International Thermonuclear Experimental Reactor (ITER) Assembly

Why in News

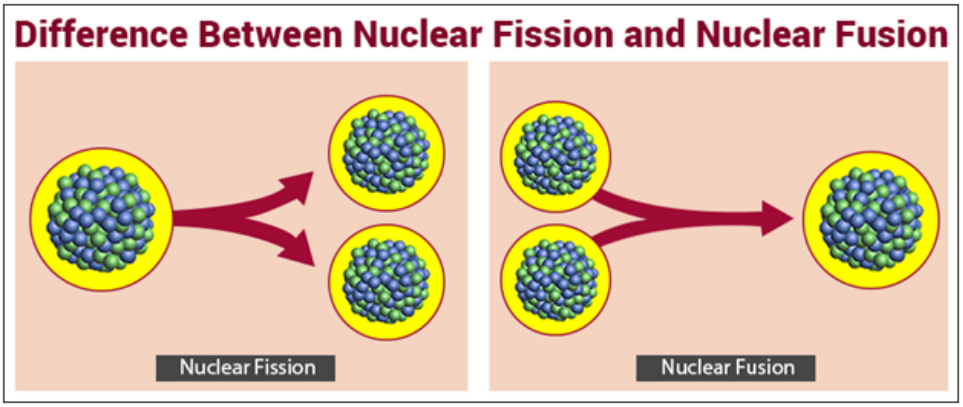
Recently, the International Thermonuclear Experimental Reactor (ITER) celebrated the start of **Assembly of the ITER Tokamak at Saint-Paul-Lez-Durance, France.**

Key Points

- **Significance of the Event:**
    - The Celebration was hosted **virtually** by the French President and **all ITER member** countries **participated** either in person, or electronically through remote mode.
    - India also participated in the celebrations and considered the **global participation of scientists** to project as a perfect illustration of the age-old Indian belief - **Vasudhaiva Kutumbakam.**
        - Vasudhaiva Kutumbakam is a Sanskrit phrase which means **'The World is One Family'.**
- **India's Contribution:**
    - India also mentioned about its fair share in terms of its in-kind contributions, viz., the cryostat, cryogenic and cryo-distribution systems, auxiliary heating devices, multi megawatt power supplies, etc.
    - ITER cryostat is manufactured by **India (Larsen and Tourbo).** Cryostat is a chamber that can maintain **very low temperatures.**
        - It is the largest stainless steel high-vacuum pressure chamber ever built (16,000 m^3) providing the high vacuum, ultra cool environment for the ITER vacuum vessel and the superconducting magnets.
        - The target for the **first plasma is 2025.** At extreme temperatures, electrons are separated from nuclei and a gas becomes a plasma—**an ionized state of matter similar to a gas.**
    - **European Union (EU)** is responsible for the **largest portion of construction costs** (45.6%); the remainder is **shared equally** by China, Japan, South Korea, Russia, USA including **India (9.1% each).**

Nuclear Reactions

- **Description:**
    - A nuclear reaction is the process in which **two nuclei,** or a nucleus and an external subatomic particle, collide to produce one or more new nuclides.
    - Thus, a nuclear reaction must cause a transformation of at least one nuclide to another.
- **Types:** //



- **Nuclear Fission:**
    - The nucleus of an **atom splits** into two daughter nuclei.
    - This decay can be **natural** spontaneous splitting by radioactive decay, or can actually be **simulated** in a lab by achieving necessary conditions (bombarding with neutrons, alpha particles, etc.).
    - The resulting fragments tend to have a combined **mass which is less than the original.** The missing mass is usually converted into nuclear energy.
    - Currently all commercial nuclear reactors are **based on nuclear fission.**
- **Nuclear Fusion:**
    - Nuclear Fusion is defined as the combining of two lighter nuclei into a heavier one.
    - Such nuclear fusion reactions are the **source of energy in the Sun and other stars.**
    - It takes considerable energy to force the nuclei to fuse. The conditions needed for this process are extreme – millions of degrees of temperature and millions of pascals of pressure.
    - The **hydrogen bomb** is based on a thermonuclear fusion reaction. However, a **nuclear bomb based on the fission** of uranium or plutonium is **placed at the core of the hydrogen bomb** to provide initial energy.

International Thermonuclear Experimental Reactor

- **Establishment:**
    - International Thermonuclear Experimental Reactor (ITER) is a collaboration of **35 nations** launched in **1985.**
    - It is located in **France.**
- **Aim:**
    - It aims to build the **world's largest tokamak** to prove the **feasibility of fusion** as a **large-scale and carbon-free** source of energy.
        - The **tokamak** is an experimental machine designed to harness the energy of fusion. Inside a tokamak, the energy produced through the fusion of atoms is absorbed as heat in the walls of the vessel. Like a conventional power plant, a fusion power plant uses this heat to produce steam and then electricity by way of turbines and generators.
- **Applicable Principle:**
    - The project is based on **fusion** which is also an **energy source** for the **Sun and stars.**

        - Every fusion reaction in the Sun, in which two hydrogen atoms fuse into one helium atom, releases two **neutrinos.**
- **Significance:**
    - ITER will be the **first fusion device** to maintain **fusion for long periods** of time and also **to test the integrated technologies,** materials, and physics regimes necessary for the commercial production of fusion-based electricity.
- **Participation:**
    - The ITER members include **China, the European Union, India, Japan, South Korea, Russia and the United States.**
    - According to the **ITER Agreement (2006),** the above mentioned seven members will share the cost of project construction, operation and decommissioning.
    - They also share the experimental results and any intellectual property generated by the fabrication, construction and operation phases.

Source:PIB