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NUCLEAR PROPULSION IN SPACECRAFT AS A UNIQUE SOLUTION FOR A MARS MISSION

Abstract

Mars has been one of the most important celestial bodies that have been the focus of mankind. It has become a cornerstone for mankind's quest for the stars and as a result, many space agencies all across the world have put Mars Mission as a main objective that needs to be achieved in the next two decades. The preliminary studies show that Mars Mission is quite probable within a mission envelope of 500 to 700 days. However, the life support as well as the power requirements of such a long mission would preclude using conventional propulsion methods as a way to achieve the Mars Mission. Moreover, there would also be a major power source requirement for the missions that need to be concluded on Mars, while the spacecraft is orbiting the body. Thus, by using techniques of nuclear propulsion, both of these objectives can be achieved with ease. With nuclear propulsion, it would be possible to handle the life support requirements as well as the overall power requirements of the mission. However, more importantly, it would be essential to increase the specific impulse of the spacecraft using nuclear means, so that the transit time can be reduced as well. Hence, nuclear propulsion methods are the only means to complete such a mission within a reasonable frame of time and within reasonable operational considerations. Nevertheless, there are also several shortcomings to having a nuclear mission such as radiation shielding requirements, safety aspects, cooling aspects in microgravity, as well as fission kinetics control in microgravity conditions. In this paper, we will concentrate on solution to these problems by using non conventional nuclear propulsion techniques. We will use gaseous core reactor with Uranium Hexafluoride as a nuclear fuel. However instead of classic MHD shielding to control the fission kinetics; we will use turbulent flow and pressure variations as a way to control nuclear reaction dynamics under microgravity conditions. In this paper, several CFD presentations will also be there, so that the flow conditions in the reactor chamber will be shown to some degree of accuracy. Overall, through this analysis, a better mission profile for Mars can be developed, allowing for a less costly mission to take place within a reduced time frame. This way, more than one mission can easily be scheduled with the techniques described in this paper.