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NUCLEAR THERMAL PROPULSION FOR IN-SPACE APPLICATIONS FOCUSING BERYLLIUM AS THE WORKING FLUID AND GRAPHITE AND FLIBE AS MODERATOR AND COOLANT AND THORIUM BLANKET

Abstract

This proposal deals with the Beryllium as working fluid due to the various properties of the beryllium to be capable of the fusion driven fuel. Beryllium is a plasma facing material which holds the thermal capabilities better than the fusing fuel itself. Fusion of such plasma facing materials becomes huge contributor to the system, which requires higher energy which simultaneously has a efficient standby for the overall system. The various simulations on the NTP deals with its supreme capability to work with the toroidal aerospike nozzle. The usage of Thorium Breeder Blanket increases the fuel burn-up. By concentrating on the conventional nuclear reactor structure we could replace the Beryllium within the structure itself to achieve slower tritium production rate. The ceramic moderator or FLiBe coolant allows us to have a better thermal gradients in terms of the higher thermal stability. The simulated graphs for the Coefficients are straight lines showing the constant thermal profile throughout. Thus the FLiBe Coolant can also be a part to avoid the hydrogen sputtering which usually occurs in the fusion. In terms of the dimensional analysis this system is only 275 cm long if the overall section for the toroidal aerospike nozzle is considered. The Be-D Fusion also provides slow tritium release which is beneficial in terms of achieving higher temperature and restrict the chemical sputtering of the hydrogen. The freshly extracted Beryllium pebbles are entered through the system, where inert gases such as Neon or Helium are splashed throughout, which after replaces the traditional structure of Lithium which separates fusion from the tritium reproduction section. The preferred structure frame is made up of the Ceramics and make the less usage of the moderator the system replace more with the coolant which is better again at the astronautical mathematics. The rough mass estimation (kg) for the NTP Engine for the stated parameters is, 1. NTP Engine =1200 2. Dry Tank= 700 3. PBR= 100 (Special Case usage) 4. Liquids= 700 5. The total estimation for the system is on very light side. Special case usage for the PBR, are tend to the emergency production of beryllium in shortage of the on-board extraction of Be from native soil around 1000 gms to 1500 gms. The estimated specific impulse for the system is 1030 sec with the thrust generation of around 580MW for 15,000 kg payload mounted.