



India's First Hydrogen-Powered Train: Advancing Green Rail Mobility

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The Hydrogen Rail Transition

Indian Railways is entering a new era of clean and sustainable transportation. **Hydrogen fuel cell technology** has emerged globally as a promising alternative to fossil fuel-based traction systems. India's first indigenous hydrogen-powered train marks an important step in adopting this next-generation technology. It is a locomotive that generates its own electricity onboard using hydrogen. With the inauguration on **17 July 2026**, the hydrogen fuel cell-powered train is set to begin operations. It will run on the **Jind-Sonipat section** of the Northern Railway. The project combines advanced propulsion technology with dedicated hydrogen storage, refuelling and operational infrastructure. It will demonstrate the feasibility of clean rail transportation in India. Developed as a pilot initiative, the project reflects Indian Railways' commitment to innovation. It also advances energy efficiency and environmentally responsible transportation.

With this, India joins a select group of countries exploring hydrogen-powered rail transportation. These include Germany, Japan, China and the United States. As the technology remains at a nascent stage, the project will provide valuable operational experience. This will support future applications of hydrogen-powered mobility in the railway sector.

Inside India's First Hydrogen Train

The hydrogen train project has been developed in accordance with design approval and technical specifications prepared by the **Research, Design & Standards Organisation (RDSO)**. Designed and developed entirely in India, the project demonstrates the vision of **Atmanirbhar Bharat**.

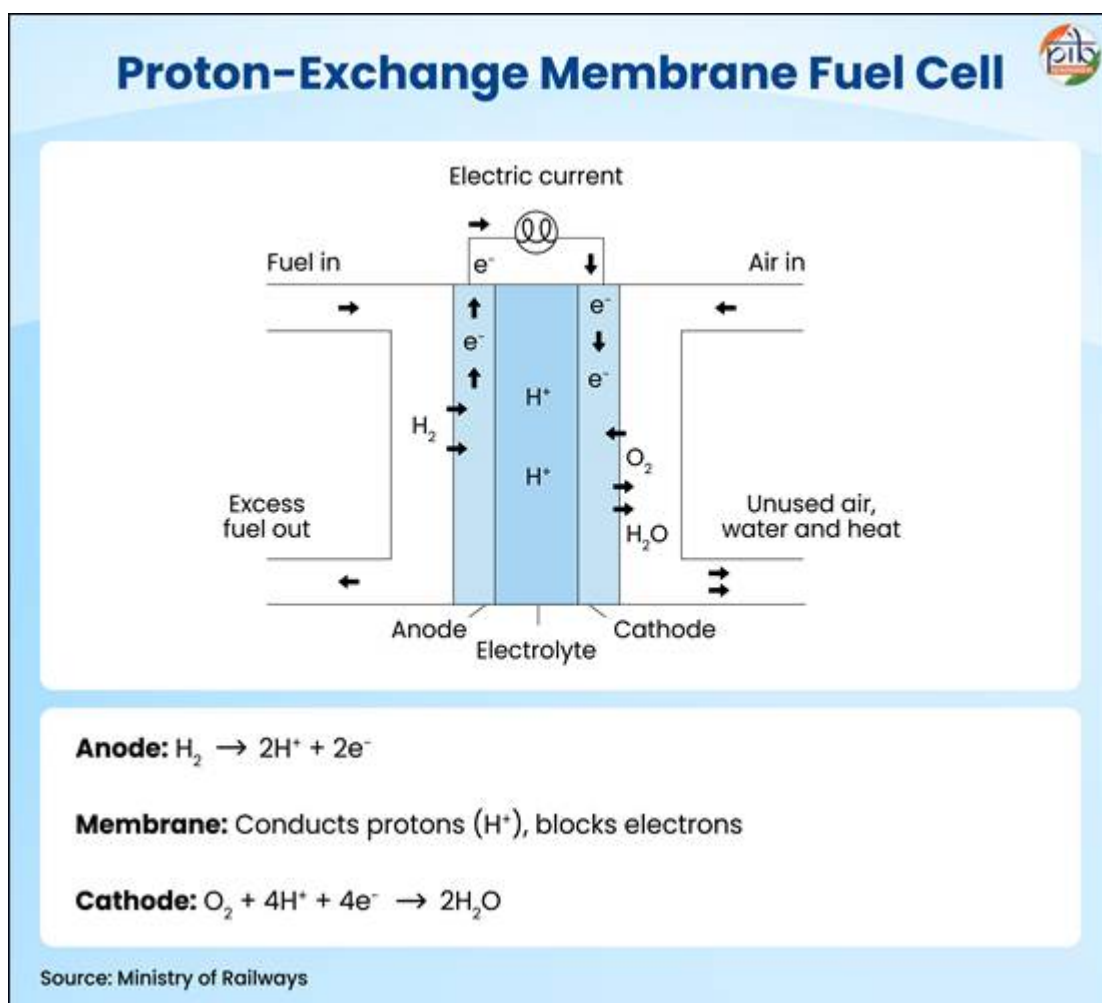
Key Features of the Hydrogen Powered Train on the Jind- Sonipat Section

- **10-car** hydrogen fuel cell-based trainset.
- Powered by a **1200 kW** hydrogen fuel cell propulsion system.
- Approved to operate at a maximum speed of **75 kmph** with a design speed of **110 kmph**.
- Capacity of Around **2,600** Passengers.
- Developed from the **design stage** through **prototype manufacturing**.
- It will connect Jind Junction, Gohana Junction and Sonipat while serving intermediate stations.
- Proposed halts include Jind City, Pandu Pindara Junction, Lalit Khera Halt, Bhambhewa, Isapur Kheri Halt, Butane Halt, Khandrai Halt, Rabrah Halt, Lath Halt, Mohana, Barwasni Halt and Sonipat New.



Technology Behind the Train

Hydrogen fuel cell technology produces electricity through a chemical reaction using hydrogen. The primary energy source is a **Proton Exchange Membrane Fuel Cell (PEMFC)**. This is a fuel cell that generates electricity by reacting hydrogen and oxygen across a proton-conducting Perfluorosulfonic Acid (PFSA) polymer membrane. The process produces only water vapour and heat as byproducts. Hydrogen is a high-energy fuel, 120 MJ/Kg (megajoules per kilogram) in comparison to diesel, which is 43 MJ/Kg. It is low maintenance with a manageable carbon footprint. This makes hydrogen the cleanest propulsion technology currently available for rail transport. To support this, Indian Railways has established dedicated infrastructure.



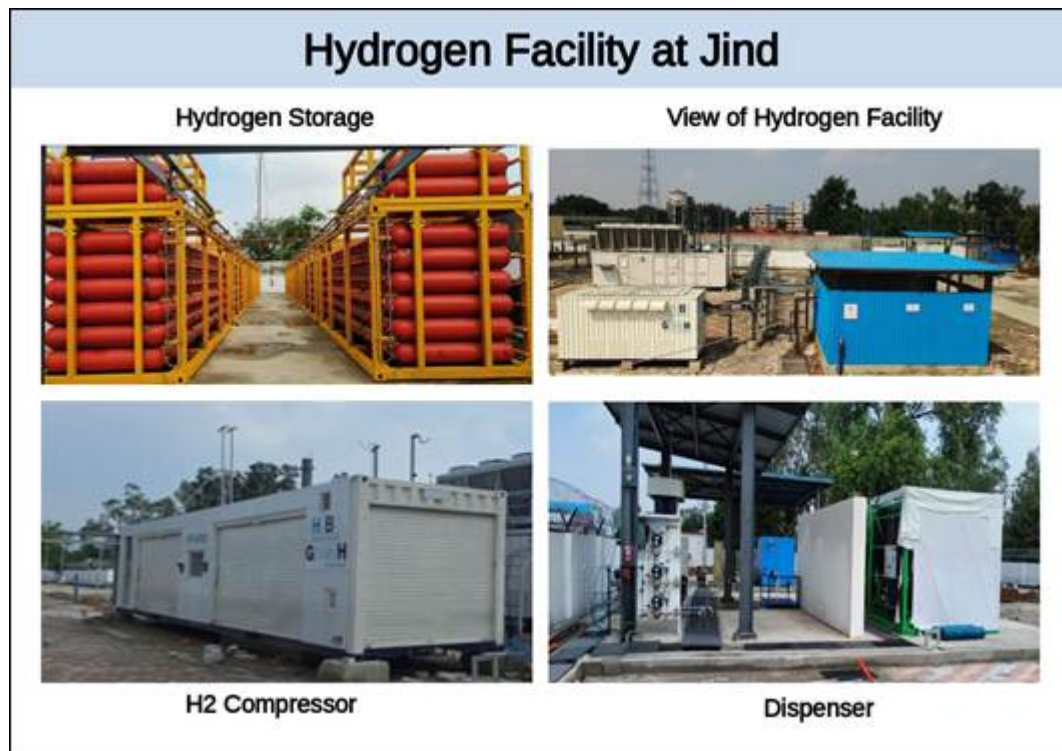
Hydrogen Infrastructure

The country's largest railway hydrogen storage and refuelling facility has been established at **Jind, Haryana**. The indigenous facility stores nearly **3,000 kg** of hydrogen at a time. It will support hydrogen-powered train operations. The **Petroleum and Explosives Safety Organisation (PESO)** has granted the required licence. The licence covers storage and dispensing of compressed hydrogen gas at the site. The hydrogen ecosystem has been designed in accordance with internationally accepted standards. This includes NFPA-2 (National Fire Protection Association) and ISO (International Organisation for Standardisation) 19880 Series. The entire system underwent an independent third-party safety assessment. It was done by TÜV SÜD, Germany, one of the world's leading technical inspection and certification agencies.

The train consists of **two Hydrogen Driving Power Cars (DPCs) and eight Trailer Coaches (TCs)**. Each DPC houses fuel cells, lithium iron phosphate (LFP) batteries and hydrogen storage cylinders. To ensure reliable operations, the facility has been equipped with:

- A hydrogen compression system for refuelling operations.
- Technical support and critical spares for reliable functioning.
- A standby compressor to ensure uninterrupted refuelling.

The integrated infrastructure supports safe and efficient hydrogen-powered rail operations.



Ensuring Safe Operations

Indian Railways has established a comprehensive operational and safety framework to support the hydrogen train operations. Multiple independent safety systems continuously monitor, verify and protect every stage of hydrogen storage, transfer and utilisation.

Operational Preparedness

- Standard operating procedures, regular audits and prescribed safety provisions are in place.
- The maintenance facility at Shakurbasti in Delhi has been prepared for hydrogen train operations.
- Trained and certified personnel will manage critical operations.
- Technical staff will accompany the train during the initial phase.
- The hydrogen refuelling system will remain under 24×7 monitoring.

Safety Measures

- Hydrogen leak detectors have been installed at the production, storage and dispensing facilities.
- Flame detectors have also been installed for continuous monitoring.
- Safety sensors will undergo regular inspection and cleaning.
- Non-stop ventilation keeps air moving through the train at all times.
- If anything unusual is detected, like heat, flame or smoke, the system can automatically cut off the hydrogen supply on its own.
- The Loco Pilot's cabin has been designed with a special mode that allows the train to be moved to safety in an emergency.
- A screen shows the real health of the whole system to the Loco Pilot at all times.
- Inspection and maintenance schedules have been prescribed to ensure safe operations.

Towards Sustainable Rail Mobility

The hydrogen train represents more than the introduction of a new trainset. It establishes the systems, infrastructure and institutional capacity needed for future hydrogen-powered rail operations. The project helps validate technology, operating procedures and maintenance practices. It also strengthens the technical capabilities required to support hydrogen-powered mobility at scale. It supports the National Green Hydrogen Mission and net-zero carbon emission goals. With the continued modernisation of Indian Railways, the initiative lays the foundation for wider adoption. The project represents an important step towards building a more resilient transport system.

References

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