

A Review of Fifty Years of Space Nuclear Fuel Development Programs

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ABSTRACT

The era of space nuclear power and propulsion started with the launching of the ROVER program in 1955. Development of nuclear fuel has been an essential part of any space nuclear power and propulsion program that has been performed in the US or Former Soviet Union. Test results characterizing carbon based and ceramic-metallic (cermet) fuels are available from fuel development programs conducted for the ROVER and ANP project, the 710 reactor program and the Argonne National Laboratory (ANL) nuclear rocket programs. There is some overlap in the materials candidates tested in these programs. Test conditions were however significantly different due to wide variation in intended applications of these high temperature nuclear fuels. This paper provides an overview of these development efforts, define (where possible) the damage mechanisms thought to be responsible for fuel operating limitations, and identify the fundamental physical mechanisms thought to be responsible.

In more recent years, new investigation by the Innovative Nuclear Space Power and Propulsion Institute, University of Florida, and the Scientific Research Associates "LUTCH" of Russia have resulted in the development of mixed carbide and cermet fuels. Mixed carbide fuels are primarily based on processing solid solution of uranium carbide with one or more other refractory carbides such as zirconium carbide, niobium carbide, tantalum carbide, or hafnium carbide. The new cermet fuel is based on using uranium-zirconium carbonitride (U,Zr)CN in tungsten or tungsten alloys matrices.