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NUCLEAR POWERED ROCKETS: LEGAL ISSUES AND PERSPECTIVES.

Abstract

As spaceports around the world work to modernize and futureproof their operations, a serious challenge to their safety and liability frameworks is emerging from increasing pressure to launch rockets equipped with nuclear power sources (NPS) for deep space missions. While the use of NPS in space exploration is not new, it has been largely neglected in favor of chemical means of propulsion for space objects. Legal efforts have been made to address the use of NPS, but they have yet to sufficiently address many of the most concerning and legally ambiguous aspects of launching with these fuel sources.

Contemporaneous space exploration has seen a renewed interest in the use of NPS, announced by several actors that target Mars as a feasible destination in the mid-term. Both industry and governments are looking back to nuclear as an alternative to chemical propulsion for crewed deep-space travels. As one example, in 2023 NASA and DARPA joined efforts to demonstrate the feasibility of using a Nuclear Thermal Reactor (NTR) in cislunar spaceflights by 2027. The project is called Demonstration Rocket for Agile Cislunar Operations (DRACO). NPS missions may assist in reducing time-to-target missions, and provide reliable propulsion for long-term missions.

Despite the benefits, the use of nuclear reactors always poses some environmental risks, both to the spaceports where rockets will be launched, and to the space environment itself. The present work analyzes the risks and legal consequences of the use of such technology, specifically those associated with Unprotected Loss of Fuel Accidents (ULOFA) and Unprotected Reactivity Initiated Accidents (URIA) that may occur during launch and in-space operational phases. Potential accident causes are presented, and each cause is associated with the corresponding technology and legal solutions that may constitute mitigation measures. This presentation therefore aims to address the nature of ULOFA and URIA in the field of NPS, coupled with an assessment of the legal consequences of such incidents under international law in general, and the lex specialis of international law in outer space more specifically. The unique concerns of spaceports hosting the launch of NPS-equipped space objects is examined, particularly with an eye towards liability, insurance requirements for potentially dangerous fuel sources, and contractual mechanisms that may need to be implemented to ensure safety and success. Additionally, suggestions are made as to a pathway forward to prevent NPS accidents in the future, with an eye to both domestic and international legal mechanisms.