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THE INTERNATIONAL SAFETY FRAMEWORK FOR NUCLEAR POWER SOURCE APPLICATIONS IN OUTER SPACE – USEFUL AND SUBSTANTIAL GUIDANCE CONTAINED IN RELATIVELY HIGH-LEVEL GENERIC RECOMMENDATIONS

Abstract

In 2009, the International Safety Framework for Nuclear Power Source Applications in Outer Space has been adopted, following a multi-year process that involved all major space faring nations in the frame of the International Atomic Energy Agency and the UN Committee on the Peaceful Uses of Outer Space. The safety framework reflects an international consensus on best practices. After the older 1992 Principles Relevant to the Use of Nuclear Power Sources in Outer Space, it is the second international document dedicated to promoting the safety of applications of nuclear power sources in space missions.

While the safety framework is deliberately high level and thus as much as possible independent of technological progress, national organisational setups and space missions, the application of its guidance nevertheless has some profound implications on all design, development and operational phases of space NPS missions. This paper presents an analysis of the guidance provided in the safety framework focussing specifically on those aspects that are of direct relevance to engineers and mission designers during the early phases of mission developments.

NPS applications in space have unique safety considerations compared with terrestrial applications. Mission launch and outer space operational requirements impose size, mass and other space environment limitations not present for many terrestrial nuclear facilities. Potential accident conditions could expose NPS to extreme physical conditions.

The safety framework is structured to provide guidance for both the programmatic and technical aspects of safety, including the design and application of space NPS. In addition to sections containing specific guidance for governments and for management, its section 5 is dedicated to "technical guidance". This guidance is particularly pertinent to the design, development and all mission phases of space NPS applications. It is structured into the key elements of this technical guidance, which evolve around the elements of technical competence in nuclear safety, on safety in design and development, risk assessments and technical guidance for accident mitigation. The challenge for organisations and engineers involved in the design and development processes of space nuclear power sources is to interpret the guidance provided in the safety framework and apply it into specific, dedicated and applicable safety requirements. Some bear substantial consequences on missions intending to use space NPS in terms of technical, programmatic and organisational added complexity that need to be integrated into standard space mission approval processes.