NUCLEAR PROLIFERATION
PREVENTION PROJECT

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U.S. Government Finds that Reactor for Moon Does Not Require Bomb-Grade Uranium Fuel
NPPP Obtains Report under Freedom of Information Act

AUSTIN – The nuclear reactor that NASA plans to launch to the Moon's surface later this decade to power a manned mission would not require weapons-grade, highly enriched uranium (HEU) fuel, according to a government study released yesterday that contradicts previous assertions. The report, "Analysis of Alternative Core Designs for Fission Surface Power Capability Demonstration Mission," was released to the Nuclear Proliferation Prevention Project at the University of Texas at Austin, in response to a Freedom of Information Act request.

As recently as 2018, U.S. officials had claimed that bomb-grade fuel was necessary to reduce the weight of space power reactors and had tested such a reactor at a national laboratory. By contrast, the new report reveals that using low-enriched uranium (LEU) fuel, which is unsuitable for nuclear weapons, would not increase the total weight of the reactor system if a "moderator" were used to slow down the neutrons to facilitate nuclear fission.

The report compares the weight of reactor systems including fuel, moderator, and radiation shield. It finds that two alternative LEU designs have similar weight ranges as the HEU baseline design, and the lightest estimate is actually for one of the LEU versions. The report says the two proposed moderators, yttrium hydride (YH) and zirconium hydride (ZrH), still require some research and development – but there is time because NASA's deadline for launching a power reactor is not until 2027.

Space Reactor Weight Comparison: Moderated LEU vs Fast HEU

Fuel (moderator)	Kg including shield
HEU (none)	900 - 1100
LEU (YH)	800 - 1200
LEU (ZrH)	900 - 1200

Before being finalized this year, the report was distributed within the U.S. government in February 2020 as a "final draft." This may explain why the U.S. government's Space Policy Directive–6, in December 2020, effectively banned bomb-grade uranium fuel in space reactors by declaring that, "The use of HEU in space nuclear power and propulsion systems should be limited to applications for which the mission would not be viable with other nuclear fuels or non-nuclear power sources." Last month, the Department of Energy confirmed that space nuclear power reactors must comply with Space Policy Directive–6.

The U.S. government's rapid evolution from viewing bomb-grade uranium fuel as essential for space nuclear power in 2018, to effectively banning it in 2020, is analyzed in NPPP's April 2021 presentation to a national laboratory. In October 2019, NPPP hosted a symposium on space reactors and proliferation, including participation by officials from NASA and Congress. The national-security importance of avoiding HEU in space reactors also was analyzed in a 2020 project by UT-Austin graduate students.

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