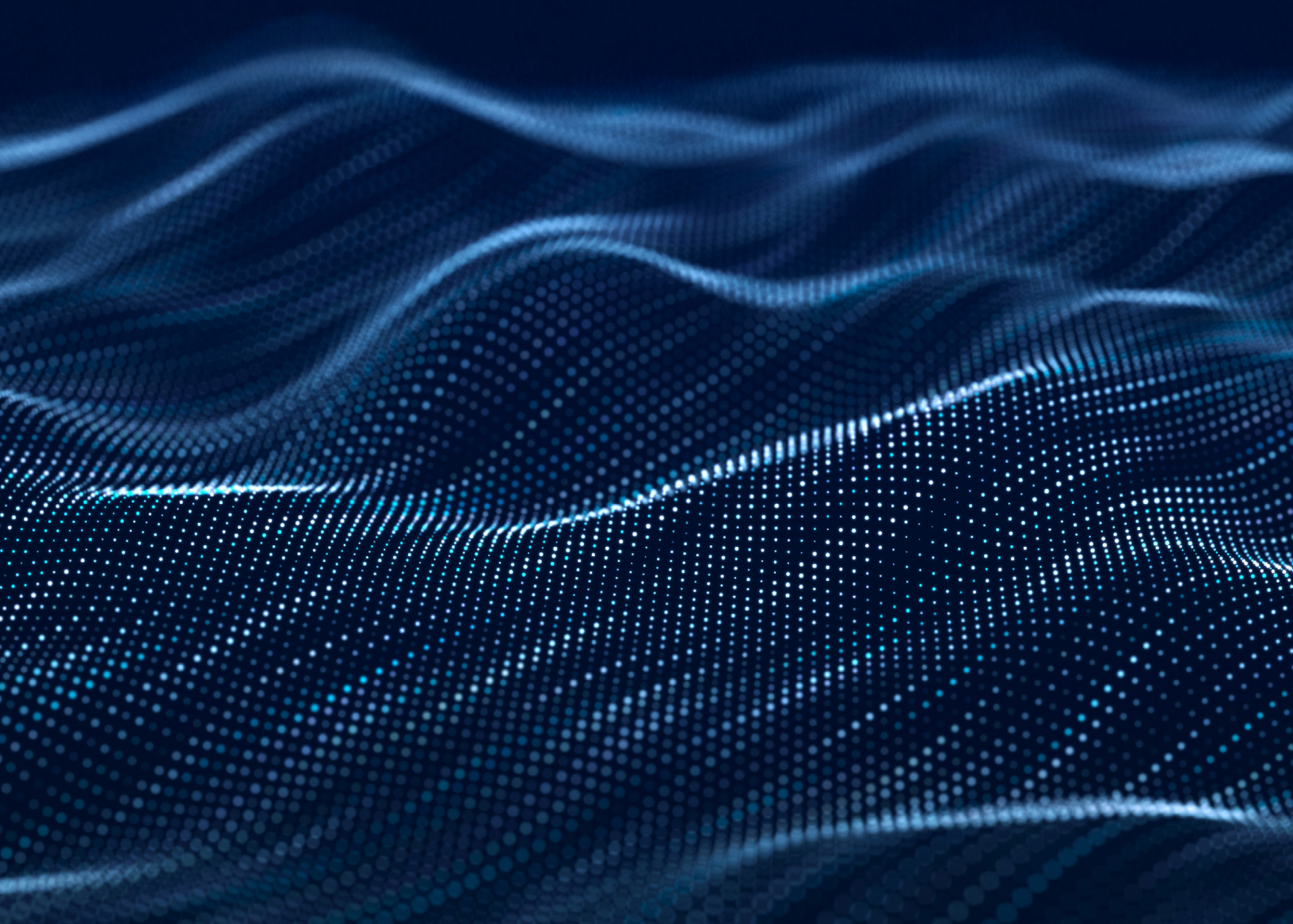
U.S. DEPARTMENT of ENERGY | Office of Nuclear Energy

Spent Fuel and High-Level Waste Disposition

CENTER FOR USED FUEL RESEARCH



Vision Statement

Creating the world's premier knowledge hub for used nuclear fuel management.

Mission Statement

To develop innovative technologies and solutions, conduct research that ensures regulatory compliance, and build public trust in the safe storage and transportation of commercial and U.S. Department of Energy-managed used nuclear fuel.

Over the course of my career, I've been privileged to serve in roles centered on energy policy, particularly nuclear energy policy. Much of that service has been at the U.S. Department of Energy (DOE), where I began as General Counsel, later served as Principal Deputy Director of the Office of Civilian Radioactive Waste Management, and currently serve as the Assistant Secretary for Nuclear Energy.

Today, we stand at a pivotal moment. Nuclear energy is poised to reclaim its role as a cornerstone of America's energy future, not only as a provider of clean, reliable electricity but also as a source of industrial heat for sectors such as chemical production and mining. But to realize this potential, we must resolve one of the industry's most persistent challenges: managing used nuclear fuel (UNF)*. The current reactor fleet is expected to generate over 180,000 metric tons heavy metal (MTHM) of UNF. DOE currently carries about $40 billion in liabilities to utilities for not taking possession of this material from commercial nuclear power plants. To reduce this burden, DOE plans to assume ownership and consolidate UNF from more than 70 sites into one or more Federal staging facilities for used nuclear fuel.

This effort demands a collaborative, transparent approach, engaging States and Federally-recognized Tribes that may host storage, reprocessing, and/or repository facilities. DOE's safe management of UNF must be the foundation for discussions around the potential benefits to host communities, including advanced manufacturing, enrichment and fuel fabrication plants, research reactors, university partnerships, and meaningful benefits packages. Establishing the Center for Used Fuel Research would position the United States as a global leader in managing UNF. It will provide the capabilities needed to address technical questions related to UNF from both today's commercial fleet and tomorrow's advanced reactors.

When I served as Assistant Secretary for Nuclear Energy in the late 1980s, the challenges were different, but the mission remains unchanged: to ensure that nuclear energy continues to serve the American people—safely, securely, and sustainably. The establishment of the Center for Used Fuel Research is an important step in continuing to meet our mission.

Theodore J. Garrish,
Assistant Secretary for Nuclear Energy

*The term "used nuclear fuel" is intended to be synonymous with the term "spent nuclear fuel" as used and defined in the Nuclear Waste Policy Act of 1982, as amended, and the Standard Contract for the Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste (10 CFR Part 961).

Dry storage systems and the High Burnup Research Cask at the North Anna Power Station.

Center for Used Fuel Research: Leading the Future of Used Nuclear Fuel Management

The success of the nuclear power industry is closely linked to its ability to safely manage waste streams. Any error within any segment of the industry will impact its overall reputation. To properly address the back end of the nuclear fuel cycle and better position the nuclear industry for success, DOE is instituting the Center for Used Fuel Research (CUFR), hosted at Idaho National Laboratory (INL). The CUFR will serve as a global hub for advancing solutions to real-world challenges regarding the storage and transportation of UNF. Operating under the authority of the DOE Office of Nuclear Energy (DOE-NE), the CUFR will lead the development of innovative technologies, conduct regulatory-compliant research, and foster public confidence in the safe management of both commercial and DOE-managed UNF. The United States faces the challenge of managing over 95,000 metric tons of commercial UNF—an amount projected to nearly double over time—as well as the wide variety of DOE-managed UNF generated in support of the defense programs or past research.

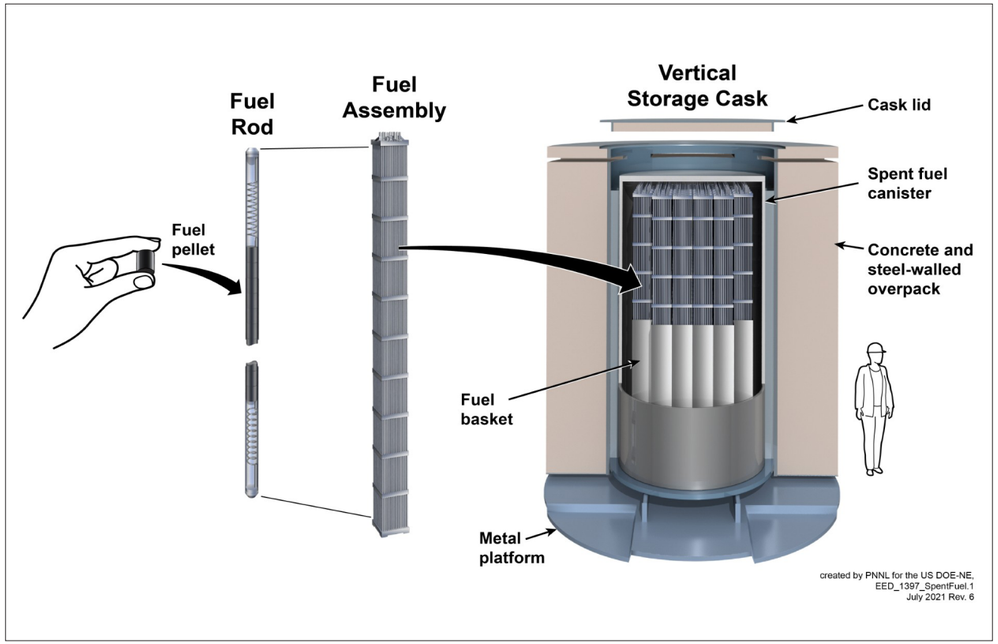
UNF Management in the United States

For over 60 years, nuclear generation has served as a safe, reliable source of energy. Upon discharge, UNF can be stored in spent fuel pools to help manage both thermal and dose considerations. When these spent fuel pools began to reach capacity, the nuclear industry supplemented this storage capacity by using dry storage.

The first dry storage system in the United States was loaded and moved to an independent spent fuel storage installation in 1986. Since then, dry storage casks have been safely and securely stored at reactor sites, pending future geological disposal.

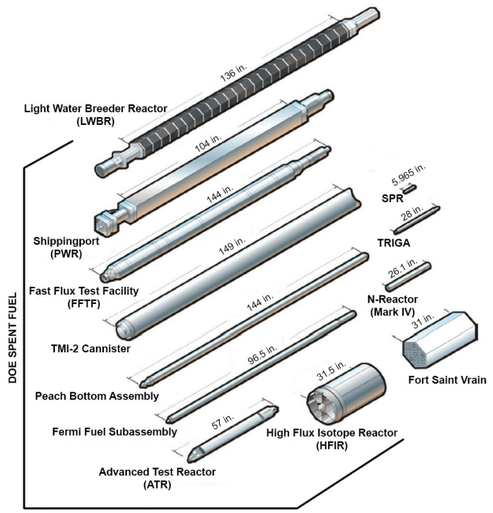
One complication in this continual evaluation of safety and security is that the design and utilization of nuclear fuel have evolved over the decades. Utilities desire extended cycle lengths to increase power uprates, potentially requiring changes to the claddings, uranium enrichments, fuel burnups, fuel manufacturing techniques, etc. This evolution has led to an inventory of UNF with widely varying characteristics. When onsite dry storage first began in 1986, the discharge assembly burnups were considered low (less than 45 GWd/MTHM) and the storage was expected to be temporary. In the mid-1990s, discharge assembly burnups started to rise above 45 GWd/MTHM. By 2030, discharge burnups are expected to increase to ~68 GWd/MTHM rod average burnup. To address potential physical and performance changes in the UNF, the U.S. Nuclear Regulatory Commission (NRC) provided guidance and additional limitations on the dry storage of high burnup fuel.

Additionally, DOE and its predecessor agencies have generated, transported, received, stored, and reprocessed UNF at DOE facilities nationwide. The unique design features of many of these reactors led to the wide range of UNF types now principally stored at DOE-managed sites at INL, the Savannah River Site, and the Hanford Site.



A diagram of nuclear fuel pellets stacked into a fuel rod and fuel assembly with a cutaway figure of a vertical used nuclear fuel storage cask.

The total inventory of DOE-managed UNF* is relatively small (~2,450 MTHM) in comparison to the commercial UNF inventory (~95,000 MTHM). However, packaging of the DOE-managed UNF is considered complex due to the aforementioned wide variety of fuel characteristics. The Spent Fuel Database maintained at INL estimates that 2,800–3,200 DOE Standard Canisters and 410 multi-canister overpacks are needed to dispose of DOE-managed UNF.



Example of variety of shapes, sizes, and designs for U.S. Department of Energy-managed used nuclear fuel.

While commercial UNF and DOE-managed UNF all take different forms, they share many common aging management issues related to their long-term storage until the United States can develop a final-disposal capability. To ensure safe, long-term storage of all this material, it is necessary to invest in aging management and related R&D projects.

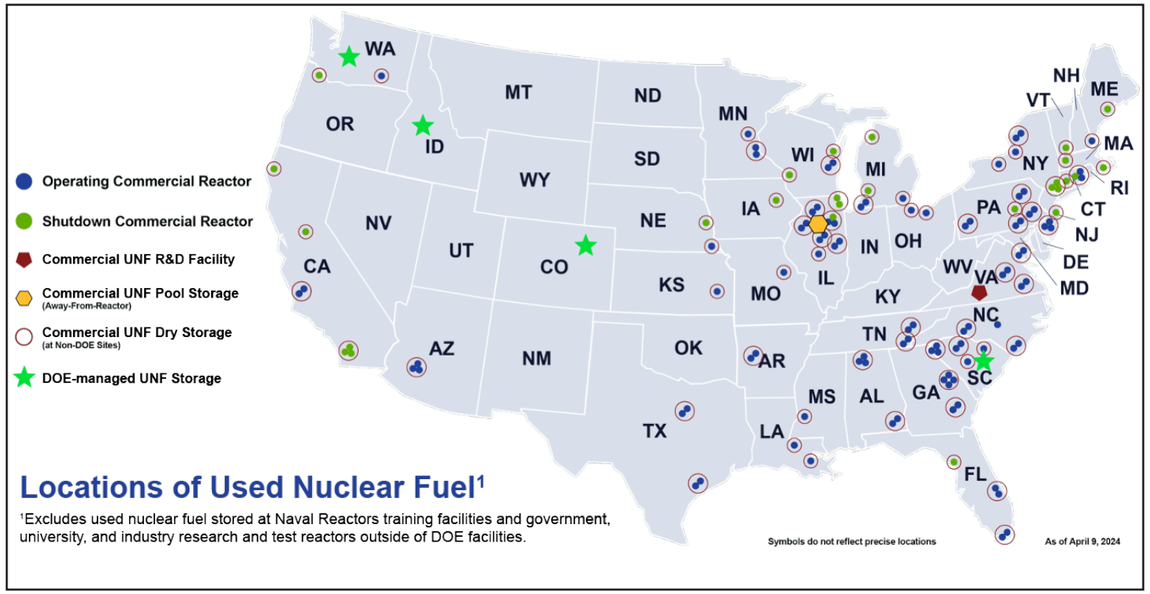
***DOE-managed UNF does not include UNF managed by Naval Reactors**

The Future of UNF in the United States

Concept of a Federal staging facility for used nuclear fuel.

Today, UNF is stored across the country at nuclear power plants, DOE facilities, and research reactors. New reactors that use traditional light-water fuel and advanced fuels, both of which generate waste, are also expected to be deployed.

To more efficiently manage the back end of the fuel cycle throughout the country, the DOE Office of Spent Fuel and High-Level Waste Disposition is developing and implementing a plan for the safe and secure long-term management of the Nation's UNF.



Used nuclear fuel storage locations in the United States.

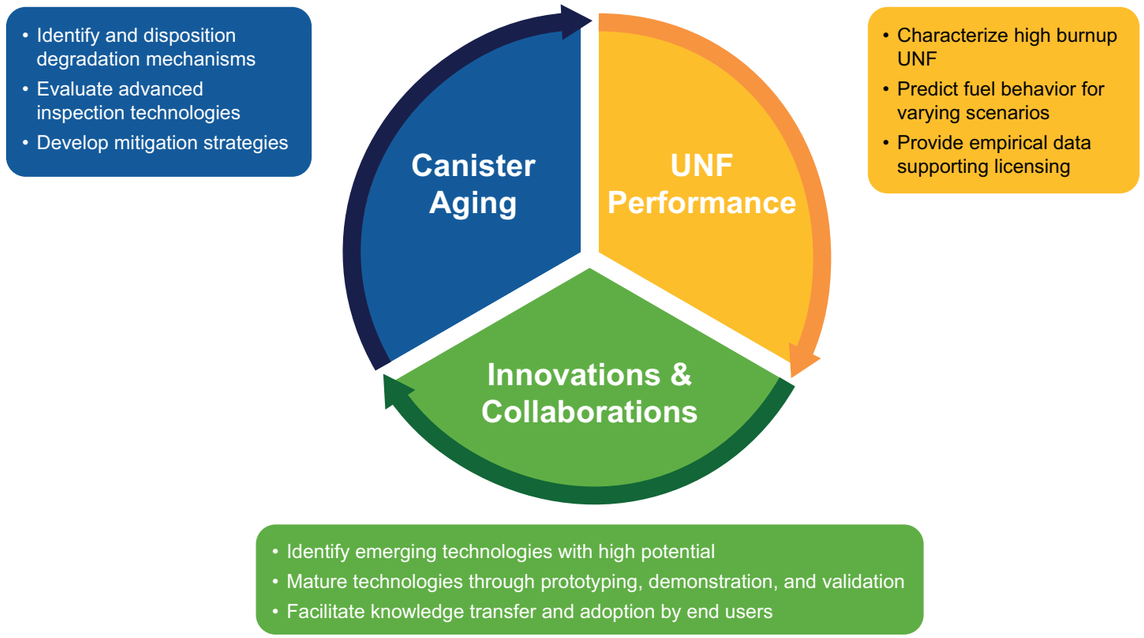
DOE is Required to Take Ownership of the UNF.

In accordance with the Nuclear Waste Policy Act of 1982, as amended (NWPA), DOE entered into contracts with UNF owners, agreeing to begin disposal of commercial UNF by January 31, 1998. However, the U.S. deep geologic repository program in DOE was discontinued in 2010, and as of 2025 has not yet resumed. Therefore, as of September 30, 2025, the U.S. Federal Government has paid out $12.2 billion in litigation settlements and judgments, with the remaining liability estimated to be between $38.6 billion and $44.3 billion assuming DOE begins accepting UNF in the 2030s.

DOE is working to reduce this liability by fulfilling its contractual obligations to accept UNF for transport to a Federal used nuclear fuel staging facility.

Ultimately, UNF is planned to be permanently disposed of within a Federal deep geologic repository. However, siting a repository and transporting all the existing UNF to the repository will take decades.

Atlas Railcars will be used to transport used nuclear fuel across the country.



The Center for Used Fuel Research is envisioned to perform work in the areas of used nuclear fuel performance, canister aging, and innovations and collaborations.

Mission of the Center for Used Fuel Research

Today, UNF is being stored safely, but the variety of fuel and waste forms, along with their long-lived characteristics, can cause public concern over how best to address evolving future technical issues. Therefore, DOE is creating the CUFR, envisioned to be the world's premier knowledge hub for UNF management. Its mission will be to develop innovative technologies and solutions, conduct research that ensures regulatory compliance, and build public trust in the safe storage and transportation of commercial and DOE-managed UNF.

To accomplish this mission, the CUFR will:

- Reduce DOE's contractual and technical liabilities associated with the management of UNF until it can be permanently disposed of.
- Leverage U.S. and international research and operational experience to provide mutual benefits and avoid duplication of effort.
- Furnish data and methods sufficient to meet regulatory requirements in order to support extended storage and transportation of UNF prior to its eventual disposal.

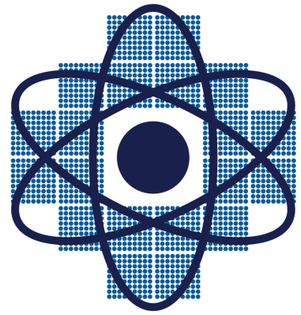
Partnerships and Operations

The CUFR will operate based on a hub-and-spoke model. The hub represents the physical location of the CUFR at INL; the spokes are the principal partners, associates, and other participants. This will enable DOE to more effectively collaborate with the many stakeholders interested in the management of commercial and DOE-managed UNF.

These stakeholders include various government offices and contractors, including the DOE Office of Environmental Management (DOE-EM), Federally-recognized Tribes with ancestral lands near INL, and representation from the Idaho State governor. Universities will participate through the Nuclear Energy University Program. Additional stakeholders include utilities who currently store commercial UNF, the Electric Power Research Institute (EPRI), and the Nuclear Energy Institute, together representing utility interests, fuel vendors, cask vendors, and other countries with nuclear waste management programs.

The future UNF ownership transfer has created a natural partnership between DOE and utilities storing commercial UNF, making industry's perspective vital for defining beneficial research.

Additionally, the CUFR will ensure that its work adheres to quality requirements deemed acceptable by the NRC to benefit all stakeholders. Proposed activities will fall under Emerging Issues (1 year), Technical Gap Closures (3 years), and First-of-a-Kind Research (>3 years). All proposed activities funded by DOE will have clear objectives with defined outcomes and be approved by the DOE-NE Deputy Assistant Secretary for Spent Fuel and High-Level Waste Disposition.



Semblance of the Hub-and-spoke model of the Center for Used Fuel Research.

Concept of unloading a transportation cask at a Federal staging facility for used nuclear fuel.

Performing experiments at the Hot Fuels Examination Facility at Idaho National Laboratory.

The High Burnup Research Cask Supports the Nuclear Industry and Ensures Safe Long-Term Management of UNF for DOE

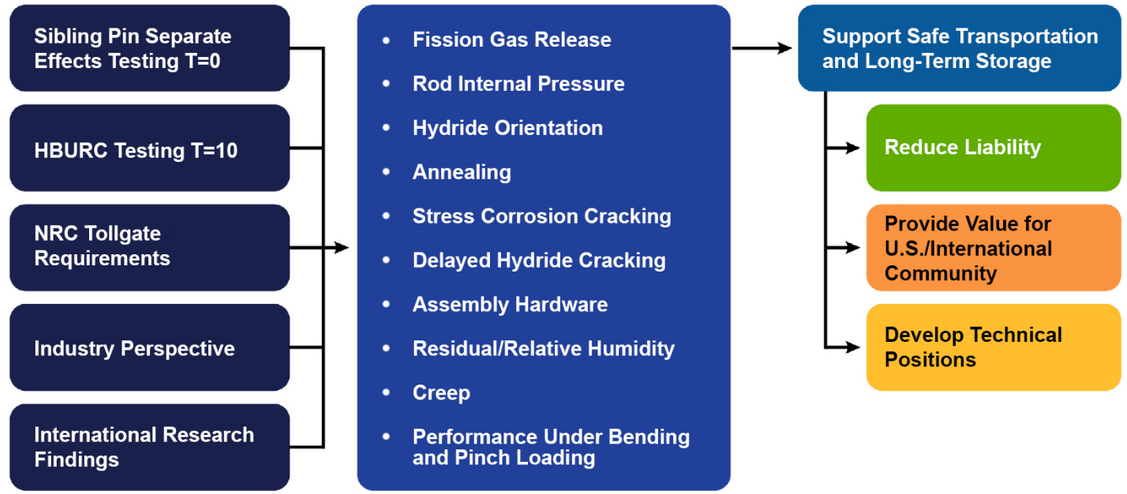
Nuclear power utilities have increased their efficiency and shifted to high burnup fuel. The transition to high burnup fuel can alter certain UNF behaviors. As a result, storage operators may have to apply for license and Certificate of Compliance (CoC) renewals before they can verify the applicability of potential dry cask storage aging effects and mechanisms to high burnup UNF. To account for the possible changes in behavior, requirements called “tollgates” were included in renewal applications for independent spent fuel storage installation licenses and CoCs. In such cases, information to be collected in the future will enhance the understanding of how UNF and the canisters containing it age.

In 2013, to address these tollgates and enable continued storage of high burnup UNF, DOE and EPRI launched a project to collect the needed data, resulting in the loading of 32 high burnup commercial UNF assemblies into the High Burnup Research Cask (HBURC). However, not all data needs can be met at the nuclear power plant site where the UNF was loaded, so DOE plans to ship the HBURC to INL for more extensive testing and inspections of the high burnup UNF.

In total, more than 50 nuclear power plants in 28 different States rely on collecting data from the UNF inside the HBURC in order to support licensing for extended storage.

In addition to collecting data to satisfy tollgates, data from the UNF could support industry innovation and provide information to help meet future DOE needs.

High Burnup UNF Research Pathway



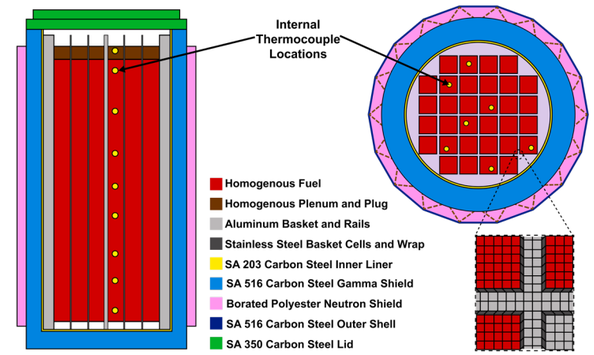
The high burnup used nuclear fuel research and development pathways.

To successfully achieve long-term storage, technical requirements from the NRC tollgate process, insights from industry stakeholders, findings from international research efforts, regulatory guidance, and the initial results from sibling pin testing in the HBURC are all valuable inputs.

Together, these sources of information highlight key technical challenges, including fission gas release, rod internal pressure, hydride behavior, cladding integrity, assembly hardware performance, and other factors such as humidity and creep.

A collaborative approach is needed to successfully address DOE and international waste management organization efforts so as to increase public confidence in safe dry storage and transportation of UNF over the next century. Beyond simply calling for an integrated waste management system, the CUFR’s approach will be to systematically evaluate issues to identify key technical gaps, leading to real-world solutions intended for widespread adoption by both industry and regulators. This will be accomplished by utilizing best-in-class resources from DOE-NE, DOE-EM, DOE national laboratories, industry, academia, and the communities of practice.

The CUFR was established on January 14, 2026 at INL.



Cross-section illustration of used nuclear fuel in cask.

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