GAIN Gateway for Accelerated Innovation in Nuclear

Yellowcake is a type of uranium concentrate powder obtained as an intermediate step in the processing of uranium ores.

High-Assay Low-Enriched Uranium (HALEU) Program

Advancing tomorrow's nuclear supply chain

DOE's HALEU Program enables deployment of advanced reactors to help secure America's clean energy future.

What is HALEU?
High-assay, low-enriched uranium. Uranium containing between 5% and 20% U-235.

Why is HALEU needed?
Fosters advanced reactor development and supports better nuclear power plant economics.

What are the HALEU sources?
Long-term – Enrichment
Interim – Downblending current and/or recovered highly enriched uranium (HEU) in the federal complex. HEU contains 20% or more U-235.

The United States needs more clean, reliable, affordable electricity. To that end, the Department of Energy (DOE) supports the development of advanced nuclear reactors.

Interim Supply

INL is evaluating the feasibility of providing an interim supply of HALEU to support fuel-fabrication needs for research and development, and potential demonstration of advanced reactor concepts.

INL has feedstocks with large amounts of residual HEU that currently must be disposed of at a cost to taxpayers. INL is examining the feasibility of recovering and downblending HEU from these feedstocks, which would allow DOE to provide an interim HALEU supply so that fuels for advanced reactors can be further tested. This solution allows the HALEU market to evolve through timely private industry investment when the advanced reactor vendors come to market.

Recovery methods—available or under development at INL—are determined by characteristics of the feedstock and may include:

- Electrometallurgical process
- Hybrid process known as ZIRCEX
- Others

The final HALEU composition is determined by the fuel specifications and fabrication needs for individual advanced reactor types. It includes but is not limited to metallic and oxide forms.

Fuel Fabrication

Private-sector nuclear technology developers have responded to market needs for economic, low-carbon energy with initiatives to design, license, and sell nuclear reactors of advanced design. Nuclear technology developers seek to accelerate their path to market and have requested DOE assistance to supply an interim amount of HALEU to support fuel performance demonstrations.

INL's fuels program supports the fabrication of test fuels used as first cores of advanced reactors or lead test rods and assemblies for insertion in commercial light-water reactors.

A variety of fuels is of interest to developers. Most advanced reactor designs use metallic, ceramic, and intermetallic fuels. In addition, interest in fluid fuels has been growing. Final fuel specifications and fabrication needs depend on the technology developer needs.

How do we transition from a LEU to a HALEU Fuel Cycle?
Infrastructure updates are needed to address safety, safeguards and security. Companies making investments need a robust HALEU market. Advanced reactor developers require HALEU to test their concepts, which in turn create the HALEU market.

This research-and-bridge role is a familiar one for DOE. The agency has been instrumental in advancing technologies for renewables and other energy types.

For more information

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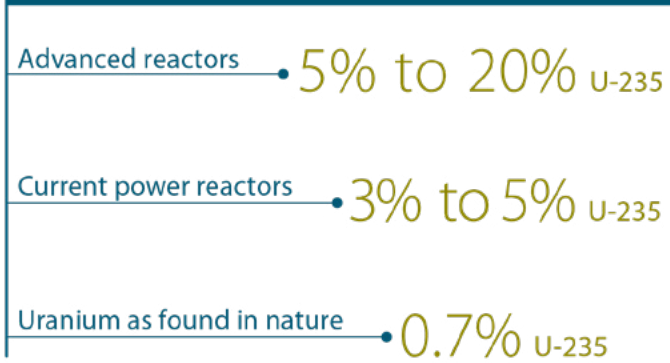
Transportation
The nuclear industry, both domestically and around the world, has many decades of safe, large-volume transportation of LEU materials. Transitioning to tomorrow's nuclear supply chain requires the development of a HALEU certified transport package (cylinder and protective overpack) for a range of uranium forms. The INL program is developing transportation solutions that reduce expenses and encompass activities from enrichment to fuel fabrication facilities.

Uranium Enrinchment Levels



- U-238 is the most common isotope of uranium found in nature.
- U-235 is the fissile isotope of uranium found in nature at a concentration of 0.7%.
- The fuel used in most prevalent nuclear reactors needs to have a higher concentration of the U-235 isotope than what is found in nature.
- International agreements define high-enriched uranium (HEU) as having 20% or more U-235.


Pilot scale demonstration of Zircex technology