

# The Nuclear Review

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Spotlight on Technology—  
Orano USA's HALEU Program

TradeTech's 2021 Uranium  
Mining Risk Register



# Spotlight on Technology— Orano USA's HALEU Program



While the world's existing fleet of light water reactors (LWRs) uses fuel enriched to about 5% U-235, many advanced reactor designs will require high-assay low-enriched uranium, or HALEU, which is enriched to a higher degree—between 5% and 20% (**Figure 1**). HALEU offers improved reactor economics, greater fuel efficiency, enhanced safety and proliferation resistance, and lower volumes of waste. As a result, uranium enrichers and fuel developers are working on production plans for HALEU as the nuclear power industry looks to a future that includes advanced reactors, small modular reactors (SMRs), and accident-tolerant fuels. This "Spotlight on Technology" features an interview with Amir Vexler, President and CEO of Orano USA, which is at the forefront of HALEU fuel development plans.



Amir Vexler, President & CEO, Orano USA

**TNR:** As initial plans for the production and use of HALEU continue to advance, does Orano have plans for supplying HALEU to the international nuclear power industry?

**Vexler:** Orano realizes the strategic importance of clean energy initiatives and the future of our industry when supporting next-generation nuclear reactors, including building on our current fuel capabilities to provide a reliable supply of HALEU. The success of next-generation nuclear projects will rely on more than simply being able to enrich uranium fuel to +5% levels, but also how to deconvert, transport, and handle the waste of the entire advanced fuel universe.

Orano's plans include leading the market as a long-term provider of fuel, services, and material critical to building and sustaining the many

facets of this effort. With Orano's decades of experience providing front-end, logistics, and back-end services, advanced reactor developers can rely on our existing capabilities and know-how to support a robust supply chain (**Figure 2**).

*"Using Nuclear Energy Institute estimates, demand for HALEU fuel could be 200tU to 500tU per year by the early 2030s. This would translate to additional annual demand of more than 10 million SWU and 10,000t of U<sub>3</sub>O<sub>8</sub> and conversion services."*

**TNR:** Considering the new demand for HALEU that is on the horizon, what potential impacts does Orano anticipate within the front end of the nuclear fuel cycle?

**Vexler:** We expect that the impact on the front end of the nuclear fuel cycle will be significant. Using Nuclear Energy Institute estimates, demand

for HALEU fuel could be anywhere between 200tU to 500tU per year by the early 2030s. This would translate to additional annual demand of more than 10 million SWU and 10,000t U<sub>3</sub>O<sub>8</sub> and conversion services.

These figures would represent a 20 percent increase on top of today's demand. If all current SMR projects succeed, the additional quantities needed could more than double over time.

**TNR:** Will Orano be able to transition to the production of HALEU at its existing uranium enrichment facilities, and if so, what is the estimated schedule for the start of production?

**Vexler:** Orano recognizes the unique challenges supplying HALEU fuel presents from both a time and operational standpoint. In our view, a new facility dedicated to these higher enrichments (up to 19.75%) would be

required to serve the potentially large commercial demand arising from SMR development. The estimated schedule depends on the solutions developed by industry and government to allow HALEU producers to invest in the supply chain.

**TNR:** *How does Orano envision meeting this new demand for HALEU fuel over the next decade?*

**Vexler:** Orano is evaluating how to create solutions that allow us to shorten the timeline to meeting this HALEU demand, along with our partners in government, other enrichers, fuel fabricators, and SMR developers. Clearly, the interest in ramping up to commercial quantities of HALEU production is shared across the industry. To bring this capacity online sooner than later, we expect

that some commercial arrangement of enrichers, logistics providers, and SMR developers, with strong government support, could provide the environment needed.

**TNR:** *Is Orano considering expanded production to ensure that adequate uranium conversion and enrichment supplies are available, given this new demand related to the proposed manufacturing of HALEU fuel for the SMR market?*

**Vexler:** Larger adoption of nuclear energy to fight climate change, regardless if the reactors are LWRs or SMRs, will put pressure on the market's existing capabilities. Mining, conversion, and enrichment (low-enriched uranium) are commodities and will supply both LWR and SMR

fleets. Capacity expansions will depend on price developments and/or demand from customers to secure large and long-term quantities.

**TNR:** *Are there pathways for bridging gaps in HALEU production, including downblending existing highly enriched uranium (HEU) inventory or small-batch production methods?*

**Vexler:** Orano's interest is in providing long-term supply of HALEU—the use of stop-gap measures or one-off deals do not promote a sustainable, reliable supply chain. HEU reserves for downblending are limited. A reliable supply chain dedicated to the production of this material is a must.

**TNR:** *Recently, there have been certain supply chain issues related to transportation. As a result, safeguards and security issues, and challenges associated with the transportation and use of HALEU, are currently a focus of regulatory review and research. As a global uranium fuel transporter, can you address some of the unique challenges involved in the transportation and delivery of HALEU fuel, given that it exceeds the current 5 percent U-235 limit for existing LWRs?*

**Vexler:** There are no "challenges" associated with transporting HALEU other than identifying packages with sufficient capacity and fleet size to meet the industry demand.

In the USA, HALEU will likely be categorized at Special Nuclear Material – Moderate Strategic Significance (SNM-MSS), which is also referred to as Category II material per International Atomic Energy Agency

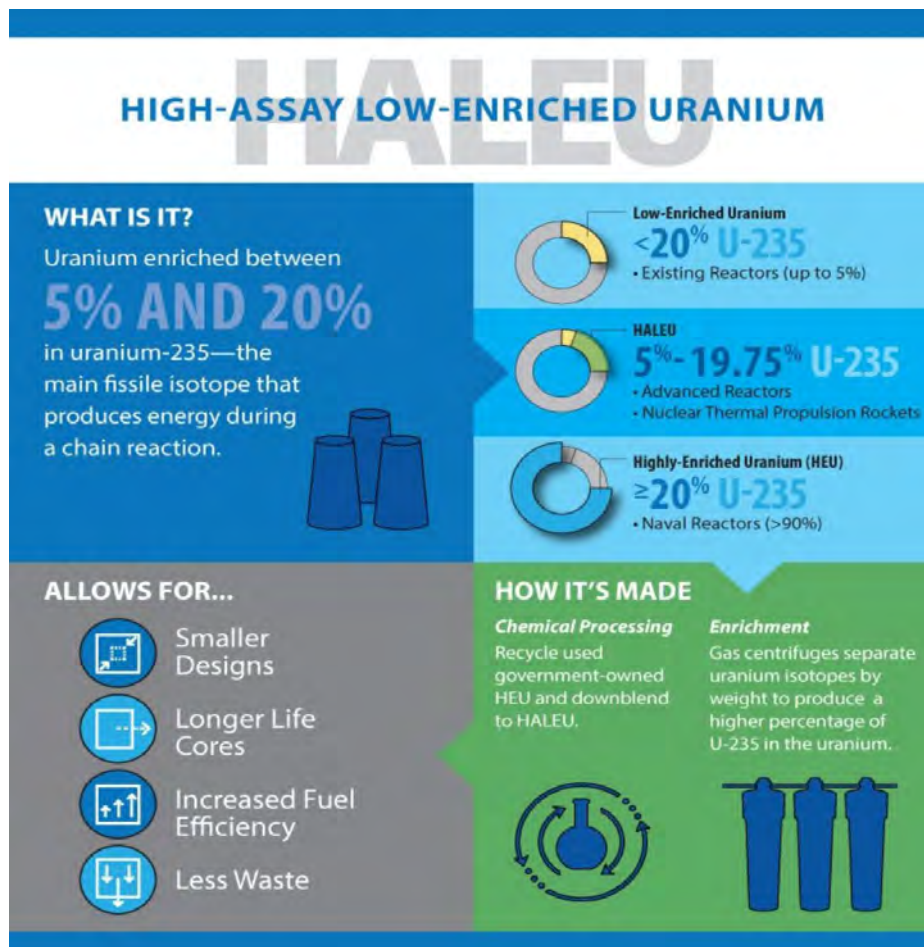


Figure 1 **High Assay Low-Enriched Uranium**  
Source: US Department of Energy



(IAEA) INFCIRC225 R5. US Nuclear Regulatory Commission (NRC) regulations (NRC 10 CFR 73.67) provide the physical protection requirements for SNM-MSS. These requirements do not present any challenges, as the physical protection requirements are minor and addressed.

However, most of the international countries implement their transportation regulations based on IAEA protocols (IAEA SSR-6 and INFCIRC225 R5). For HALEU, that means the shipment categorization will increase from Cat III (for most commercial fuel with enrichments <5%) to Cat II. The international physical protection requirements per INFCIRC225 R5 for Cat II material are more stringent than in the USA.

Under the international requirements, Cat II material is to be protected with guards and escorts, which will make coordination more complicated and potentially increase costs. Cat II material is transported internationally without issue, but additional measures may be needed for transporting the expected higher quantities of HALEU for future reactors.

**TNR:** *HALEU can be fabricated into different fuel forms and has the potential for improved reactor economics and fuel efficiency. Operating LWRs could potentially transition to HALEU-based oxide fuels for extended operating cycles and improved plant economics. Is Orano considering the potential market for HALEU within the existing nuclear power industry, where HALEU could be used in fuel for plants that are operating today?*

*"The success of next-generation nuclear projects will rely on more than simply being able to enrich uranium fuel to +5% levels, but also how to deconvert, transport, and handle the waste of the entire advanced fuel universe. Orano's plans include leading the market as a long-term provider of fuel, services, and material critical to building and sustaining the many facets of this effort."*

**Vexler:** It is very important to highlight that the various forms of next-generation nuclear fuel certainly present a challenge to HALEU suppliers. Being able to enrich uranium to 19.75 percent is only a portion of the requirements to serve this market.

As you point out, being able to provide the various fuel forms is a significant consideration for any entity promoting itself as part of the solution. In the

immediate term, Orano is working with existing nuclear energy utilities to fulfill their growing interest in LEU+, which we define as enrichments in the 5-8 percent range. We expect to provide those enrichment levels to our worldwide utility partners within the next few years.

**TNR:** *Before advanced reactor developers boosted the expectation of future demand for HALEU, the need for the material was already increasing in other sectors, such as research reactors that have been converted from HEU to HALEU around the world. Does Orano anticipate being involved in the market for HALEU outside of the nuclear power industry?*

**Vexler:** The increase in our HALEU capacity is targeted to serve all customers, including research reactors.

**TNR:** *What steps should the demand sector (utilities) take to ensure a smooth transition and availability of HALEU at a reasonable cost when they need it?*

**Vexler:** The obvious challenge facing HALEU and its production is identifying potential demand without a clear supply solution. The solution to establishing a reliable HALEU supply is likely to be a function of industry, utilities, and government working together for a comprehensive defined solution. Most importantly, this would include financial and operational certainties to allow potential HALEU producers to make the significant investments.

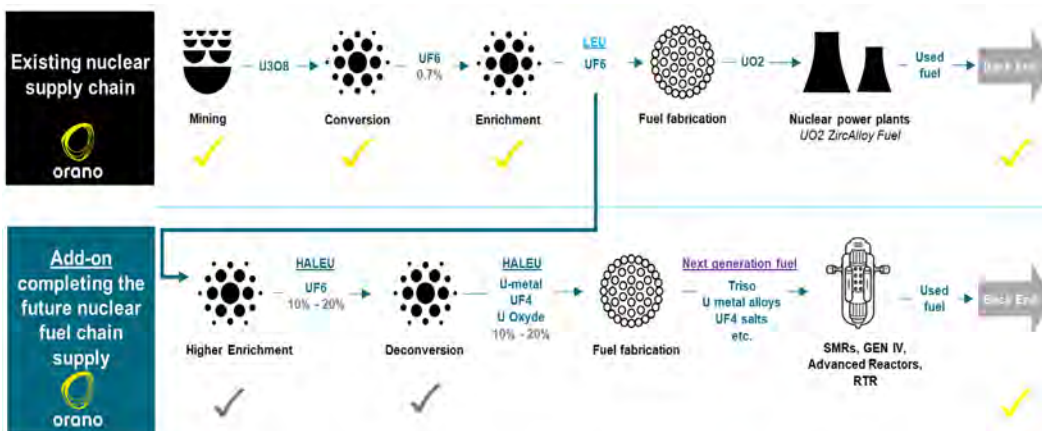


Figure 2 Impact on Front-End Supply Chain & Orano Capabilities  
Source: Orano

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