

# Radio Thermoelectric Generators

#### Source: BL

### Why in News?

Recently, Indian Space Research Organisation (ISRO) in collaboration with the Bhabha Atomic Research Center (BARC), has embarked on the joint development of Radio thermoelectric generators (RTGs), an innovative approach aimed at surpassing the constraints of conventional chemical engines for interplanetary voyages.

- Chemical engines work well for satellite thrusters, but they are inadequate for deep space travel due to fuel limitations and lack of solar power in distant regions.
- RTGs have been successfully employed by US spacecraft such as the Voyager, Cassini and Vision Curiosity, to power missions with exceptional achievements.

### What are the Radio Thermoelectric Generators (RTGs)?

- About:
  - RTGs are innovative power sources designed to address challenges in deep space missions.
  - RTGs utilize radioactive materials, such as Plutonium-238 or Strontium-90, which emit heat as they decay over time.
  - This heat is harnessed and converted into electricity, enabling the propulsion and power of spacecraft.
- Components of RTGs:
  - Radioisotope Heater Unit (RHU):
    - The RHU is responsible for generating heat through the decay of radioactive
    - It initiates the process by releasing thermal energy, which serves as the foundation for electricity generation.
  - RTG (Heat-to-Electricity Conversion):
    - The RTG component transforms the heat generated by the RHU into usable electricity.
    - This conversion takes place through a thermocouple, a material that generates voltage when subjected to a temperature gradient.
    - The voltage produced by the thermocouple is utilized to charge batteries onboard the spacecraft.
    - These batteries, in turn, power various systems, including propulsion mechanisms, enabling interplanetary travel.
- Advantages of RTGs for Space Missions:
  - Independence from Solar Proximity:
    - Unlike solar-powered systems, RTGs operate effectively regardless of the spacecraft's distance from the sun.
    - This characteristic eliminates constraints related to launch windows and planetary alignment.
  - Reliability and Consistency:
    - RTGs offer a consistent and reliable source of power, essential for sustaining

- prolonged deep space missions.
- The gradual decay of radioactive materials ensures a continuous supply of heat and electricity.

## **Bhabha Atomic Research Centre**

- BARC is India's premier **nuclear research** facility based in Mumbai, Maharashtra.
- It is a multi-disciplinary research center with extensive infrastructure for advanced research and development.
- Its core mandate is to sustain peaceful applications of nuclear energy, primarily for power generation.

