

# **PREPAREDNESS FOR HIGH ASSAY LOW ENRICHED URANIUM AVAILABILITY**

**A Report for the  
Senate Committee on Appropriations and the  
House Committee on Appropriations**



**By the U.S. Nuclear Regulatory Commission**

## **Introduction**

The U.S. Nuclear Regulatory Commission (NRC) developed this report as required by the Energy Act of 2020/Consolidated Appropriations Act of 2021 (Public Law No. 116-260), Title II, Section 2001 of Division Z. The Consolidated Appropriations Act, 2021 directed the NRC to provide a description of updates to regulations, certifications, and other regulatory policies that the NRC determines are necessary in order for high-assay low-enriched uranium (HALEU) to be commercially available, including timelines to complete such updates, regarding (1) guidance for material control and accountability of special nuclear material (SNM), (2) certifications relating to transportation packaging for HALEU, and (3) licensing of enrichment, conversion, and fuel fabrication facilities for HALEU, and associated physical security plans for such facilities.

HALEU is defined as uranium enriched to greater than 5 weight percent and less than 20 weight percent of the uranium-235 (U-235) isotope. In general, industry representatives have indicated that operators of existing conventional light-water reactors (LWRs) expect these facilities to use HALEU enriched to between 5 and 10 weight percent U-235 and designers of advanced reactors propose to use HALEU enriched to between 10 and 20 weight percent U-235.

Generally, the NRC's regulations, certifications, and policies for enrichment, conversion, fabrication, and transportation are sufficiently performance-based and technology neutral for use in licensing and regulating HALEU fuel. The NRC staff is working on regulatory guidance documents, which clarify but do not impose requirements, to ensure openness, clarity, and efficiency regarding the NRC staff's regulatory expectations and planned licensing review practices for HALEU fuel applications.

In addition, the NRC staff is identifying challenges and data needs for longer-term advanced non-LWR HALEU (e.g., nonsolid fuel forms) so that the agency will be ready to efficiently conduct the necessary licensing reviews. The NRC staff has received and is currently reviewing several licensing requests for enrichment, fabrication, and transportation of HALEU, and anticipates more license amendment requests in the future.

## **Guidance for Material Control and Accounting of Special Nuclear Material**

The NRC has determined that no near-term updates to regulations or policies for Material Control and Accounting (MC&A) are necessary to facilitate HALEU licensing and commercial availability.

While the NRC does not consider changes to existing guidance or new guidance necessary to support the commercial availability of HALEU, the NRC is updating MC&A guidance to enhance openness, clarity, and efficiency. On September 2021, in volume 86 of the *Federal Register*, page 52926, the NRC published a notice soliciting public comments on draft guidance for SNM of moderate strategic significance, the category of material that includes HALEU. This guidance, while not limited to HALEU, would apply to facilities licensed to possess HALEU. The staff will consider the comments received in finalizing the guidance document, NUREG-2159, "Acceptable Standard Format and Content for the Fundamental Nuclear Material Control Plan Required for Special Nuclear Material of Moderate Strategic Significance," Revision 1, issued for comment in September 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21263A119). The NRC expects to issue the final guidance document by the spring of 2022.

## **Certifications Related to Transportation Packaging for High Assay Low Enriched Uranium**

The NRC staff has determined that no near-term updates to regulations, policies, or guidance are necessary to support HALEU transportation plans as they are currently known to the NRC.

The NRC regulations in 10 CFR Part 71, "Packaging and Transportation of Radioactive Material," apply to any level of enrichment. To support the licensing and commercial use of HALEU, the NRC staff will rely on its regulatory experience gained from reviewing transportation packages with LWR fuel assemblies enriched greater than 5 weight percent U-235 and near-term non-LWR fuel types such as tri-structural, isotropic (TRISO) fuel, metallic and plate fuel, and research reactor fuel with enrichments up to 20 weight percent U-235.

Commercial availability of HALEU fuel depends on the transport of uranium hexafluoride (UF<sub>6</sub>) in quantities that exceed the capacity of currently certified transportation packages. The NRC staff is currently reviewing an amendment request (ADAMS Accession No. ML21181A000) for changes to an existing UF<sub>6</sub> transportation package design certification to allow shipment of larger quantities of HALEU in the form of UF<sub>6</sub>. The staff expects to complete the amendment review in June 2022.

In September of 2020, the NRC staff approved an amendment to a transportation package design certification that authorizes shipment of fresh fuel assemblies with enrichments in the HALEU range (ADAMS Accession No. ML20255A297). The NRC staff is currently reviewing two additional transportation package amendment requests for fuel assemblies containing HALEU and expects to complete them in January and June 2022, respectively.

The NRC staff continues to sponsor and conduct research activities, literature reviews, and technical evaluations to identify regulatory information needs related to transportation of increased enrichment for both LWR and non-LWR fuel technologies. These activities may inform updates to the NRC's existing guidance. As part of these activities, the NRC staff has issued the following reports:

- "Review of Operating Experience for Transportation of Fresh (Unirradiated) Advanced Reactor Fuel Types," issued January 2019 (ADAMS Accession No. ML20184A151)
- "Potential Challenges with Transportation of Fresh (Unirradiated) Advanced Reactor Fuel Types," issued February 2019 (ADAMS Accession No. ML20209A541)
- "Transportation Experience and Potential Challenges with Transportation of Spent (Irradiated) Advanced Reactor Fuel Types," issued January 2020 (ADAMS Accession No. ML20237F393)
- "Information Gaps and Potential Information Needs Associated with Transportation of Fresh (Unirradiated) Advanced Reactor Fuel Types," issued June 2020 (ADAMS Accession No. ML21021A326)

## **Licensing of Enrichment, Conversion, and Fuel Fabrication Facilities**

The NRC has determined that no near-term updates to the regulations, policies, or guidance, for licensing enrichment, conversion, and fabrication facilities are necessary to facilitate HALEU licensing and commercial availability.

The staff recently approved a license amendment authorizing American Centrifuge Operating, LLC, (ACO) a subsidiary of Centrus Energy Corporation, to demonstrate commercial production of HALEU at the U.S. Department of Energy (DOE) reservation in Piketon, OH (ADAMS Accession No. ML21138A827).

With respect to near-term production of HALEU for advanced reactor fuels, the NRC staff has had preapplication interactions with four commercial vendors considering license applications or amendments to permit production of HALEU and has received one formal letter of intent (ADAMS Accession No. ML21292A180).

The NRC has also engaged with the DOE national laboratories to compile information on the potential hazards of metal fuel fabrication and the processing of fuel salts used for molten salt reactors. This information will help the NRC review applications that involve these technologies, including those that involve HALEU. Based on this information and on information provided by applicants, the NRC will determine whether to update regulatory guidance to address hazards specific to non-LWR fuel cycles.

## **Physical Security Plans Associated with Enrichment, Conversion, and Fuel Fabrication Facilities for HALEU**

The NRC has not yet determined whether near-term updates to the regulations, policies, or guidance are needed for physical security plans related to facilities with HALEU. The NRC currently uses risk-informed analysis on a case-by-case basis to develop appropriate site-specific supplemental security measures. If needed, staff would implement such measures through license conditions to ensure the security of facilities that propose to possess HALEU. To communicate the established, risk-informed approach, the NRC has developed a physical security information sheet, which is available on the NRC public Web site<sup>1</sup> and answers questions that stakeholders have posed in the past.

The physical security requirements for licensees possessing SNM of moderate and low strategic significance, including HALEU, appear in 10 CFR 73.67, "Licensee fixed site and in-transit requirements for the physical protection of special nuclear material of moderate and low strategic significance." After the events of September 11, 2001, the NRC issued security orders to licensees that possessed Category I or Category III quantities of SNM, as those terms are defined in 10 CFR Section 73.2. In 2006, the Commission approved the staff's schedules and resources for the initial rulemaking on enhancing security for SNM. The scope of the rulemaking included incorporating the physical protection requirements of the post-9/11 security orders into generically applicable regulations to increase regulatory predictability and stability.

In 2010, the Commission approved the staff's request to amend the scope of the rulemaking to pursue a revised categorization scheme for SNM, based on material attractiveness. In April 2016, the Commission directed the staff to suspend all activities on the proposed SNM rulemaking. In August 2021, the Commission directed the staff to analyze more options for the

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<sup>1</sup> See <https://www.nrc.gov/reactors/new-reactors/advanced/rulemaking-and-guidance/fuel-cycle.html>.

scope of the rule and the potential regulatory, resource, and timing impact of each option, including considerations for HALEU (ADAMS Accession No. ML21217A065). The staff is currently developing a paper on the options, which it expects to submit to the Commission in September 2022.

### **Conclusion**

The current NRC regulatory framework has sufficient flexibility to accommodate licensing reviews and decisions related to HALEU. The NRC will continue to engage with potential applicants and other stakeholders and encourage industry to share its plans, including schedules and potential technical challenges, to be prepared for the submission of complete, high-quality HALEU licensing requests.