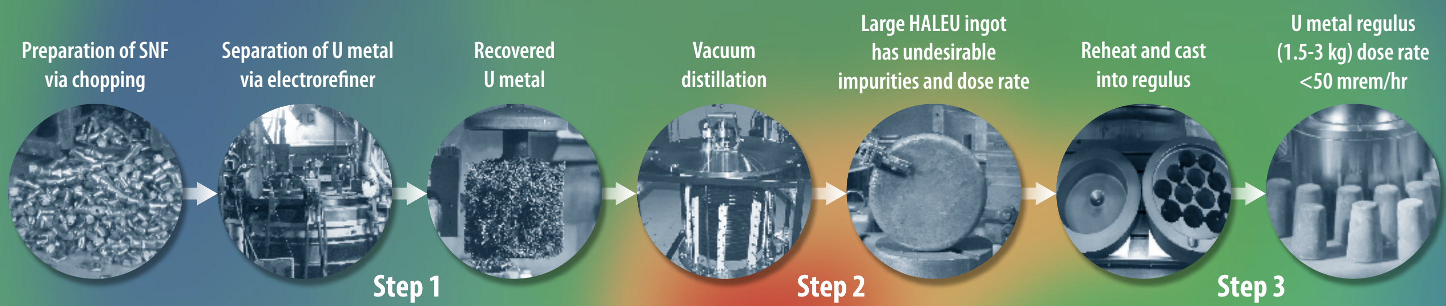


The EMT process for HALEU recovery

HALEU via Electrometallurgical Treatment (EMT) Process

Recovering and downblending HEU from fuels irradiated in sodium cooled fast reactors

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 electrometallurgical treatment (EMT) process has been used in the conditioning of irradiated sodium bonded fuels for over 20 years. The process recovers highly enriched uranium (HEU) and downblends it to create High-Assay Low-Enriched Uranium (HALEU), defined as uranium containing between 5% and 20% U-235.

Fuel Fabrication Ready

Originally HALEU recovered using the EMT process was scheduled for future disposition. To facilitate this, the product was generated as large ingots. DOE's research-and-bridge program requires HALEU materials to be available in a fuel fabrication ready configuration. As such, INL has implemented process enhancements to reduce the physical size and lower the radiological dose rate of the EMT product. The smaller product is known as the regulus. Moving from ingots to reguli enables the management of the materials in gloveboxes, facilitating fuel fabrication.

The EMT Process

The process feed is composed of previously irradiated, sodium bonded metallic fuels from DOE research reactors (EBR-II and FFTF). The process incorporates three steps:

- ***Step 1*** – Irradiated fuel is prepared and placed into a molten salt electrorefiner, which facilitates recovery of uranium metal from fission products and transuranics.
- ***Step 2*** – Recovered uranium undergoes vacuum distillation to remove electrorefiner salt and is downblended to an enrichment less than 20% U-235.
- ***Step 3*** – The recovered uranium metal is configured to support fuel fabrication by reheating and casting into low-dose, reduced size HALEU regulus.

EMT to Date

In support of fuel fabrication R&D needs, DOE conducted an environmental assessment (DOE/EA-2087) investigating the utilization of the EMT HALEU inventory as feedstock for potential fuel fabrication. The assessment concluded there was no significant impact for a glovebox-based fuel fabrication scenario to be located at INL.

Treatment to date of irradiated EBR-II HEU fuel has generated nearly 4 metric tons (MT) of HALEU metal as ingots. These ingots will need to be recast into reguli before they can be used for fuel fabrication.

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.

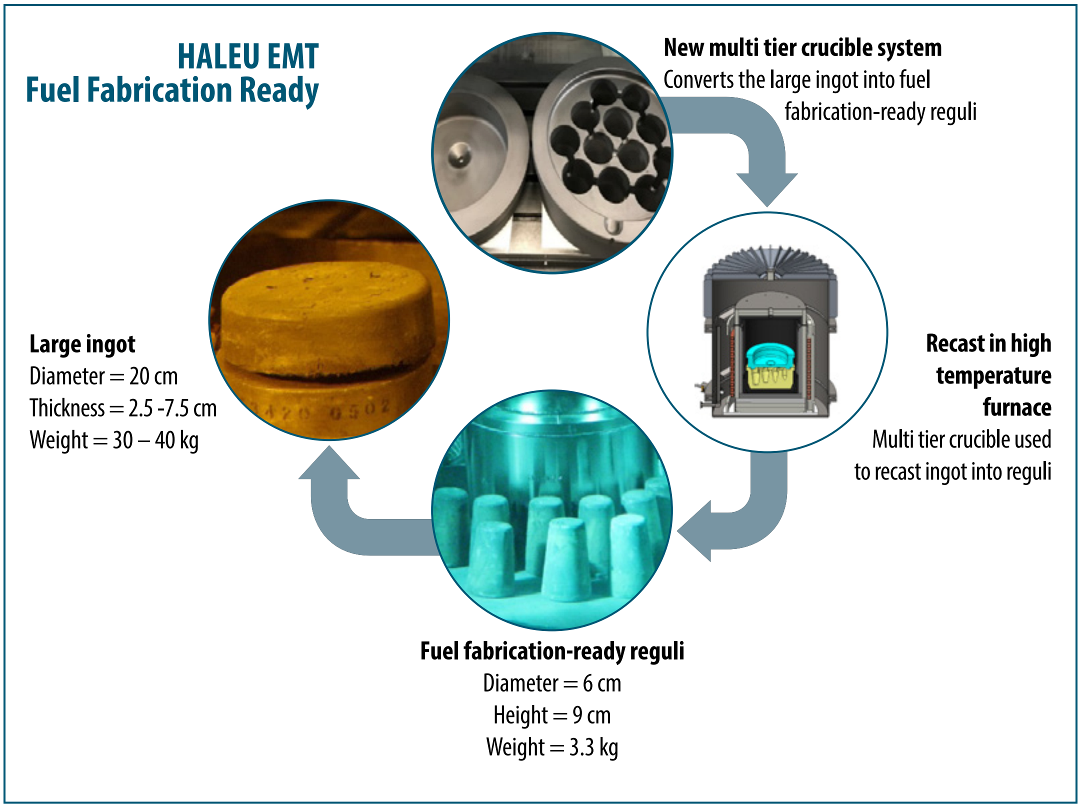
This research-and-bridge role is a familiar one for DOE. The agency has been instrumental in advancing technologies for renewables and other energy types.

Process enhancement to support fuel fabrication ready configuration has been completed. The first reguli batch was produced early in 2019.

EMT of the remaining EBR-II driver fuel inventory and recasting of the existing ingots is on track to produce an estimated quantity of approximately 10 MT of HALEU feedstock suitable for glovebox-based fuel fabrication. By the end of 2019, 600 kg of HALEU material in a fuel fabrication ready configuration would be available.

Path Forward

INL is pursuing research intended to decrease residual impurities of the EMT HALEU product. R&D is being conducted to polish the reguli in support of fuels and reactor designs with narrow tolerances. This material is limited to laboratory-scale applications.



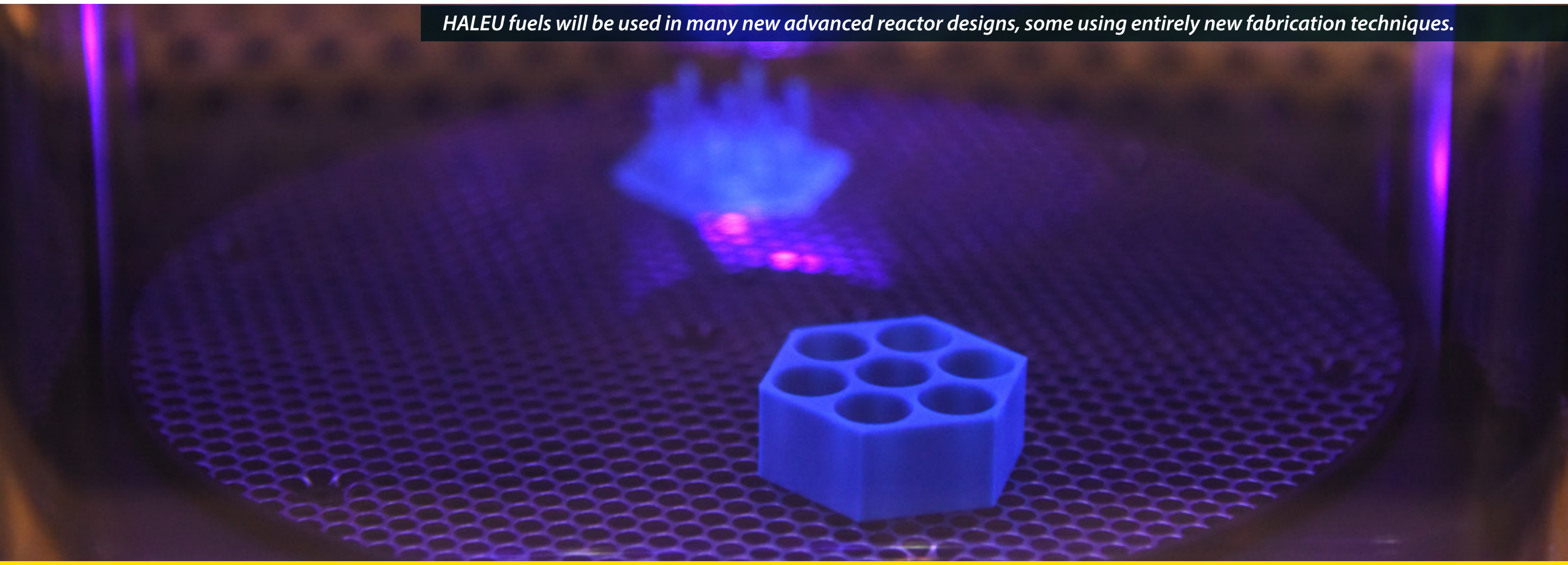
For more information

Bob Miklos
(208) 533-7760
robert.miklos@inl.gov

Joseph Campbell
(208) 526-7785
joseph.campbell@inl.gov

gain.inl.gov

GAINnuclear
GAINnuclear
gain_nuclear



HALEU fuels will be used in many new advanced reactor designs, some using entirely new fabrication techniques.

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