DEVELOPMENT IN HYDROGEN ECOSYSTEM- ROLE OF PESO

By

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Role and Responsibilities of PESO

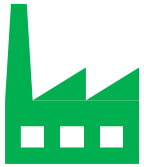
With an overall objective of ensuring safety and security of public and property from fire and explosion, the Organisation as a statutory authority is entrusted with the administration of Explosives Act, 1884, Petroleum Act, 1934; Inflammable Substances Act, 1952 and various Rules framed under these Acts

NATIONAL GREEN HYDROGEN MISSION

National Green Hydrogen Mission: Working group on regulations and standards.

- **Chairman:** Secretary, MNRE
- **Additional Secretary, DPIIT is one of the members**
- Other representatives from MoRTH, MoPNG, BIS, CII, FICCI, SIAM, ARAI etc.

MNRE formed 3 Sub Groups:



Sub Group-I: H_2 Production and Use.
Convener: CII
Members: BIS, Electrolyser manufacturers, Green H_2 producers

Sub Group-II: H_2 Storage and Transportation.
Convener: FICCI
Members: DPIIT/PESO, BIS, GAIL, Gas handling and supply industry

Sub Group-III: H_2 fuelled mobility.
Convener: SIAM
Members: MoRTH, ARAI, BIS, IOCL, NTPC, Automobile Industry

National Green Hydrogen Mission- ROLE OF PESO

- The committee vide order no. C.VIII(3)125/committee/21 dated 25.10.2023 is duly constituted by the Chief Controller of Explosives, PESO with partial modification in the composition carried out on 02.09.2024

- CCE Committee Composition: - Comprises of 5 PESO officers, Hydrogen technical experts and design specialists from key stakeholders: M/s Indian Oil Corporation, M/s Reliance Industries Limited, M/s Aegis, M/s VRV CHART INDUSTRIES, M/s Time Technoplast (Type-4 Composite Cylinder manufacturer), M/s DNV and other related stake holders.

- Evaluation Process: - To review standards, regulations, and codes recommended by MNRE.
  - Collect feedback from trial runs. Conduct comprehensive risk assessment studies using the latest tools to determine safety distances and station layouts.

- Draft Amendments:- Drafted amendments for inclusion of hydrogen storage, transportation, and dispensing in Gas Cylinder Rules, 2016 and SMPV (U) Rules, 2016 which are yet to be notified.

Amendments proposed in the Gas Cylinders Rules and SMPV(U) Rules

- Bar code means a machine and human readable graphical picture having alphabet, character, number embedded in it and includes radio frequency identification (RFID) or quick response code (QR Code). All the cylinders and cryogenic containers used for filling of compressed gases and liquids shall have permanent and tamper proof marking in form of bar code or RFID or QR code or any means of electronic identification number at conspicuous place on cylinders and containers. The bar code on the cylinder shall be duly scanned before fillings of Auto LPG, Auto LNG, CBG, CHG, CNG in it and bar code which fails to be read or the cylinder which do not have valid bar code shall not be filled with Auto LPG, Auto LNG, CBG, CHG, CNG in it
- Compressed Hydrogen Gas (CHG) means hydrogen gas including Green Hydrogen consisting predominantly of hydrogen in gaseous form which has been compressed for use as automotive fuel conforming to specification IS 16061 or ISO: 14687 as amended from time to time or any other standards accepted by the Chief Controller.

Amendments proposed in the Gas Cylinders Rules and SMPV(U) Rules

- Compressed Hydrogen Gas Dispensing station means a gaseous hydrogen dispensing station to dispense hydrogen gas as an automotive fuel into the on-board gas cylinders fitted to vehicles and includes hydrogen pipeline from hydrogen generation unit, hydrogen buffer vessel, hydrogen compressor, gas cylinder cascades, chilling unit, hydrogen dispenser, control panels, emergency shutdown devices and other related infrastructure. The compressed hydrogen gas dispensing station shall be designed, constructed, operated and maintained in accordance with NFPA-2 and ISO 19880- Part 1, Part 3, Part 5, Part 8 as amended from time to time or any other standard accepted by the Chief Controller.

Amendments proposed in the Gas Cylinders Rules and SMPV(U) Rules

- CHG mother station means CHG facilities connected with hydrogen gas pipeline, onsite generation of hydrogen through electrolyser or reformer and having a compressor meant primarily to fill mobile cascade of daughter station and includes stationery cascade for CHG dispensing to vehicles;
- CHG online station means CHG facilities connected with hydrogen gas pipeline, onsite generation of hydrogen through electrolyser or reformer and having a compressor primarily to fill stationary cascades for dispensing CHG to vehicles;

Amendments proposed in the Gas Cylinders Rules and SMPV(U) Rules

- CHG daughter station means CHG facilities not connected to hydrogen gas pipeline and receives CHG through mobile cascade
- CHG daughter booster station means CHG facilities not connected to hydrogen gas pipeline and such CHG dispensing stations where mobile or stationary cascades are connected to the booster compressor for increase in discharge pressure for refueling of the vehicles;
- Electrolyser means an equipment used to generate hydrogen, designed, constructed, operated and maintained as per specifications of IS 16509 or ISO 22734 as amended from time to time.

Amendments proposed in the Gas Cylinders Rules and SMPV(U) Rules

- Fitting means valve, safety relief device or safety fittings that are directly or indirectly fitted on the cylinder or container to prevent abnormal functioning of the cylinder or container and manufactured as per National or International code or specification and accepted by the Chief Controller.
- “Gas cylinder" or "cylinder" means any closed metal container having a volume exceeding 500 ml but not exceeding 1000 liters intended for the storage and transport of compressed gas, including any liquefied petroleum gas (LPG) container or liquefied natural gas (LNG) container or compressed natural gas (CNG) cylinder or compressed hydrogen gas (CHG) cylinder fitted to a motor vehicle as its fuel tank but not including any other such container fitted to a special transport or undercarriage and includes a composite cylinder and cryogenic container, however, the water capacity of cylinder used for storage of CHG, CNG, nitrogen or compressed air, etc., may exceed 1000 liters up to 3000 liters provided the diameter of such cylinder does not exceed 60 cm;
Explanation:- For purpose of this clause, the diameter of cylinders used for filling and storage of CHG may exceed 60 cms but shall not exceed 80 cms.

Amendments proposed in the Gas Cylinders Rules and SMPV(U) Rules

- Gas cylinder cascade means a battery of cylinders connected with each other, a tube trailer, multiple element gas containers and bundle of cylinders, conforming to the specifications BS EN-13769 or BS EN13807 or ISO-10961 or BS-EN 17339, as amended from time to time or as recommended by Ministry of New and Renewable Energy, National Green Hydrogen Mission or any other code or specification or standard accepted by the Chief Controller; The cascade shall be provided with a non-return valve and quick shut off isolation valve in an easily accessible and clearly marked position provided that, cascade enclosed in an enclosure, shall have sufficient perforations of adequate size on the side walls and on roof of the enclosure.

Amendments proposed in the Gas Cylinders Rules and SMPV(U) Rules

- Green Hydrogen means hydrogen produced using renewable energy, including, but not limited to, production through electrolysis or conversion of biomass and having well-to-gate emission (i.e. including water treatment, electrolysis, gas purification, drying and compression of hydrogen) of not more than 2 kg CO2 equivalent per Kg H2 as defined by Ministry of New and Renewable Energy, National Green Hydrogen Mission vide Office Memorandum Number 353 / 35/2022-NT dated 18th August 2023 and published by Press Information Bureau vide Release ID: 1950421, dated 19th August 2023.

Amendments proposed in the Gas Cylinders Rules and SMPV(U) Rules

- Hydrogen Generation System means a packaged, factory assembled or site constructed hydrogen gas generation appliance or system such as an electrolyzer that uses electro- chemical reactions to electrolyze water to produce hydrogen and oxygen gas; or a reformer that converts hydrocarbon fuel to a hydrogen rich stream; or a gasifier that converts coal to a hydrogen rich stream of composition and conditions suitable for a type of device using the hydrogen but does not include hydrogen generated as a byproduct of a waste treatment process.
- Hydrogen Storage System means part of a closed system used for retaining hydrogen in gaseous or liquid form upstream of the source valve and includes cylinder or gas cylinder cascade.

Amendments proposed in the Gas Cylinders Rules and SMPV(U) Rules

- Chief Controller may accept the National or International codes or standards or specifications for cylinders and valves for any compressed gas application or for hydrogen application as recommended by Ministry of New and Renewable Energy, National Green Hydrogen Mission as amended from time to time.
  Explanation: For purpose of this rule, in order to allow the entry of new technology in the country, in future, any cylinders or valves manufactured as per any particular standard or code may be approved by the Chief Controller of Explosives after carrying out the physical evaluation of manufacturing unit if felt necessary in the interest of the safety. Specifying any particular code or standard or specification in the rules will restrict entry of new technology in the country. This will also be in line with the spirit of ease of doing business as amendment of rules for inclusion of particular code or standard or specification takes significant time.
- Chief Controller or the Central Government may under exceptional circumstances to be recorded in writing waive off any of the requirements of the rules. This will, inter alia include approvals for trials for data gathering, promoting research and development in the country and ease of doing business. The period for trial shall be maximum two years only.

Amendments proposed in the Gas Cylinders Rules and SMPV(U) Rules

- The cylinders for CHG or hydrogen, if fitted with safety relief devices or pressure relief devices in their bodies or valves, shall have such safety devices manufactured and maintained in accordance with IS: 5903, CGA S-1.1, CGA S1.2, CGA S-1.3, UN R-134 code or any other code or standard or specification recommended by Ministry of New and Renewable Energy, National Green Hydrogen Mission or any other standard accepted by the Chief Controller or equivalent standards

Amendments proposed in the Gas Cylinders Rules and SMPV(U) Rules

- Electrical Installation: In premises for filling and storage of flammable gas in cylinder, all the electrical components such as meter, distribution board, junction box, switches, fuses, terminals, plugs, sockets, electric fittings, fixed lamps, portable hand lamps, motors, etc shall be in accordance with IEC or IS/IEC 60079 series standards and of the type approved by the Chief Controller of Explosives
- The service life of on board CHG or Green Hydrogen cylinder and cascades shall be fifteen years.

Amendments proposed in the Gas Cylinders Rules and SMPV(U) Rules

- For CHG dispensing station following additional documents to be submitted:- An overall layout of surround area lying within 500 meters from edge of the facilities which are proposed to be licensed
- For composite cylinder testing station, list of persons having qualifications and certification issued by a cylinder manufacturer or training institute recognized by the Chief Controller for safe handling, testing, maintenance and operation of composite cylinder conforming to specification ISO 11623.
- The vehicles shall have approved type of CHG kit fitted in accordance with guidelines of the Ministry of Road Transport and Highways, Government of India as amended from time to time.

Hydrogen covered under the MSIHC Rules

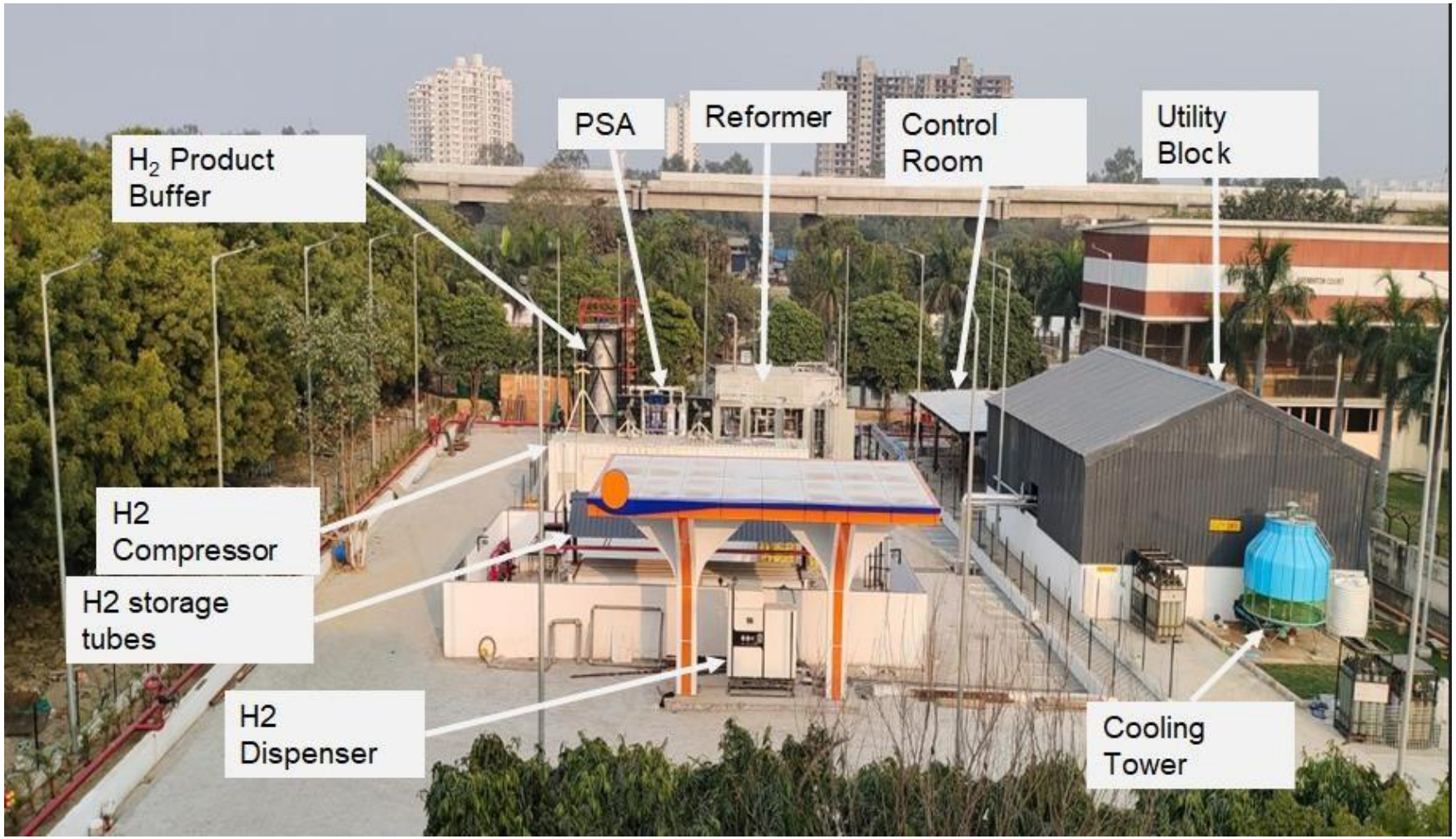
- Manufacture, Storage and Import of Hydrogen also comes under the purview of MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICAL (MSIHC) RULES, 1989.
- In MSIHC Rules 1989, PART II, LIST OF HAZARDOUS AND TOXIC CHEMICALS. Sl. NO.314 - Hydrogen is listed as hazardous chemical
- GROUP 3-HIGHLY REACTIVE SUBSTANCES, Sl.No. 143, Hydrogen is mentioned.
- Threshold Quantity for application of MSIHC Rules 5, 7-9 and 13-15 is 2 Tons and threshold quantity for application of Rules 10-12 is 50 T

Trial permissions issued by PESO as a part of pilot studies for development in hydrogen ecosytem

1. PESO has issued trial permission for storage and dispensing of hydrogen for key developments in Green Hydrogen Infrastructure and Deployment:
   - 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. In-principle approval to Indian Railways under Hydrogen Trainset Project for setting up compressed Hydrogen Refuelling Station in Jind, Haryana
4. Trial permission for import of Tube Trailers for storing of Hydrogen Gas.
5. Electrical components of Hydrogen Dispenser.
6. Electrical components of Hydrogen Compressor.

PESO Approved IOCL Natural Gas and Bio-CNG reforming based Hydrogen Station



IMPORTED HYDROGEN CYLINDERS

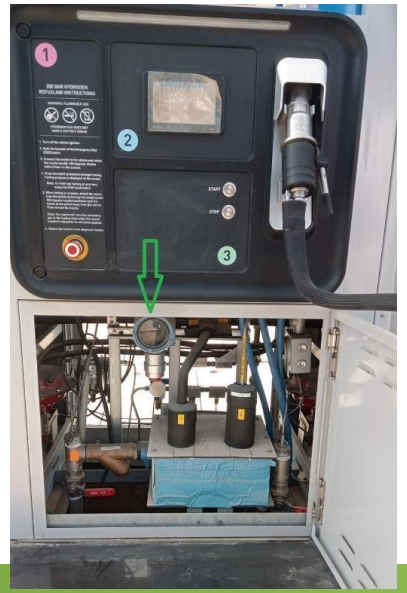
Compressor of the hydrogen station

CASE STUDY - IOCL Hydrogen Purification & Dispensing Facility at Gujarat

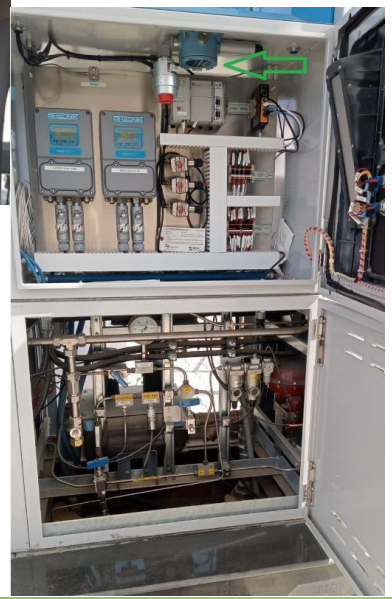
CASE STUDY - Hydrogen Initiative by IOCL, Gujarat Refinery, H2 Purification and Dispensing facility

CASE STUDY - DISPENSER PROTECTION

Dispenser- Chillers installed at Site



Dispenser- Gas Detector (Bottom Cabinet)



Dispenser- Gas Detector (Top Cabinet)

Dispenser-Hose Breakaway Coupling

RIL - Hydrogen Refuelling Station Jamnagar

RIL - Hydrogen Refuelling station Jamnagar

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**

India’s First Green Hydrogen Blending with Natural Gas, NTPC Kawas Township, Surat, Gujarat

Project Details of India's First Green Hydrogen Blending with Natural Gas, NTPC Kawas Township, Surat, Gujarat

- Collaboration: **NTPC & GGL** (Gujarat Gas Limited)
- **200** Households and **Guest House**Canteen
- Blending H2 with PNG: **5-20%** by volume
- RE Power : NTPC Kawas **Floating Solar Plant** (1MW)
- Electrolyzer: **PEM** Type
- H2 storage : **13 Nm3** (640 WL) at 30 bar(g)
- H2 blending : Active & Monitor, PID c/v, H2 Analyzer
- Safety Studies: **HAZOP, HAC, QRA, EMERA**
- Commissioned on **02/01/2023** with **5% v/v.**
- Increased blending level to **8% v/v** from **03/11/2023**

PESO Safety Provisions in BLENDING

- **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

Thank You