Radio Thermoelectric Generators

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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 materials.
 - 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.

The Vision

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.

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