

IAF SPACE PROPULSION SYMPOSIUM (C4)  
New Missions Enabled by New Propulsion Technology and Systems (9)

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NUCLEAR POWERED AIR-BREATHING ELECTRIC THRUSTERS PROPULSION SYSTEM  
DEVELOPED FOR SPACE EXPLORATION VEHICLES

**Abstract**

With an interest in space exploration developing at a remarkable rate in the course of the most recent couple of years, it has become a daunting task to explore the different planets because of hostile environmental conditions present on them. This paper aims to study and develop the propulsion system to be incorporated in different space exploration vehicles, which can be employed in various space missions. These vehicles will run using motors electric thrusters and will use nuclear fuel Plutonium-238 ( $^{238}\text{Pu}$ ) as its power generation source. The heat from the decay of  $^{238}\text{Pu}$  will be extracted by using Multi Mission Radio Thermoelectric Generator (MMRTGs) using thermocouples thus providing electricity. Here, MMRTG acts as a main power source. The idea of utilizing MMRTG has been proposed as it works well in both the space vacuum and the planetary atmosphere. The heat energy from the MMRTG can be used as a consistent wellspring to keep up with appropriate working temperatures for the vehicle and its instruments in cold environmental conditions. The air-breathing electric thrusters works by compressing the air molecules into plasma and accelerating the stream of plasma molecules to provide thrust for the system, thus can be very well utilized in vacuum of space for continuously providing thrust for its operation in low-earth orbits. The thrusters are connected to a propeller, as in atmospheric conditions, air-breathing electric thrusters require a continuous flow of air to generate thrust. This paper describes the complete working of the propulsion system to be embodied in these vehicles working under various environmental conditions and depicts the advantageous uses of MMRTGs & Air-breathing electric thrusters. With a robust propulsion system been developed they can profoundly be used for extra-terrestrial space exploration and also extends its research for future space investigation.