



NUCLEAR PROLIFERATION
PREVENTION PROJECT

RAPPORTEUR'S SUMMARY

**Nuclear Energy in Space:
Nonproliferation Risks and Solutions**
The Archer Center – University of Texas
Washington, DC
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- NASA is developing nuclear reactors for two different purposes:
 - To increase the power of rockets by heating gas prior to expulsion, known as nuclear thermal propulsion (NTP), to reduce transit time to planetary bodies.
 - To supply energy on planetary surfaces, such as the Moon and Mars, especially in dark regions where solar power is not available.

- The symposium focused mainly on planetary surface reactors, because NASA's prototype tested in 2018 used nuclear weapons-grade, highly enriched uranium (HEU) fuel – arousing proliferation, security, economic, and other concerns. By contrast, NASA's NTP program uses low-enriched uranium (LEU) fuel, which is unsuitable for nuclear weapons.

- NASA used HEU for the surface reactor prototype for two reasons:
 - Mass – An HEU reactor requires less uranium, reducing its mass and thereby its launch cost.
 - Urgency – The HEU fuel and reactor were simpler to design and thus more quickly able to be demonstrated as ready for a space mission.

- Is mass a constraint? Although LEU reactors require more uranium, the increase in mass is not disqualifying for several reasons:
 - In medium- and high-power reactors, fuel is a small portion of the total reactor system, so using LEU fuel only marginally increases the overall mass.
 - Even in low-power reactors, the amount of LEU can be sharply reduced by introducing a “moderator” to facilitate nuclear fission, so that the overall mass of the reactor system would not even double – mitigating the launch expense especially as private space companies have sharply reduced launch costs.
 - LEU fuel offers other savings to offset the increased launch expense, including:
 - Reduced security costs at the launch site, partnering with cost-saving commercial reactor developers that are licensed for LEU but not HEU, and avoiding the need for an emergency search team to retrieve HEU in case of launch failure.

- Is urgency a constraint? NASA's current timeline could preclude an LEU reactor, but that timeline is optimistic and likely to slip, providing sufficient time to demonstrate and select an LEU reactor.
 - The Trump Administration seeks to "establish a sustainable human presence on the Moon by 2028," so NASA aims to demonstrate a reactor on the Moon by 2027.
 - Several years prior to that lunar demonstration, NASA must select a reactor that has been demonstrated terrestrially.
 - An LEU planetary surface reactor requires several years of R&D before it could be demonstrated, so if NASA selects a reactor before then, the only option would be HEU.
 - However, Congress has not authorized or appropriated sufficient funding for NASA's ambitious timeline, which therefore is almost certain to slip, providing time to demonstrate an LEU reactor before NASA must select the reactor for its lunar mission.
 - The U.S. House of Representatives has adopted an FY 2020 appropriations amendment, sponsored by Rep. Bill Foster, to fund development of an LEU planetary surface reactor.

- Deploying an HEU planetary surface reactor could severely undermine longstanding U.S. nonproliferation efforts to minimize and eventually eliminate all civilian use of HEU worldwide to inhibit the spread of nuclear weapons to terrorists or additional countries.
 - Since the 1970s, the United States has abstained from deploying civilian HEU reactors, has refused to supply HEU to new foreign reactors, and has converted 71 domestic and foreign reactors from HEU to LEU fuel.
 - U.S. domestic HEU minimization has helped persuade most foreign countries to eschew HEU in new research reactors, naval reactors, floating reactors, icebreaker reactors, medical isotope production, and other non-weapons nuclear activities.
 - In the late-1980s, when the U.S. briefly curtailed domestic HEU minimization, foreign countries responded by halting their own HEU minimization efforts and building a new HEU reactor.
 - Thus, if NASA deploys an HEU space reactor, some other countries likely would respond by constructing their own HEU reactors for space and terrestrial missions, increasing global risks of nuclear proliferation and nuclear terrorism.

- As the Trump Administration contemplates this fuel choice, it should consider that HEU would increase proliferation risks and public controversy, endangering domestic political support for nuclear power in space.
 - NASA confirmed that its ongoing study with the U.S. Department of Energy of planetary surface reactor options, due in early 2020, does not address such considerations.
 - The IDA Science and Technology Policy Institute, which advises the White House and NASA, stated that it could conduct a more comprehensive study including such considerations if the White House so requested.