NASA Space Nuclear System Safety and Authorization Activities for Lunar Missions

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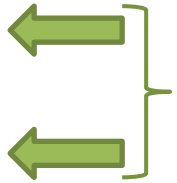
Types of devices

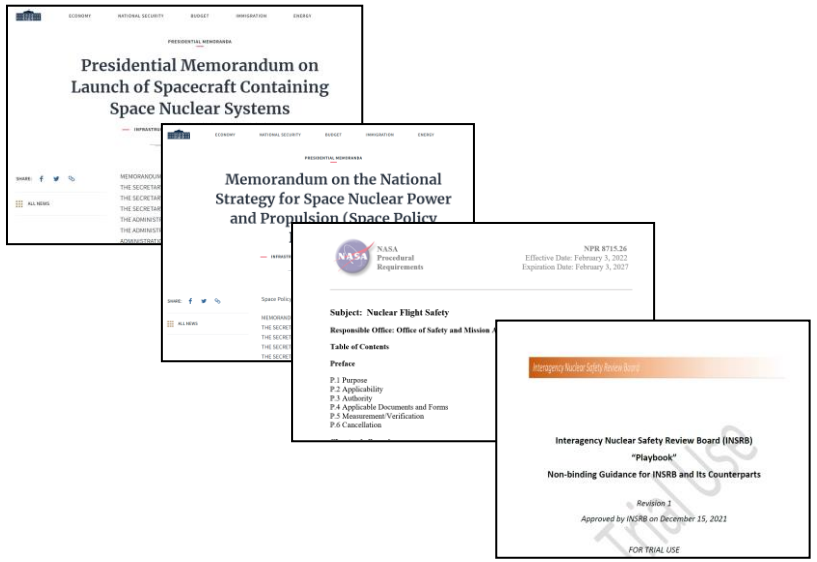
- Incidental (small) sources (e.g., calibration sources)
- Industrial-use sources (e.g., radiography)
- Equipment that generates ionizing radiation (e.g., irradiators)
- Radioisotope power systems (for heat and electricity)
- Fission systems (a.k.a., reactors)
- Fusion devices



The focus of this presentation

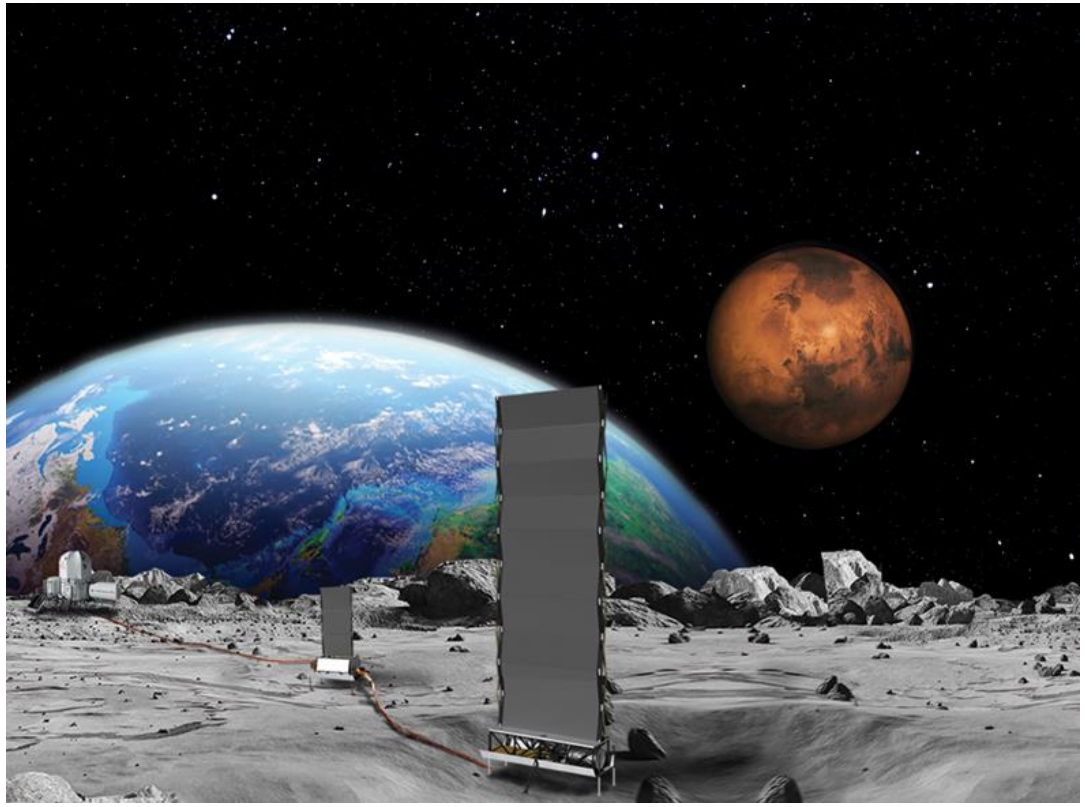
Applicable U.S. and NASA Safety Policy

- National Security Policy Memorandum No. 20
- Space Policy Directives No. 1 and No. 6
- NASA NPR 8715.26
  - supported by NASA-HDBK-8715.26
- Interagency Nuclear Safety Review Board



Technology Demonstration – Fission Surface Power

- NASA, Department of Energy, industry
- 40-kilowatt class fission system to operate on the Moon by the early 2030s
- High-assay low-enriched uranium



A concept image of NASA's Fission Surface Power Project, as of January 2024.
Credit: NASA

Technology Development - Survive-the-Lunar-Night

- Tipping Point Award - Harmonia Radioisotope Power Supply for Artemis
  - Zeno Power and partners - Am-241 isotope with Stirling dynamic power conversion
- Recent Small Business Award Examples:
  - Ultra Safe Nuclear Corporation – Technologies Affordable In-Space Demonstration of Dynamic Radioisotope Power Conversion
  - Advanced Cooling Technologies, Inc. - Additively Manufactured Ceramic Heat Pipes for Space Nuclear Reactors
  - Direct Kinetic Solutions - Modular Radioisotopic Power Sources
- Lunar Surface Innovation Consortium – Surface Power Focus Group

System Deployment

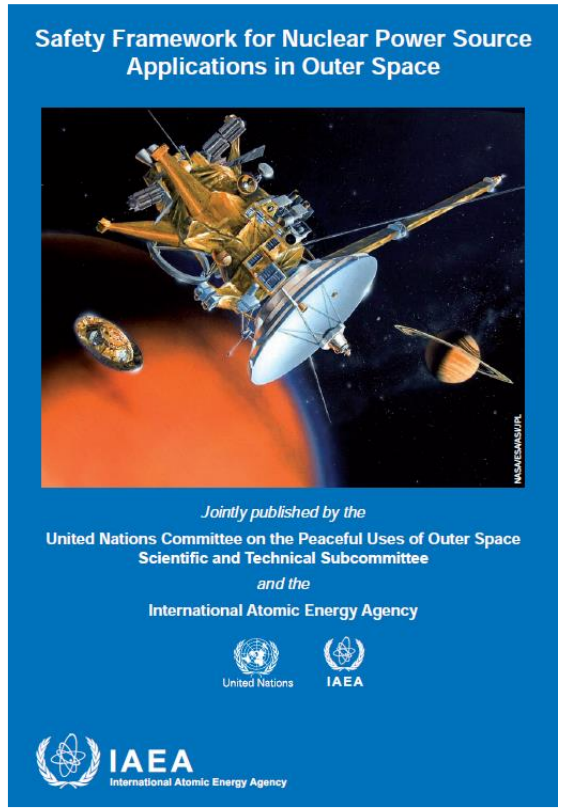
- Earth launch:
  - Use of conventional chemical-based lift and heavy-lift vehicles
  - Government-sponsored or commercial services
- Lunar landing (potential options):
  - Commercial Lunar Payload Services Program
  - Human Landing System Program
  - Others

NASA's Involvement in U.S. Harmonization Activities

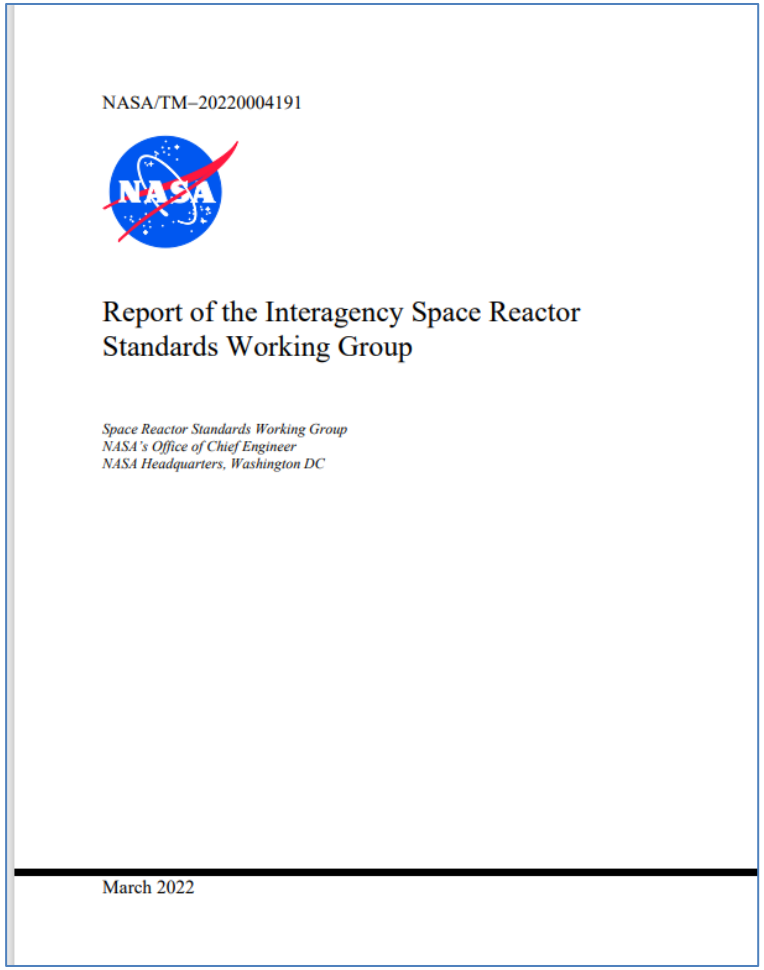
- Range and flight safety
  - NASA, Department of Defense, Federal Aviation Administration
  - Common Standards Working Group
  - Better align NASA, Space Force, and commercial licensing process for launch
- Whole-of-government ("Regulatory Harmonization Pathfinder") –
  - Forum for 12 affected agencies to discuss the integrated government roles and responsibilities in novel contexts

NASA's Involvement in International Harmonization Activities

- UN COPUOS Scientific and Technical Subcommittee on Nuclear Power Sources
- International Space Exploration Coordination Group
- Bilateral agreements
- Etc.



NASA's Involvement in Voluntary Consensus Standards



NASA/TM–20220004191

Report of the Interagency Space Reactor Standards Working Group

Space Reactor Standards Working Group
NASA's Office of Chief Engineer
NASA Headquarters, Washington DC

March 2022

NASA/TM–20220004191, March 2022, publicly available

- ASTM International Task Group
  - Safe Operating Practices In-Space for Space Reactors
- American Nuclear Society
  - Testing and Facility Practices for Terrestrial Testing of Space Reactors

Opportunities for NASA/JAXA/ESA Cooperation

- Aligning agency policies and practices
- Continued collaboration on specific missions
- International forums
- International Standards