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India Commissions World's First Nuclear Process Heat-Based Hydrogen Production Facility

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India has commissioned the world's first hydrogen production facility based on nuclear process heat using the Copper-Chlorine (Cu-Cl) Thermochemical Cycle at the Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam, Tamil Nadu. ?

It has been developed as a technology demonstrator to validate hydrogen production using nuclear process heat from fast reactors, marking a major breakthrough in clean energy and advanced nuclear technology.

The indigenous technology has been jointly developed by the Bhabha Atomic Research Centre (BARC) and IGCAR.

The integration of nuclear energy with hydrogen production enables the generation of carbon-free hydrogen with higher efficiency and lower greenhouse gas emissions than conventional methods.

The achievement supports India's National Green Hydrogen Mission, strengthens the country's energy security, and advances its commitment towards Net Zero emissions by 2070.

About the Nuclear Hydrogen Production Facility

Key Highlights

Technology: Copper-Chlorine (Cu-Cl) Thermochemical Cycle

Location: Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam, Tamil Nadu

Developed by: BARC and IGCAR

Inaugurated by: Dr. Ajit Kumar Mohanty

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Purpose: Demonstrate hydrogen production using nuclear process heat from fast reactors.

What is the Copper-Chlorine (Cu-Cl) Thermochemical Cycle?

The Cu-Cl Thermochemical Cycle is an advanced hydrogen production technology that splits water into hydrogen and oxygen using:

Nuclear process heat

Electricity

Chemical reactions involving copper and chlorine compounds

Advantages

Produces carbon-free hydrogen

Requires lower operating temperatures than many other thermochemical cycles

Offers higher thermodynamic efficiency

Reduces dependence on fossil fuels.

Additional Key Facts

National Green Hydrogen Mission

Launched: January 2023

Nodal Ministry: Ministry of New and Renewable Energy (MNRE)

Financial Outlay: ₹19,744 crore

Objectives

Produce 5 Million Metric Tonnes (MMT) of green hydrogen annually by 2030

Make India a global hub for green hydrogen

Reduce fossil fuel imports

Promote decarbonisation of hard-to-abate sectors

Bhabha Atomic Research Centre (BARC)

Established: 1954

Headquarters: Mumbai

Director: Vivek Bhasin

Functions under the Department of Atomic Energy (DAE)

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India's premier nuclear research institution

Indira Gandhi Centre for Atomic Research (IGCAR)

Established: 1971

Location: Kalpakkam, Tamil Nadu

Director: C G Karhadkar

Functions under the Department of Atomic Energy

Specialises in:

Fast Breeder Reactor technology

Advanced nuclear systems

Materials and reactor engineering

Department of Atomic Energy (DAE)

Established: 1954

Minister of State in the Department of Atomic Energy: Jitendra Singh

Functions directly under the Prime Minister

Responsible for:

Nuclear power

Atomic research

Nuclear fuel cycle

Strategic nuclear programmes

Fast Breeder Reactor (FBR)

A Fast Breeder Reactor:

Produces more fissile fuel than it consumes

Uses fast neutrons instead of slow (thermal) neutrons

Is a key component of India's three-stage nuclear power programme

Can provide both electricity and high-temperature process heat, making it suitable for hydrogen production.

Why Nuclear-Assisted Hydrogen?

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Compared with conventional hydrogen production, nuclear-assisted hydrogen:

Produces near-zero carbon emissions

Provides continuous (24×7) hydrogen production

Is less dependent on weather than solar or wind energy

Can support industries such as:

Fertilisers

Refineries

Steel

Heavy transport

Energy storage

Exam Focus Points (Quick Revision Notes)

Achievement in News ? World's first nuclear process heat-based hydrogen production facility

Location ? IGCAR, Kalpakkam, Tamil Nadu

Technology Used ? Copper-Chlorine (Cu-Cl) Thermochemical Cycle

Developed by ? BARC & IGCAR

Inaugurated by ? Dr. Ajit Kumar Mohanty

Administrative Department ? Department of Atomic Energy (DAE)

Related Mission ? National Green Hydrogen Mission

Mission Target ? 5 MMT green hydrogen annually by 2030