NUCLEAR INNOVATION ALLIANCE

Spent Nuclear Fuel Management

The U.S. nuclear power industry has safely and effectively managed spent nuclear fuel (SNF) for decades. This specific form of nuclear waste is tracked with great precision and stored to keep it isolated from the public and the environment. SNF is currently stored at facilities on nuclear power plant sites, several well-understood approaches could be used for long-term storage, and innovators are exploring new ones. Given the relatively small quantity of SNF compared to the energy generated, it is feasible to greatly expand nuclear energy production while safely and effectively managing spent fuel. **To summarize:**

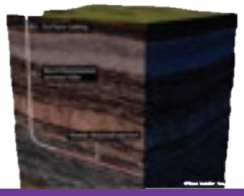
- **Safety:** Commercial SNF has been stored safely in the United States for decades. No member of the public has ever been harmed by the commercially generated spent nuclear fuel that is stored across 39 states.
- **Amount:**The total amount of SNF produced in the United States is very small compared to other waste streams and relative to the amount of energy it produces. In over 65 years of operation, the entire U.S. nuclear industry produced around 90,000 metric tons of SNF . In contrast, coal power plants produce over 100 million metric tons of coal ash every year. For context, the amount of SNF generated from an individual's lifetime electricity consumption of nuclear-generated electricity would only fill a soda can.
- **Management:** SNF is currently **stored safely at reactor sites** across the United States in dry casks or in wet storage, and it is precisely tracked and managed. The nuclear energy industry is the only industry that is completely responsible for monitoring and managing every aspect of its waste and ensuring it does not negatively affect the public or environment.

There are several approaches to disposing SNF:

While the current SNF management system in the United States is safe and effective, it is meant to only be an interim solution. Under the original Nuclear Waste Policy Act (NWPA), the U.S. Department of Energy (DOE) is responsible for taking waste from commercial reactor sites and putting it into long-term storage. However, DOE has yet to fulfill this responsibility. SNF will eventually need to be placed in a permanent storage facility. The good news is that solutions are available, and more are being explored by innovators, to help safely and permanently dispose of SNF . They include:

Geological Repositories

A geological repository is an underground facility designed for safe permanent disposal of SNF. Geological repositories are being implemented in several countries, including **Finland and Sweden** through successful consent-based siting implementation.



Deep Boreholes

Deep borehole technology would use advanced drilling techniques to safety store SNF deep underground in multiple boreholes. These boreholes could be easier to site and can be placed much deeper underground than mined repositories. Private companies like Deep Isolation, which recently received funding from ARPA-E, are already exploring this innovative solution.

Recycling

DOE is investing heavily into two SNF recycling programs to reduce the total amount needed to be stored and to provide fuel for advanced reactors. These include Optimizing Nuclear Waste and Advanced Reactor Disposal Systems (ONWARDS) and Converting SNF Radioisotopes Into Energy (CURIE). Projects within CURIE were **awarded $38 million in funding**.

Consolidated interim Storage: While not a permanent solution, DOE is considering establishing one or more consolidated interim storage facilities. DOE is in the process of developing a **collaborative-based siting process** that will be used when selecting an interim storage site and has recently established a collaborative -based siting consortia with $26M in funding to universities, nonprofits, and private-sector entities. Entities such as Holtec are actively engaged in consolidated interim storage development.

SNF from Advanced Reactors:

Advanced reactors offer opportunities to change the conversation about SNF. The characteristics of advanced reactor waste will vary depending on the reactor design. The fuel cycle of advanced reactors varies, too, which affects the SNF generated. Oklo, for example, plans to run its reactors on fuel recycled from existing SNF stockpiles. Additionally, advanced reactor designs generally offer greater efficiency and better utilization of nuclear fuel, which can reduce the rate at which SNF is generated per unit of nuclear energy produced.

The NIA report, *From Reactors to Repositories: Disposal Pathways for Advanced Reactor Wastes* characterizes the various waste streams that will be generated by advanced nuclear reactors and examines both interim storage and permanent disposal pathways. The graphic below summarizes these SNF forms. For more information on these SNF forms, along with details regarding their interim storage and permanent disposal considerations, see the full report or its summary for policymakers.

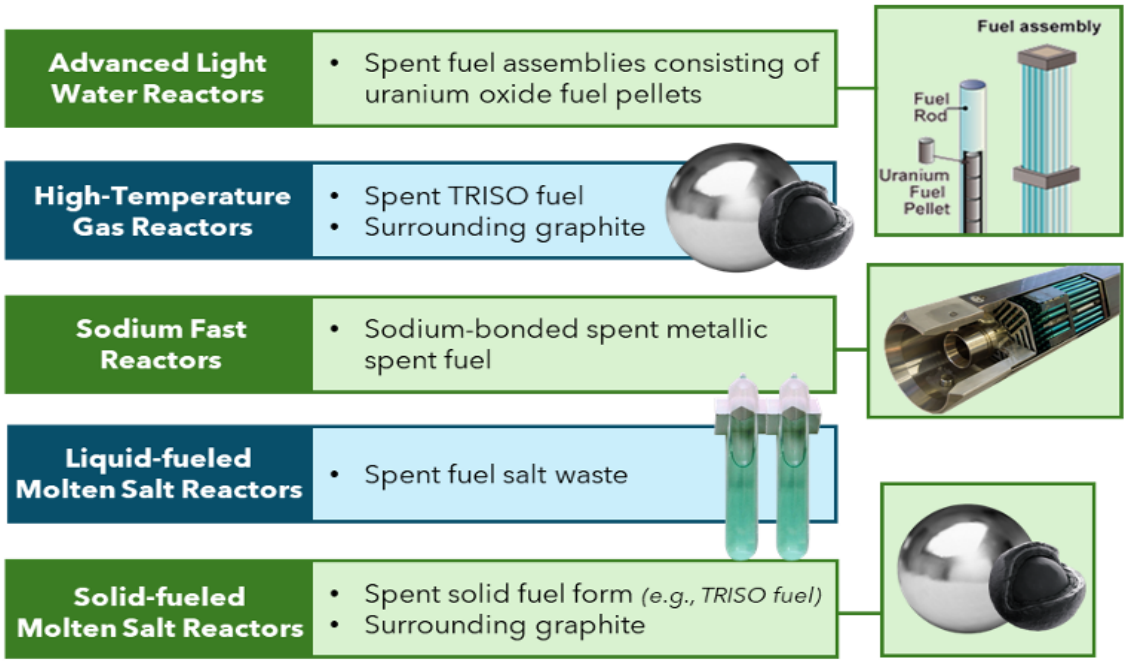


Figure 1: Spent nuclear fuel generated by several advanced reactor technologies. Source: ***NIA***

Additionally, some advanced reactors may also have the potential to reduce the lifetime of their SNF. Certain advanced reactor designs and fuel cycles can turn highly radioactive elements in SNF with extremely long half-lives into elements with much shorter half-lives. As a result, these designs could produce SNF that is radioactive for shorter time periods, which would significantly simplify the design and siting requirements for SNF disposal facilities. The SNF generated by different advanced reactor types will vary. The United States is well-positioned to manage advanced reactor waste in the near and intermediate term, but a permanent repository is still needed.

Conclusion:

Existing SNF is the byproduct of generating nearly one fifth of the United States' electricity and nearly half of its clean energy, and the quantity of SNF is very small relative to the energy produced. SNF is safely stored at existing nuclear power plant sites across the United States. Recent studies indicate that SNF from advanced nuclear reactors will be comparable to SNF generated by the existing conventional nuclear fleet in terms of quantity, but there will be differences in the physical, chemical and radiological properties of advanced reactor SNF. Broadly speaking, waste management of advanced reactor waste will generally look the same as it does for conventional reactors, but the specific waste management strategies we use must be tailored to the specific waste being managed. The United States has a long history of safely managing SNF, and our current waste management system is well equipped to handle SNF from advanced nuclear reactors as they are deployed towards the end of this decade, and beyond.