrogen Dispenser.
5. Electrical components of Hydrogen Compressor.

PESO INITIATIVES - HYDROGEN SAFETY AND REGULATIONS

PESO views & recommendations

The amendments to the Gas Cylinders Rules, 2016 for the inclusion of hydrogen as an automotive fuel include several salient features:

- Incorporation of Rules, Codes, and Standards: All the "Rules, Codes and Standards" recommended by the Working Group constituted by MNRE have been included in the draft rules. This ensures that the rules for using hydrogen as an automotive fuel adhere to the recommended guidelines.
- Definition of "Green Hydrogen": The definition of "Green Hydrogen" as notified by MNRE has been included in the Rules. This is important for distinguishing hydrogen produced from renewable sources from other forms of hydrogen.
- Definition of "Compressed Hydrogen Gas": The committee has defined "Compressed Hydrogen Gas," which includes Green Hydrogen as well. This is aimed at promoting research and development in the country and facilitating ease of doing business in the hydrogen fuel sector.
- Inclusion of Definitions: Definitions of "Compressed Hydrogen Gas System," "Hydrogen Supply System," and "Hydrogen Dispensing Station" have been incorporated to cover the generation, storage, transportation, and dispensing of hydrogen as an automotive fuel, conforming to National and International Standards.
- New License "FORM H": A new license, "FORM H," has been incorporated for the generation, storage, and dispensing of hydrogen as an automotive fuel. This would likely involve a specific set of requirements and regulations for entities involved in these activities.

Continued….

PESO INITIATIVES - HYDROGEN SAFETY AND REGULATIONS

- Use of Lightweight Material: The provision for the use of lightweight materials of construction such as resins and fiberglass reinforced plastic, i.e., "Composite Cylinders," and "Cryogenic Containers" for storing hydrogen at -253 °C has been incorporated. This is essential as hydrogen, being a lighter gas, requires high-pressure storage to maximize the quantity within the available space.
- Enhanced Diameter of Gas Cylinder: The diameter of the gas cylinder has been increased from "60 cm to 80 cm," aligning with global best practices for hydrogen applications. This change likely aims to accommodate the specific requirements for storing and transporting hydrogen at high pressures.
- Testing of Composite Cylinders in India: Provisions for testing composite cylinders in India, which was previously the monopoly of foreign or imported manufacturers, have been permitted. This move supports the "Make in India" agenda of the Central Government by promoting domestic manufacturing and testing capabilities for composite cylinders.
- Additional Safety Provisions: Additional safety provisions for the usage and testing of multiple cylinders connected to each other, forming a cascade, have been incorporated. This is crucial for ensuring the safe handling and operation of interconnected hydrogen storage and dispensing systems.
- Introduction of Tracking and Tracing: The rules introduce a provision for "tracking and tracing" gas cylinders using advanced technology, such as barcoding. This is likely aimed at enhancing safety, efficiency, and accountability in the management of hydrogen gas cylinders throughout their lifecycle, including manufacturing, distribution, and usage.

HYDROGEN SAFETY AND REGULATIONS

- Safety is seen as a paramount concern by many relevant bodies in relation to the regulation of the Indian hydrogen industry. While they do not expressly refer to hydrogen, existing safety standards and regulations are arguably broad enough to capture most aspects of the hydrogen industry. Nevertheless, it would be prudent to adopt standards and regulations specifically dealing with hydrogen to ensure that all aspects of the hydrogen industry are dealt with.
- Hydrogen safety is regulated by Explosives Act 1884, Gas Cylinder Rules 2016 ,Static and Mobile Pressure Vessels (Unfired) Rules 2016 and MSIHC Rules 1989.

HYDROGEN VESSEL

- Hydrogen Vessels requires a license in Form LS1A required under Rule 50, 54 and 55 of SMPV (U) RULES 2016.
- Transportation of compressed gas in a pressure vessel laden vehicle requires a license in Form LS2 as required under Rule 50, 54 and 55 of SMPV (U) RULES 2016

HYDROGEN DISPENSING

Approvals for R&D activities accorded to IOCL R&D Division, University of Petroleum and Energy Studies for Hydrogen dispensing station at Gurgaon and at Tata Motors

PESO has already approved Type 3 (Aluminium lined composite cylinders) and Type 4 (all composite cylinders) cylinders for CNG applications which can also be approved for Hydrogen applications as per Gas Cylinders Rules 2016

HYDROGEN DISPENSING

As far as Hydrogen dispensing is concerned, a robust design and equipments confirming to international standards are the requirement.

PESO is in the process of formulating standards, design criteria, safety regulations and fire fighting system requirements for hydrogen dispensing facility.

PESO has given Consent in JUNE 2022 to Hydrogen dispensing facility for filling Hydrogen in cylinders/cascades and dispensing in Fuel Cell Buses attached with M/S IOCL, Gujarat Refinery.

PESO has given Consent in APRIL 2023 to Hydrogen refueling station of RIL at Jamnagar for filling Hydrogen in cylinders/cascades and dispensing in Fuel cell Buses attached with RIL.

HYDROGEN STORAGE

- The most challenging part in this process is storage of hydrogen, as hydrogen is very low density gas & must be stored at high pressures ranging from 350 Bar to 700 Bar to get required quantity & mileage of vehicles.
- The development of Type 4 high pressure composite cylinders which are very light in weight and safe compared to steel cylinders made it possible to use Hydrogen as fuel in the vehicles which is future of auto industry.
- The storage of hydrogen is different in different type of vehicles at different pressures.

HYDROGEN STORAGE

- For passenger cars, size of cylinder is in between 40 to 120 Ltr water capacity at working pressure rating of 500 bar to 700 bar. One passenger car can store 5-6 Kgs of Hydrogen depending upon the pressure and typically travel 600 – 650 Km in one filling. The development of Type 4 high pressure composite cylinders which are very light in weight and safe compared to steel cylinders made it possible to use Hydrogen as fuel in the vehicles which is future of auto industry.
- The transport vehicles need more gas to be stored as consumption is more, are using number of cylinders of water capacity between 150 to 350 Ltr and can store upto 16-20 Kgs of hydrogen which can travel approx.. 500 Kms in one filling. The pressure of hydrogen is approx. 350 bar.

COMPOSITE CYLINDERS

- The composite cylinders for vehicle applications are designed as per European standard EC-79, ECER-134, ISO 19881 etc. The vehicles can be filled at dispensing unit in similar fashion as CNG is filled presently. Since hydrogen is very light in nature and having high explosion behavior, lot more precautions needed to be taken while handling the hydrogen gas.
- The working pressure of such Type 4 composite cylinders cascade is 300-350 bar. The cylinders for the Cascade are designed as per European standard EN-12245. The water capacity of one 10 ft cascade shall be approx. 8750 Ltrs which can accommodate about 250 Kgs of hydrogen gas.

CHALLENGES IN STORAGE AND TRANSPORTATION

- Big challenge is to storage & transportation of hydrogen gas to filling station. Since it is the beginning of hydrogen era in India it is not practically possible to lay the pipeline in all the places for transportation of Hydrogen to dispense. The best alternative of storage and transportation of hydrogen in cascades of Type IV composite cylinders. The cascades of hydrogen are being used in many countries which comes in the standard sizes like ISO containers of 10 ft, 20 ft & 40 ft.
- Presently these type 4 of composite cylinders for Hydrogen are being manufactured by companies like Hexagon, Quantum, Iljin etc. These companies are marketing the cylinders all over the world.

RECENT DEVELOPMENTS

- Recently our Road Transport Minister Mr. Nitin Gadkari has launched a vehicle manufactured by Toyota which is working on hydrogen fuel cell for storage of hydrogen they have used two cylinders of 60 Ltrs water capacity which can store 5 kgs of hydrogen at 700 bar pressure of gas and can travel approx. 600 Kilometers in single filling.
- In India presently no body is manufacturing Type IV composite cylinders for hydrogen gas. M/s. Time Technoplast Ltd., Mumbai is engaged in manufacture of Type IV composite cylinder for LPG & CNG. They are successfully launched Type IV composite cylinder under AtmaNirbhar Bharat for transportation & storage of CNG gas with very efficient space utilization of transport vehicle helping in reduction on transportation cost and carbon emissions.
- Time Technoplast is in advanced stage of development of Type IV composite cylinders for Hydrogen for automobile and also for cascade i.e. transportation of gas to dispensing stations. The cylinder shall be designed as per international standards ECER-134 & EN-12245. The working pressure of these cylinders shall be upto 700 bar for automobile and 350 bar for cascades.

OTHER STATUTES

- Manufacture, Storage and Import of Hydrogen also comes under the purview of MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICAL (MSIHC) RULES, 1989.

- In MSIHC Rules 1989, PART II, LIST OF HAZARDOUS AND TOXIC CHEMICALS. Sl. NO.314 is Hydrogen

- GROUP 3-HIGHLY REACTIVE SUBSTANCES, Sl.No. 143, Hydrogen is mentioned. In this, Threshold Quantity for application for application of Rules 5, 7-9 and 13-15 is 2 Tons and threshold quantity for application of Rules 10-12 is 50 T.

CASE STUDIES AND BEST PRACTICES

SUCCESSFUL EXAMPLES OF SAFE ENERGY STATIONS

BEST PRACTICES

CASE STUDY - APPROVAL FOR HYDROGEN DISPENSING STATION – IOCL GUJARAT

- PESO HAS GIVEN APPROVAL FOR IOCL GUJARAT REFINERY for Hydrogen Dispensing Facility of Indian Oil Corporation Limited, Gujarat Refinery, at Koyali, Vadodara, Gujarat.
- PESO HAS GRANTED Conceptual agreement for Hydrogen generation and filling in cylinders /cascades and dispensing installation attached with IOCL Gujarat Refinery.
- PESO has granted license to import 6 Gas cylinders for High Pressure Cylinder Storage to IOCL.
- PESO has given Consent in APRIL 2023 to Hydrogen refueling station at Jamnagar for filling Hydrogen in cylinders/cascades and dispensing in Fuel Cell Buses attached with RIL. (There is no high pressure storage, chiller and heat exchanger at RIL because of reduced compressor capacity.

CASE STUDY - APPROVAL FOR HYDROGEN DISPENSING STATION – IOCL GUJARAT

Fuel Cell Grade Hydrogen is being sourced IOCL, Gujarat Refinery. This will be further purified using a PSA (Pressure swing adsorption) facility in one of the HGU (Hydrogen Generation Unit)

Fuel cell grade hydrogen is transported through 4" above ground carbon steel pipeline (designed as per ANSI B31.12) to Hydrogen dispensing facility.

This Fuel cell grade Hydrogen is then compressed from 18 Kg/cm2 to 550 Kg/cm2 using water cooled, reciprocating diaphragm, triple metallic diaphragm compressor with a **capacity of 35 Kg/Hr (IOCL)**. This two-stage compressor discharge pressure is 500 Bar – 550 Bar. (**RIL capacity is 2.5 kg/hr**)

The High-pressure hydrogen from compressor is routed to high pressure cylinder storage with 6 tubes in cascade with a storage pressure of 500 – 550 Bar and a capacity of 24 Kg per tube.

A pressure reducing station for filling hydrogen gas to tube trailer is also constructed. The pressure reducing station reduces the pressure from 550 Bar to 200 Bar for filling the tube trailer.

Hydrogen Codes, Standards, Guidelines and Practices

A. HYDROGEN GENERATION

- ISO 22734: Hydrogen generators (electrolyser)
- ISO 16110: Hydrogen generators using fuel processing
- CGA H-10: Combustion safety for steam reformer
- ISO 15649: Industries Piping
- EIGA DOC 246: Small-Scale Hydrogen Production
- EIGA DOC 211: Hydrogen Vent Systems
- EIGA DOC 210:Hydrogen PSA Mechanical Integrity
- EIGA DOC 185: Steam Reformers
- EIGA DOC 155: Hydrogen Production by SMR
- EIGA DOC 15: Gaseous Hydrogen Installations

Hydrogen Codes, Standards, Guidelines and Practices

B. HYDROGEN STORAGE AND TRANSPORT

- ASME Section VIII
- ASME Section VIII: Division 3, Article KD-10
- ISO 9809: Gas cylinders – Steel
- ISO 7866: Gas cylinders – Aluminium
- ISO 13985: Liquid h2 fuel tanks
- ASME B31.12: Hydrogen Piping and Pipeline
- EIGA Doc 12: Hydrogen Pipeline
- ISO 16111: Reversible metal hydride h2 storage
- ASME B31.3 Process Piping
- ASME STP/PT-005: High-pressure composite h2 tanks

Hydrogen Codes, Standards, Guidelines and Practices

B. HYDROGEN STORAGE AND TRANSPORT

- CGA H-3: Cryogenic Hydrogen Storage
- CGA G-5: Hydrogen
- EIGA TB 42: Welded Vessels and Hydrogen Compatibility
- EIGA DOC 247: Hydrogen Distribution-Storage
- EIGA DOC 235: Gas Pipeline Integrity
- EIGA DOC 171: Underground Storage of Hydrogen
- EIGA DOC 10207: Safety Audit / Assessment Tool – h2 Compression, Purification and Cylinder Filling
- EIGA DOC 100: Hydrogen Cylinders and Vessels

Hydrogen Codes, Standards, Guidelines and Practices

C. HYDROGEN COMPRESSORS, PUMPS AND TURBINES

- API STD 618: Reciprocating Compressors
- API Standard 617: Axial and Centrifugal Compressors and Expander-compressors
- API STD 692: Dry Gas Sealing Systems for Axial, Centrifugal, and Rotary Screw Compressors and Expanders
- EIGA DOC 244: Reciprocating Cryogenic Pumps for Hydrogen and LNG

Hydrogen Codes, Standards, Guidelines and Practices

D. HYDROGEN FUEL CELLS/REFUELLING

- IEC 62282-3-100: Fuel cell - Safety
- IEC 62282-3-300: Fuel cell – Installation
- DIN EN 17124: Hydrogen fuel - product specification and quality assurance for h2 PEM fuel cell
- CSA/ANSI HGV 4.10: Standard For Fittings In Compressed Gaseous Hydrogen Fueling Stations
- SAE J2719: Hydrogen Fuel Quality for Fuel Cell Vehicles
- ISO 19880 series
- ISO 17268: Hydrogen refuelling
- SAE J2601: Fueling for Gaseous Hydrogen
- ISO 13984: Liquid hydrogen fuelling
- ISO 14687: Hydrogen fuel quality
- EIGA TB 43: Secondary Identification of H2 Vehicle at Dispenser

Hydrogen Codes, Standards, Guidelines and Practices

E. HYDROGEN SAFETY

- ISO 26142: Hydrogen detection apparatus Stationary applications
- EIGA Doc 06: Safety in storage, Handling and distribution of liquid hydrogen
- ISO/TR 15916: Safety of hydrogen systems
- OSHA 1910.103 Hydrogen
- NFPA 2 Hydrogen Technologies Code
- NFPA 55: Compressed Gases and Cryogenic
- NFPA 70, NATIONAL ELECTRICAL CODE (NEC)
- IEC 60079-10-1: Explosive gas atmospheres
- EIGA DOC 6: Safety in Storage, Handling and Distribution of Liquid Hydrogen

CASE STUDY - IOCL Hydrogen Purification & Dispensing Facility at Gujarat

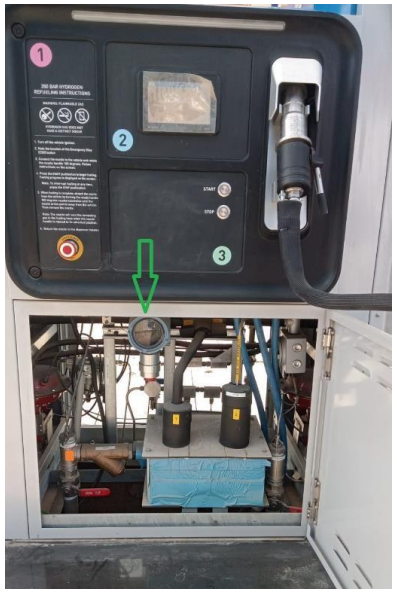
CASE STUDY - Hydrogen Initiative by IOCL, Gujarat Refinery, H2 Purification and Dispensing facility

CASE STUDY – Points considered by PESO at H2 Dispensing Stations to mitigate hazards

- **MECHANICAL INTEGRITY** – Selecting compatible materials and components, Welded connections, Relief devices, Pressure Testing, Regular Maintenance, Expansion & Contraction
- **SAFE INSTALLATION LOCATION** – Safety setback distances, Fire barrier walls, Impact prevention from Trucks by provision of bollards, Canopy design – Weather protection and adequate ventilation
- **VENTILATION** – Naturally ventilated design (should not obstruct passive airflow)
- **DETECTION** – Leak checking during preventive maintenance, leak detectors & hydrogen gas detectors
- **SYSTEM CONTROLS** – Emergency Shutdown system, Isolation valves, Venting to safe location
- **IGNITION AND ELECTRICAL DESIGN** – Classified and Intrinsically Safe Electrical equipment. All equipment must be bonded and grounded to mitigate charge accumulation and electrostatic discharge
- **PURGING** – Required if maintenance is needed
- **PPEs** – Fire Resistant clothing, Face shields
- **TRAINING AND EMERGENCY RESPONSE PLAN**

CASE STUDY - DISPENSER PROTECTION

Dispenser- Chillers installed at Site



Dispenser- Gas Detector (Bottom Cabinet)

Dispenser- Gas Detector (Top Cabinet)

Dispenser-Hose Breakaway Coupling

Performance Review of Hydrogen Dispensing Station – IOCL Gujarat Refinery

- Continuous trial and filling of buses at IOCL Gujarat Refinery is going on since 23.12.2022 as and when required and total 20 nos. of FCEV Bus Fueling operations were carried out till 11th March 2024.

- Hydrogen Dispensing Facility (HDF) is functioning very well with all equipment's are running effectively especially compressors, priority panel, high-pressure storage tubes, sequence panel, dispensers, chillers.

Performance Review of Hydrogen Refueling Station – RIL, Jamnagar

- RIL Hydrogen Refueling Station (HRS) at Jamnagar is functioning well since March 2023.

- The HRS station has cumulatively dispensed about 7,437 kg of Hydrogen gas into H2ICE vehicles, enabling an on road distance coverage of 99,140 kms. On an average, the station is able to refuel about 4 - 5 vehicles per day, with an average fill quantity of 8.2 kgs. Station has completed a total of 874 refueling cycles till date. In compliance with the PESO approval, the station operates during day time, from sunrise to sunset. The station's core-equipment like compressor, dispenser, F&G detection system and control systems are all maintained by experts of the respective OEM's. The station's current operating & control philosophy, as implemented during commissioning stage, continue to stay relevant& adequate for safe operation of station. This is primarily because of the simple configuration of station, lower throughput (lower dispensing rate), limited operating window and usage restricted to captive consumption only, resulting into minimum to nil change management.

BLENDING of Hydrogen in Natural Gas Pipelines

- Repurposing existing natural gas pipelines for hydrogen transportation by blending it with natural gas is indeed a promising approach to leverage the current infrastructure, reduce costs, and facilitate the transition to a hydrogen economy. While there are challenges and risks associated with this approach, with proper planning, engineering, and risk management strategies, repurposed pipelines can be used effectively for hydrogen transport. Here are some key points PESO requests all of you to consider:

- Metallurgical Compatibility**: The potential adverse impact on pipeline metallurgy due to hydrogen transport must be carefully assessed. Selecting pipeline materials that are compatible with hydrogen, implementing corrosion prevention measures, and monitoring the pipeline's integrity are crucial to mitigate risks associated with hydrogen embrittlement and cracking.

- Pressure and Temperature Considerations**: Hydrogen behaves differently from natural gas in terms of pressure and temperature requirements. Modifications to the pipeline system may be necessary to accommodate the unique characteristics of hydrogen and ensure safe transport. This includes addressing issues such as hydrogen diffusion, permeation, and embrittlement at high pressures.

BLENDING of Hydrogen in Natural Gas Pipelines

- Blending Ratios and Impacts**: Properly determining the blending ratios of hydrogen and natural gas is essential to ensure the safe and efficient operation of the pipeline system. Changes in combustion properties, temperature variations, and other factors resulting from blending must be carefully considered to avoid operational issues and maintain pipeline integrity.

- Regulatory Compliance and Safety Standards**: Compliance with regulatory requirements and safety standards specific to hydrogen transportation is paramount when repurposing pipelines. Adhering to industry best practices, conducting risk assessments, and implementing appropriate safety measures are essential to ensure the reliability and safety of the hydrogen transport system

- With comprehensive risk assessments, thorough engineering evaluations, and the implementation of necessary modifications and safety measures, repurposed pipelines can be used effectively for hydrogen transportation while mitigating potential risks and ensuring cost savings. Collaborating with industry experts, regulatory authorities, and stakeholders will be crucial in successfully repurposing existing pipelines for hydrogen transport to maximize benefits and minimize hassles associated with laying new gas pipeline infrastructure.

Case Study of Blending of 5 % Hydrogen with Natural Gas in PNG network

PESO has gone through the gas composition analysis reports specifically regarding the dosing of hydrogen with natural gas and ethyl mercaptan analysis at the township . Here are some key points based on the information provided:

A. Hydrogen Dosing:

- Hydrogen is being dosed at a concentration of 5% with natural gas in the PNG network at the Township.
- The expected range of hydrogen concentration is between 4.5% to 5.5%.
- Analysis of gas samples collected during May to September 2023 indicated that the hydrogen percentage in the gas ranged between 4.5% to 5%.
- This suggests that the hydrogen concentration throughout the PNG network at Township is within the expected range of 4.5% to 5%.

Continued…..

Case Study of Blending of 5 % Hydrogen with Natural Gas in PNG network

B. Ethyl Mercaptan Analysis:

- Ethyl mercaptan concentration analysis was conducted weekly in July 2023 at the blending skid and outside the blending skid.
- The preferred concentration of ethyl mercaptan for adequate smell is more than 2 PPM.
- The recorded values of ethyl mercaptan were higher than the defined minimum limits both at the blending skid and outside the blending skid.
- The smell of the odorant in the gas was found to be adequate, which is important for identifying gas leakages as ethyl mercaptan provides a distinct smell.

Continued…..

Case Study of Blending of 5 % Hydrogen with Natural Gas in PNG network

- Overall, the information provided indicates that the hydrogen dosing with natural gas and ethyl mercaptan analysis at the Township are being managed effectively. Maintaining the hydrogen concentration within the desired range and ensuring that the ethyl mercaptan concentration is sufficient for odor detection are essential for safe and efficient operation of the gas distribution network. Regular monitoring and analysis of gas composition are vital for ensuring the integrity and safety of the PNG network.

Continued…..

Case Study of Blending of 5 % Hydrogen with Natural Gas in PNG network

PESO has gone through the comprehensive material testing, training, and a perception survey conducted in relation to the blending of hydrogen with natural gas in the PNG network. Here are the key findings:

A. Material Testing:

- Composition analysis, tensile strength testing, corrosion mapping, and macrostructure examination of GI pipes were carried out.
- Thickness mapping and macrostructure examination of PE pipes were conducted.
- Compatibility tests of sealing components and macrostructure analysis of burners were performed.
- The studies indicated that there were no adverse effects on the PNG network as a result of mixing 5% hydrogen with natural gas. This suggests that the materials and components used in the network are compatible with the blended gas mixture.

Continued…..

Case Study of Blending of 5 % Hydrogen with Natural Gas in PNG network

B. TRAINING:

- Training sessions were conducted to educate personnel about the properties of natural gas and hydrogen.
- Presentations were made showcasing flame colors at different levels of hydrogen blending with natural gas in the pipeline.
- Safety aspects related to the use of hydrogen mixed with natural gas were explained to ensure that personnel are aware of the potential risks and necessary precautions.

Continued…..

Case Study of Blending of 5 % Hydrogen with Natural Gas in PNG network

C. PERCEPTION SURVEY:

- A perception survey was conducted in 25 households to gather feedback from consumers.
- The feedback received from consumers was satisfactory, indicating that they are likely comfortable with the use of blended gas in the PNG network.

Continued…..

Case Study of Blending of 5 % Hydrogen with Natural Gas in PNG network

- **Overall, the results of the material testing, training sessions, and perception survey suggest that the blending of hydrogen with natural gas in the PNG network has been well-researched, implemented with safety considerations, and has gained acceptance among consumers. The absence of adverse effects on the network, positive consumer feedback, and proper training on safety aspects are all positive indicators of the successful integration of hydrogen into the natural gas infrastructure.**

- **PESO is of the opinion that Continued monitoring and maintenance will be crucial to ensure the ongoing safety and efficiency of the blended gas system.**

THANK YOU FOR YOUR ATTENTION

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