Mains Practice Question

Q. Rising advancements in nuclear energy has its own advantages but posed several challenges. Discuss. (150 words)

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Approach

- Start your answer by briefly describing nuclear energy.
- Discuss various advantages of nuclear energy.
- Discuss challenges in the field of nuclear energy.
- Conclude accordingly.

Introduction

- Nuclear fusion and nuclear fission are two different types of energy-releasing reactions used in nuclear energy, through which energy is released from high-powered atomic bonds between the particles within the nucleus.
- The main difference between these two processes is that fission is the splitting of an atom into two or more smaller ones while fusion is the fusing of two or more smaller atoms into a larger one.

Body

- **Recent advancement in the field of Nuclear Energy:**
  - Recently a few scientists at the Lawrence Livermore facility, the US have achieved a **net gain in energy from a nuclear fusion reaction,** which is seen as a big breakthrough.
  - The experiments forced a minuscule amount of hydrogen **into a peppercorn-sized capsule,** for which scientists used a powerful **192-beam laser that could generate 100 million degrees Celsius of heat.**
  - It is also called **'Inertial Fusion'.**
- **Challenges of Nuclear Energy:**
  - **Capital Intensive:** Nuclear power plants are capital intensive and recent nuclear builds have suffered **major cost overruns.**
  - **Lack of Public Funding:** Nuclear power has **never received the quantum of generous subsidy the fossil fuel received** in the past and renewable is receiving currently.
    - In absence of public funding, nuclear power will find it tough to compete against natural gas and renewables in the future.
  - **Acquisition of Land:** Land acquisition and selection of location for Nuclear Power Plant (NPP) is also a **major problem in the country.**
    - NPP's like **Kudankulam in Tamil Nadu** and Kovvada in Andhra Pradesh have **met with several delays** due to the land acquisition related challenges.
  - **Impact of Climate Change:** Climate change will **increase the risk of nuclear reactor accidents.** During the world's **increasingly hot summers,** several nuclear power plants have already had to be **temporarily shut down** or taken off the grid.
    - Further, nuclear power plants depend on nearby water sources to cool their reactors, and with many rivers drying up, those **sources of water are no longer**

guaranteed.
        - The frequency of such extreme weather events is likely to increase in the future.
    - **Deployment at Insufficient Scale:** It might not be the appropriate choice for mitigating India's carbon emissions since it cannot be deployed at the necessary scale.
    - **Nuclear Waste:** Another side effect of nuclear power is the amount of nuclear waste it produces. Nuclear waste can have drastically **bad effects on life, causing cancerous growths**, for instance, or causing **genetic problems** for many generations of animals and plants.
        - In a densely populated country such as India, land is at a premium and **emergency health care is far from uniformly available.**
- **Advantages of Nuclear Energy:**
    - **Emissions from Nuclear Power Generation:** Nuclear power is **zero-emission**. It has **no greenhouse gases** or air pollutants.
    - **Land Usage:** According to US government data, a 1,000-megawatt nuclear plant **requires 360 times less land than a similar-capacity wind farm** and 75 times less land than solar plants.
    - **High Power Output:** Nuclear power plants produce **high levels of energy compared to most power sources** (especially renewables), which makes them a great provider of baseload electricity.
        - "Baseload electricity" simply means the minimum level of energy demand on the grid over a span of time, say a week.
    - **Inexpensive:** Nuclear power plants incur low operational costs because they rely on relatively simple operations. Additionally, nuclear plants only need to refuel every 18–24 months, meaning that fluctuating fuel prices affect them less than more volatile industries like oil and natural gas.
        - Heavy metals like uranium, nuclear power's main energy source, appear throughout the world and are only needed in small amounts, meaning that they also cost less.

Conclusion

Nuclear energy is a safe, reliable, and cost-effective source of energy. It's one of the most promising energy sources of the future. It will be one of the most effective solutions to fight climate change and global warming.