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Author: Mr. Artem Madatov
SPACE HUB Incubator, United States

Mr. Volodymyr Astapenko
SPACE HUB Incubator, Ukraine
Mr. Maksym Tkachenko
SPACE HUB Incubator, Ukraine

THORIUM NUCLEAR POWER PLANT FOR USE IN OUTER SPACE

Abstract

THE KEY PROBLEM: The main obstacle of converting thermal energy into mechanical (electrical) energy. The cosmic vacuum is an ideal heat insulator and cooling is possible only through radiation. The radiation intensity is proportional to the absolute temperature to the fourth extent. However, heat engines on a gaseous working medium cannot withstand temperatures exceeding several hundred degrees.

PROPOSED SOLUTION: Power plant based on a battery of thermoelectric converters operating at a temperature of hot junctions of thermocouples over 3000 K. The heater is a solid-state thorium oxide breeder reactor made of refractory materials, and will operate at temperatures over 3000 K. Because thorium dioxide melts at 3350 K, it remains solid at operating temperature. The reactor is cooled by heating the thermocouple hot junctions directly through the wall. Cooling of cold junctions of thermocouples will be by radiation of visible and infrared radiation into space through black sheet radiators. The reactor is started by a "nuclear switch" made of Ra-224. As a result of a series of transformations Th-232 turns into U-233, which is fissioned by thermal neutrons and ensures high energy efficiency. The neutron multiplication factor is ensured by beryllium oxide adding to thorium oxide. Beryllium converts alpha particles from intermediate thorium to uranium conversions into neutrons. Beryllium converts alpha particles of the intermediate transformations of thorium up to uranium into neutrons.

EXPECTED INDICATORS: With a reactor core mass of about 1 ton, a neutron multiplication factor will be at least one and will be provided chain reaction with thermal power at least 1 MW. The efficiency of converting thermal energy into electrical energy ranges from 5 to 10%. So the estimated electric power of the power plant will be up to 100 kW. The expected time of continuous operation is up to 30 years.

APPLICATION AREA: Electrical energy will be converted by an inverter to supply settlements on other planets (Moon, Mars, etc.), or to power supply for various propulsion systems during interplanetary and deep space missions. In particular as a power supply for the Vacuum Reactive Device: VRDspace.com