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THE IMPACT OF NUCLEAR PROPULSION ON CISLUNAR STATIONS

Abstract

There is the potential for nuclear powered orbit transport systems with effective exhaust velocities in excess of 12 km/sec. Such systems will need to be large and will require large capacity launch infrastructure either a heavy lift system or a high flight rate reusable system. SLS, Falcon Heavy, new Glenn and Skylon all have the necessary capability although the resulting in-orbit stages would differ to match the launch system. The paper will explore the impact on this combination of launch and nuclear tug on the construction of facilities in high earth and lunar orbits. A general assessment of the impact indicates that very large facilities that are comparable or larger than the ISS would be practical to assemble in a nuclear tug single flight.

The paper will illustrate this with a concept design for a combined human and cargo vehicle, called Scorpion. This system is design to match Skylon and it has a dry mass of 230 tonnes and maximum fuelled mass of 740 tonnes. It can deliver a 350 tonnes space station to geostationary orbit and over 200 tonnes to a lunar orbit, as well as the crew (6 people) and the assembly facilities that are required to construction the station once its operational orbit has been reached. The Scorpion has the capability to stay in this orbit for around 8 months although assembly is expected to take much less than this.

An un-crewed variation of the Scorpion, called Taurus, is also examined. This is in essence a pure propulsive stage that could deliver over 500 tonnes to geostationary orbit and close to 350 tonnes to lunar orbit.

It is concluded that advanced nuclear engine space transportation system when matched to the high capacity launch systems already in development provide a practical route to extending the space transport infrastructure beyond low Earth orbit. The fundamental constraints of the nuclear engine technology means such systems will need to be large, but the paper will demonstrate the practicality of such systems despite their size and they could significantly change the ability to extend substantial human space activity into Cislunar space and beyond.