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**before the**
**House Committee on Science, Space and Technology**
**Subcommittee on Space**
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Chairman Babin, Ranking Member Bera, and Members of the Subcommittee, thank you for the opportunity today to discuss the Department of Energy's efforts to ensure radioisotope power systems are available for NASA use.

The Department is committed to its partnership with NASA to provide radioisotope power systems for space exploration activities. This successful partnership has extended over 50 years and 22 missions. Radioisotope power systems have a proven track record with no failures and long power lifetimes, making them a continuing viable technology option for NASA missions. My testimony today will focus on how DOE is strengthening our relationship with NASA; ensuring delivery of radioisotope power systems through a transition to a constant-rate production strategy; and aligning planning for long-range production of plutonium for space power applications with NASA for missions beyond the current 2025 timeframe.

**Relationship with NASA**

In October 2016, the Department and NASA renewed a memorandum of understanding (MOU) to work collaboratively on future development and deployment of radioisotope power systems solutions. This arrangement updated agency responsibilities to reflect funding authority changes and to provide more emphasis on aligning and integrating work to enable future space exploration missions.

In the same month, the Office of Nuclear Energy reorganized and aligned the responsibilities for radioisotope power systems to the Office of Nuclear Infrastructure Programs, elevating the interface with NASA to the Deputy Assistant Secretary level. DOE recognizes the technical challenges in reconstituting nuclear capabilities for plutonium production that were suspended in the late 1980's and made this change to leverage Nuclear Energy's expertise in re-establishing and maintaining nuclear infrastructure capabilities in support of the radioisotope power system missions.

**Constant Rate Production**

Upon approval of the new MOU, the agencies initiated discussions to assess current activities and determine options to improve support for NASA mission goals. In early 2017, DOE and

NASA agreed to transition the delivery of radioisotope power systems from a mission-driven approach to a constant-rate production strategy. Applying a constant-rate production strategy affords both agencies the ability to improve reliability and predictability to deliver systems in support of NASA space exploration missions. Constant-rate production establishes clear deliverables, as defined by annual average production rates for plutonium-238 and fueled clads. Maintaining a predictable throughput of plutonium-238 and fueled clad manufacturing activities will level-load the work, ensuring that the capability is fully exercised, technical proficiency of the work force is maintained, and opportunities to maintain and refurbish equipment in a systematic approach are available. The agencies agreed to plutonium production targets that are aligned to NASA mission requirements, with a goal of achieving an annual heat-source plutonium oxide production rate of 1.5 kilograms/year by the year 2025 with an interim annual heat-source plutonium oxide production rate of 400 grams/year by 2019.

Specific to the production of plutonium-238, the Department's approach shifted from a project-based management construct to the framework utilized for decades at Oak Ridge National Laboratory to produce isotopes for medical and industrial use. Employing this framework provides NASA and DOE flexibility to align resources and efforts to optimize plutonium production; and identify, evaluate, and implement improvements to maximize NASA investments.

Measurable progress has been made to realign activities to directly address identified risks to achieve plutonium production rates. The Department completed its first campaign of new, domestic plutonium-238 in 2015 and the new plutonium-238 met NASA mission specification requirements. Given the composition of the material, the Department and NASA agreed to continue efforts to demonstrate the nuclear capabilities supply chain by utilizing this material as part of the Mars 2020 mission. I am pleased to report that, as of August 2017, the Department successfully fabricated two fueled clads, in part utilizing a small amount of new plutonium mixed with the existing inventory for the Mars 2020 radioisotope power system. A second campaign of new plutonium is scheduled to be completed this fall, taking into account lessons learned from the first campaign.

The Department is actively working to address and mitigate risks to establishing domestic plutonium-238 production capability. The Fiscal Year (FY) 2017 Omnibus Appropriations bill made additional funding available for domestic production of plutonium-238, and the Department is using those funds to further reduce risk and accelerate the schedule. For example, DOE has made progress to expand the capability to ship plutonium-238 heat source oxide between its sites, focusing efforts on development, design, procurement and certification of shipping containers with the majority of activities scheduled to be completed in FY 2017 for both Idaho National Laboratory (INL) and Los Alamos National Laboratory (LANL). Currently, DOE has limited capacity to load plutonium-238 heat-source oxide at Oak Ridge National Laboratory (ORNL) due to the configuration of equipment and its incompatibility to package material with new packaging containers. DOE was originally scheduled to complete modifications by FY 2020 but has accelerated this schedule by roughly 12 months. This is being

achieved by utilizing the additional funding to fast-track the procurement of gloveboxes, welders, and other equipment to modify the current packaging capability by early FY 2019. This revised schedule better aligns with established production goals.

The Department also accelerated research and testing on a production target design with the goal of recommending a final target design for both the Advanced Test Reactor (ATR) at INL and the High Flux Isotope Reactor (HFIR) at ORNL by 2019. DOE is testing a potential process improvement at ORNL to replace the current neptunium oxide/aluminum target with a new target that eliminates the use of aluminum. The new target is estimated to increase the amount and the assay of plutonium-238 produced. The increased yield per target would result in manufacturing fewer targets as well as eliminating a chemical processing step and waste stream, resulting in production cost reductions. DOE is pursuing evaluation of this target design with the goal of completing all testing and providing a recommendation to NASA in 2019 for a standardized target design for both research reactors.

**Aligning Plutonium Project to Future NASA Missions**

The Department has an existing inventory of approximately 35 kilograms of plutonium-238 that is able to meet NASA's current demands for RPS activities through a notional mission in 2025. Of this inventory, less than half of the plutonium meets the NASA mission specification of roughly 82 percent assay of plutonium-238 isotope with the remaining amount falling outside of this specification. In collaborations with NASA, the Department recognizes that there is a need to develop long-range projections of plutonium to support space exploration planning activities and assure available supplies to meet missions beyond 2025.

DOE is initiating several activities to begin this long-range planning work. Currently, the Department is utilizing the HFIR to produce small campaigns of plutonium-238 to finalize the production process. In April 2017, the Department completed a study to evaluate the use of the ATR, along with the HFIR, to produce plutonium-238 to meet the established heat source production rate of 1.5 kilograms per year by 2025. Based on this study, the Department has identified an approach for irradiation in underutilized positions in the ATR that would yield sufficient quantities of very high assay product, which can be blended with larger quantities of out-of-specification inventory at LANL, to support the overall heat source production rate of 1.5 kilograms per year while minimizing impacts to existing irradiation customers.

With the additional funding provided in the FY 2017 Omnibus, DOE is actively pursuing opportunities to further optimize use of the ATR and HFIR. The Department accelerated activities on ATR to conduct an experimental campaign to verify the results of the recent study, with the goal of obtaining data at least six months earlier than planned to support FY 2019 decisions on ATR target designs. Additional funding was also provided to support redesign of the HFIR beryllium reflector to optimize it for plutonium-238 production, with the potential to increase total yield and assay so that it could also be blended with larger amounts of out-of-specification material at LANL.

**Conclusion**

The Department remains committed to partnering with NASA to ensure the continued availability of radioisotope power systems for space exploration missions. Thank you for the opportunity to share the Department's progress and I look forward to addressing any questions you may have in this area.