INL, R&D, and Commercial Fuel

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www.inl.gov

Idaho National Laboratory

Goal: Provide Background on Proposed Commercial Fuel R&D at INL

The Idaho National Laboratory

International Intellectual Leadership

Building a Laboratory

National Reactor Testing Station

1949

Energy Mission – Reactor Science, Safety and Sustainability Solutions

1974

Environmental Management Mission

1997

Argonne NATIONAL LABORATORY- WEST

INEEL & ANL-W combined to create the new Idaho National Laboratory

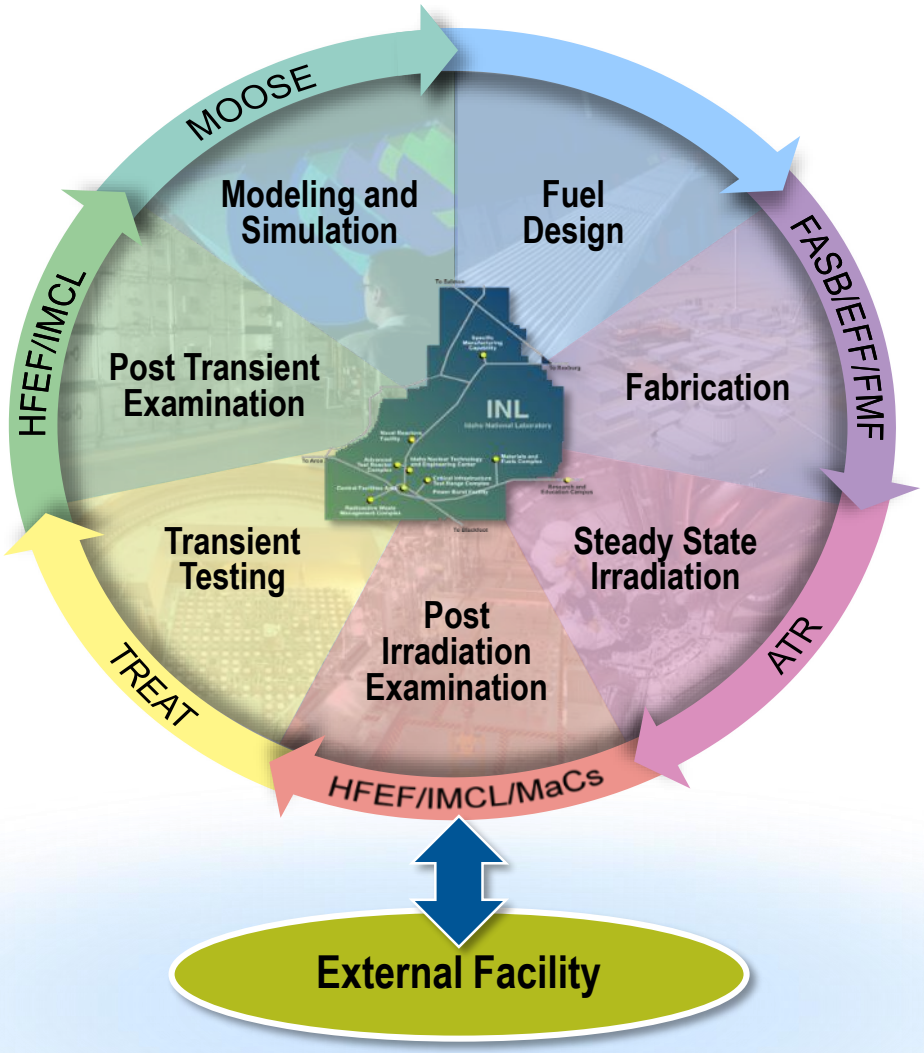
- Nuclear Energy
- National and Homeland Security
- Energy and Environment

2005

- Nuclear Energy Advancement
- Infrastructure Protection
- Clean Energy Demonstration

2015

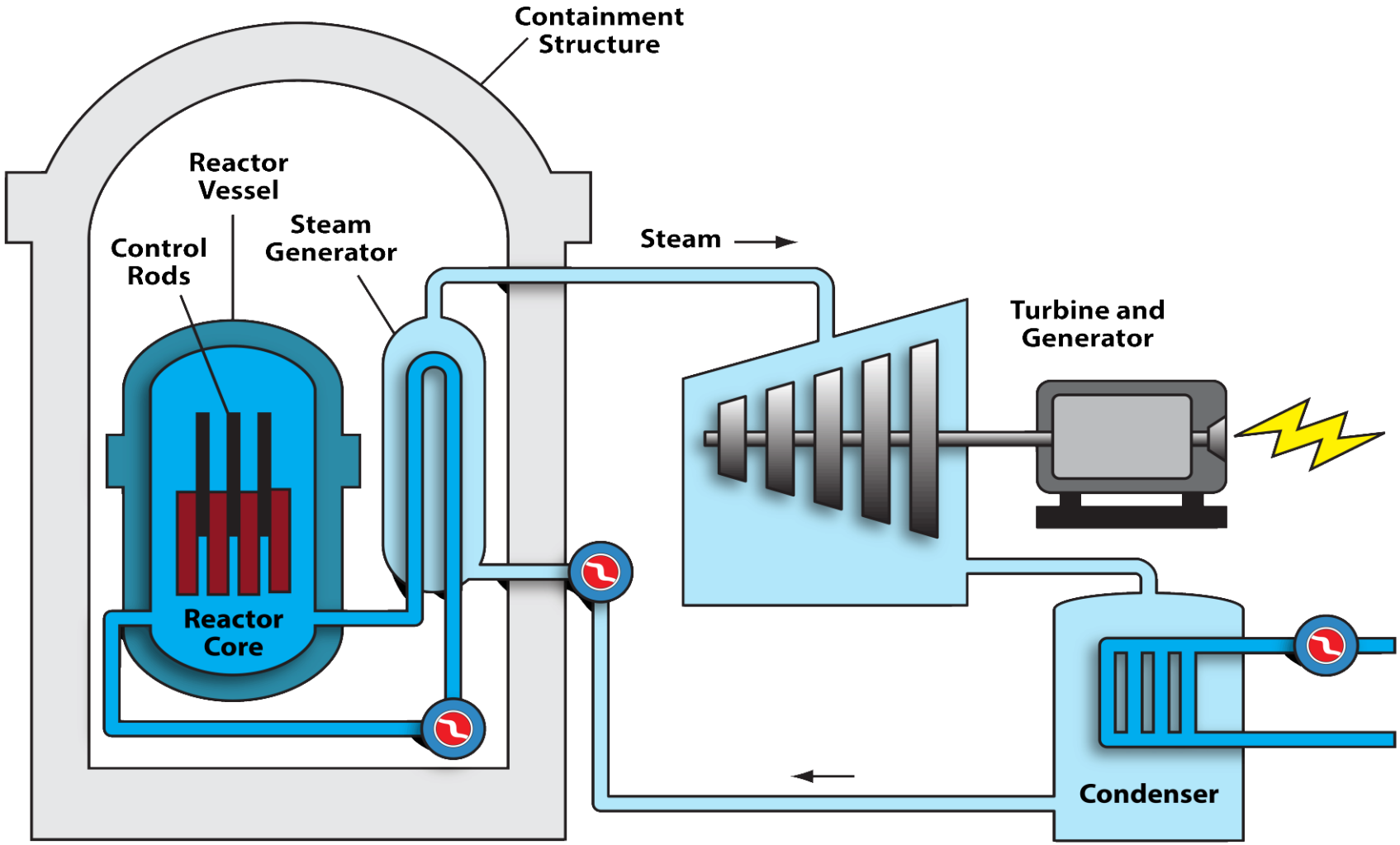
INL Fuel Analysis Capability



National R&D Questions

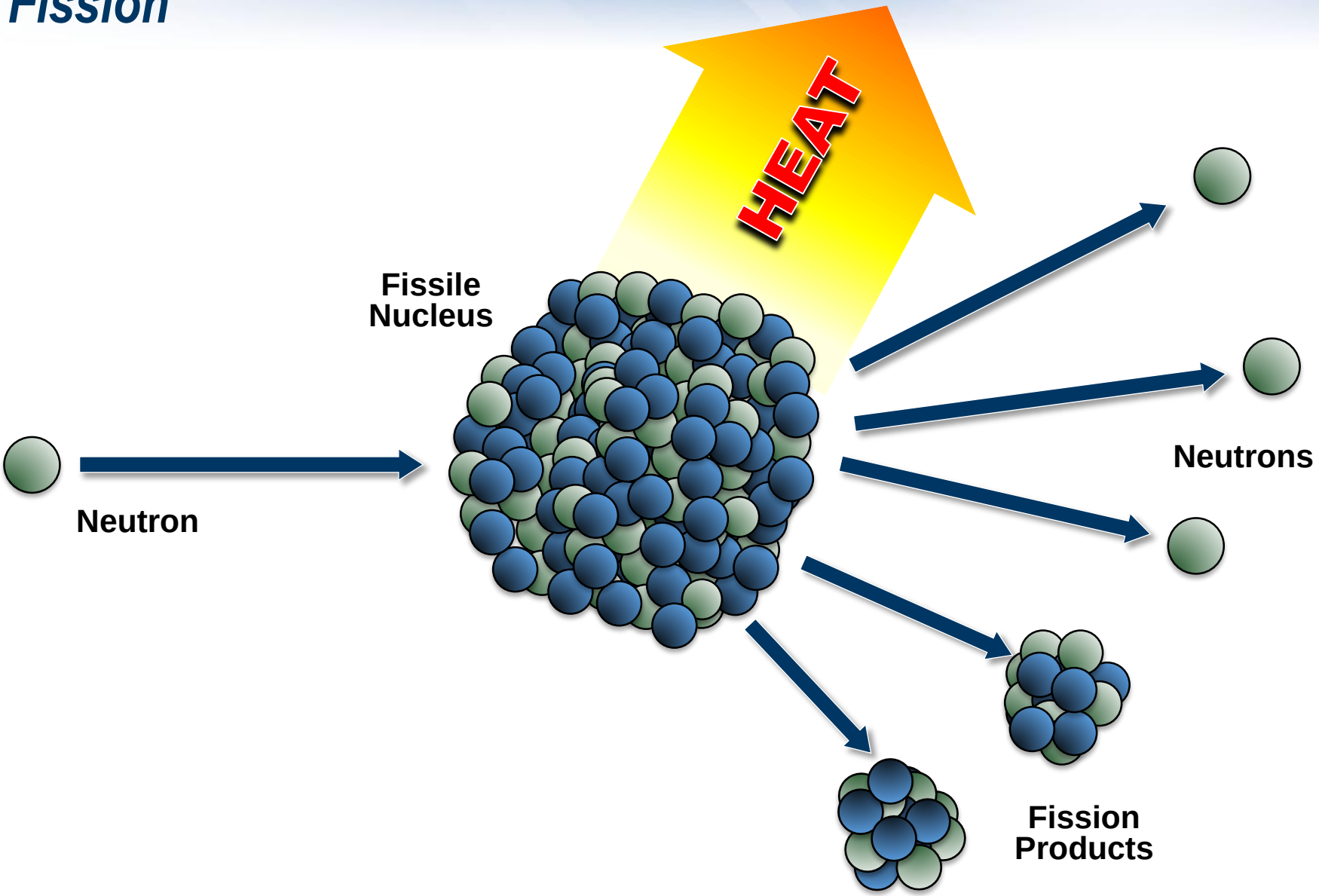
A Very Short Lecture on Nuclear Energy

Nuclear Fuel

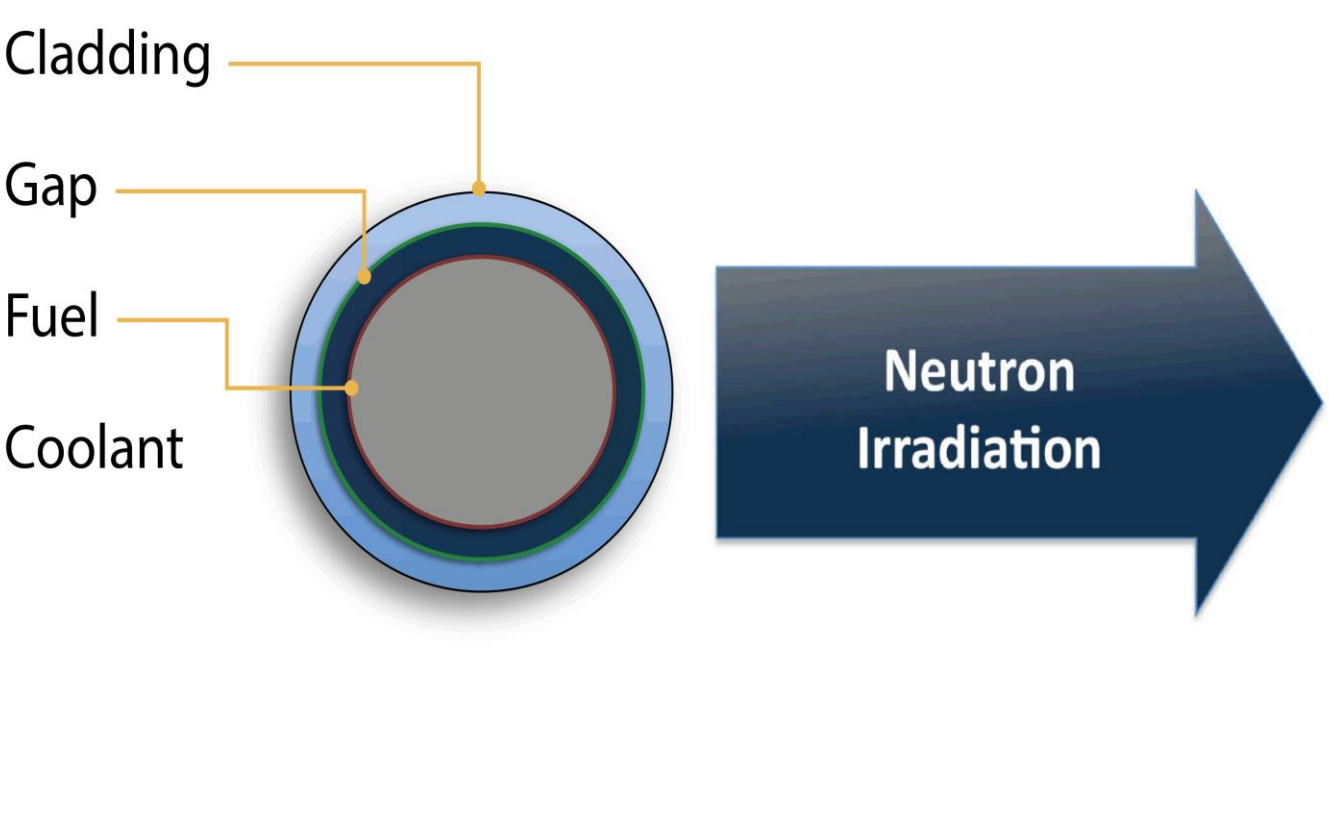


Reactor

Fission

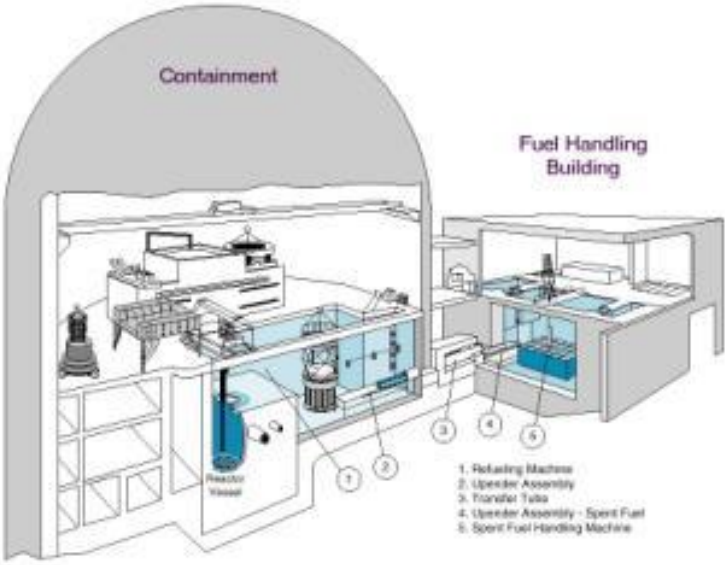


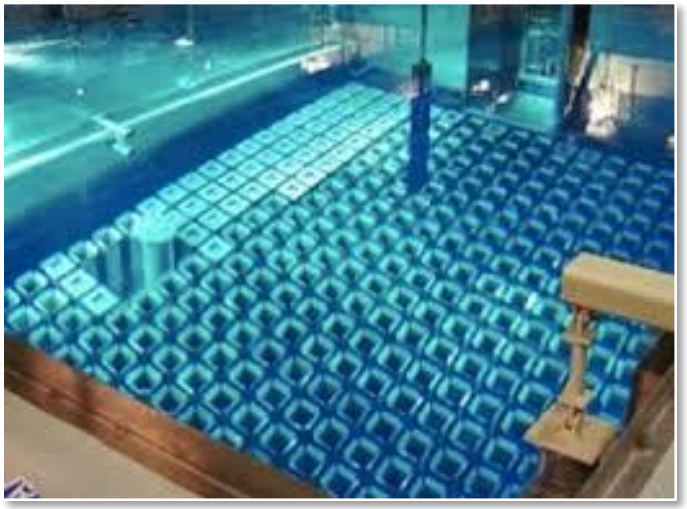
Changes to Fuel



Dry Cask Storage of Fuel

Fuel Storage





Dry Storage System Safety Requirements

- **Thermal performance:** the storage system shall be designed to ensure peak temperature limits are not exceeded.
- **Radiological protection:** peak dose limits shall not be exceeded.
- **Confinement:** SNF and HLW shall be confined such that radioactive gases and particulates shall not be released to the environment.
- **Sub-criticality:** shall be maintained under all normal and off-normal conditions of storage.
- **Retrievability:** the SNF in storage shall be able to be retrieved by normal means (i.e., crane and grapple).

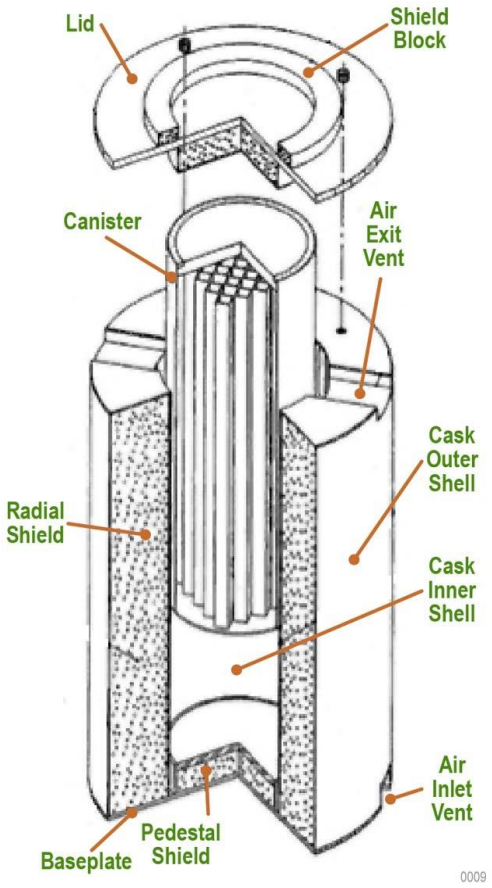


Figure 1-3: Example of a Welded Metal SNF Storage Canister Inside a Concrete Overpack (Cross Section of the HI-STORM 100 Overpack with MPC [NRC 2001]).

Dry Storage of Spent Nuclear Fuel

- Lower burnup SNF [less than 45 gigawatt days per metric ton uranium (GWD/MTU)] storage has occurred in the United States (U.S.) since 1986
- Dry storage of high burnup SNF has been more recent.
- As of December 2012, approximately 200 dry storage casks have been loaded with at least some high burnup SNF. Furthermore, almost all SNF being loaded in the U.S. is now high burnup.
- Since high burnup SNF has different mechanical properties than lower burnup SNF, industry needs additional data on high burnup SNF under typical conditions.

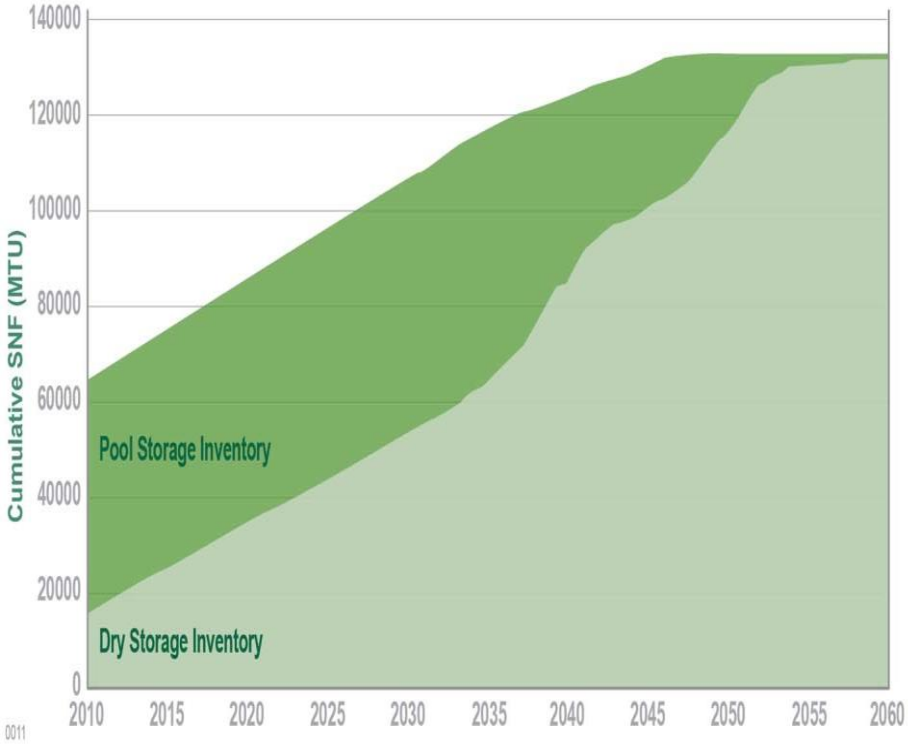
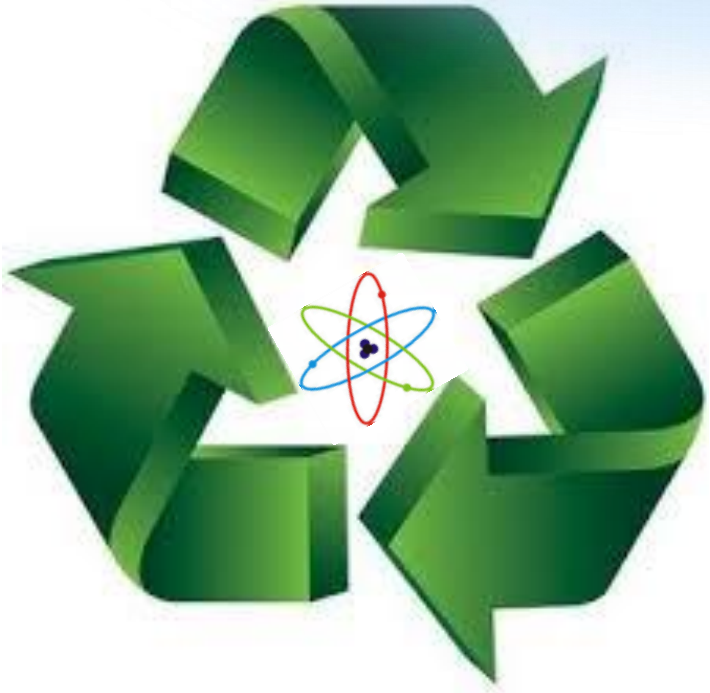


Figure 1-1: Projected SNF Inventory in Wet and Dry Storage in the U.S. [produced for EPRI by Energy Resources International, EPRI 2010].

Recycling

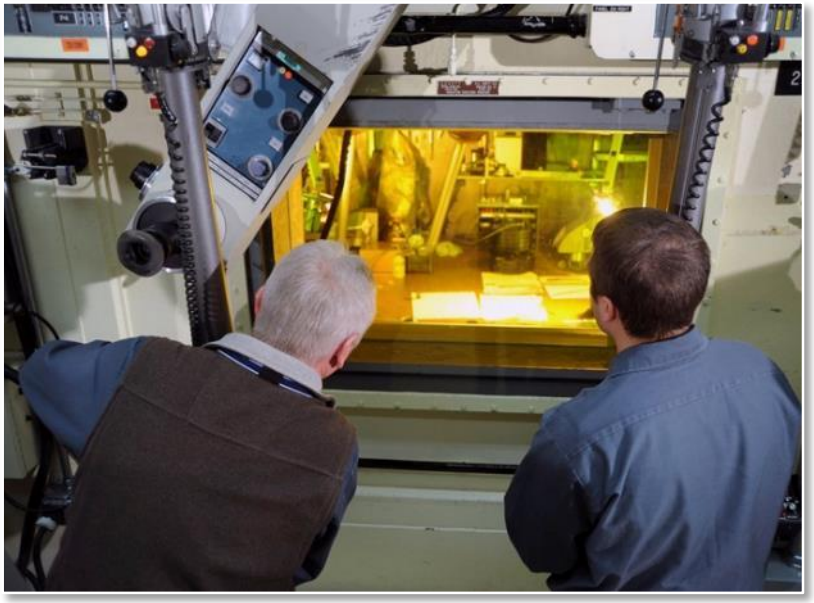


Electrochemical Recycling

- **Electrochemical recycling is a process using a molten salt for the recovery of still usable uranium and transuranic elements from used nuclear fuel.**
- **In the United States this work is primarily performed at Idaho National Laboratory and Argonne National Laboratory.**
- **Heart of the separation process is electrorefining, a process also used to produce a variety of commercial metals.**

Why Electrochemical Processes?

- A number of nations (India, China, Korea, Japan, UK, EU, and Russia) are now pursuing this technology for eventual deployment.
- We need to continue to be the leaders in the technology, including the development of effective safeguards.
- Our work is therefore focused on evaluating the technology for application to the management of used light water reactor fuel to produce fuel for advanced reactors.
- We are assessing the technical and economic feasibility and nonproliferation acceptability of the fuel cycle.



How much fuel?

Characteristics of Commercial Fuel

By the numbers:

2 Shipments

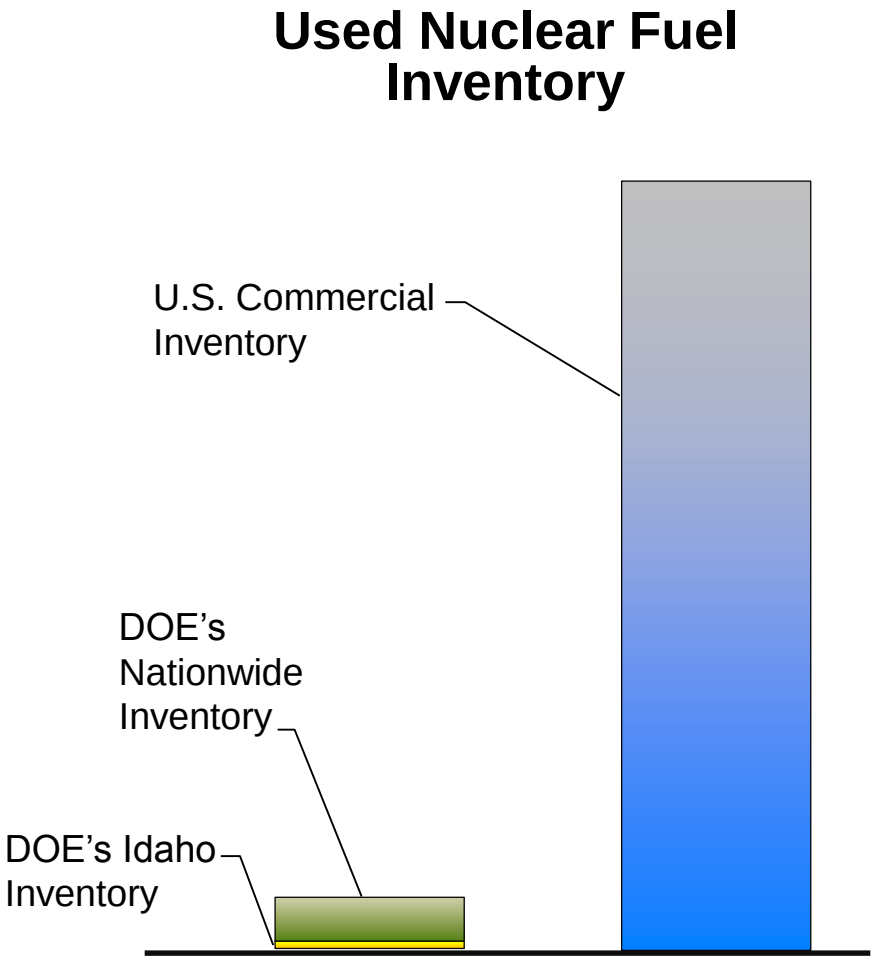
50 Fuel rods

4 Pounds per fuel rod

200 Total pounds of material

50 Years of experience in fuel research at INL

Used Nuclear Fuel



INL Fuel Transportation and Storage

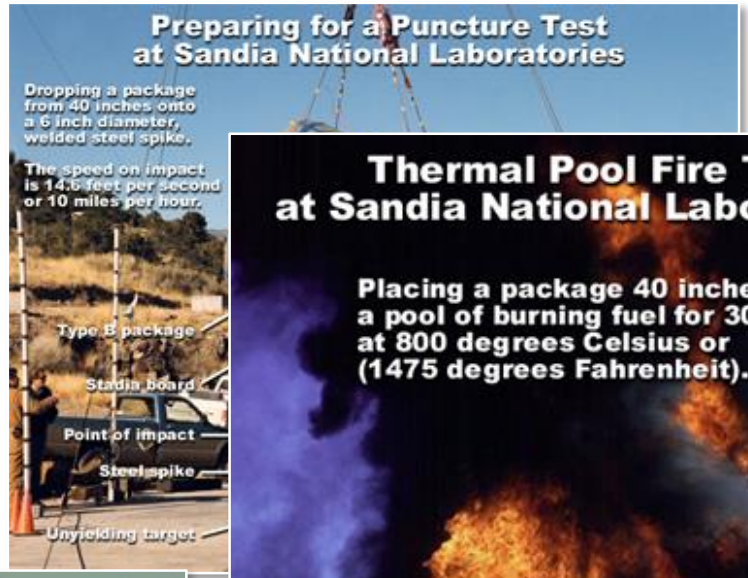
Transportation

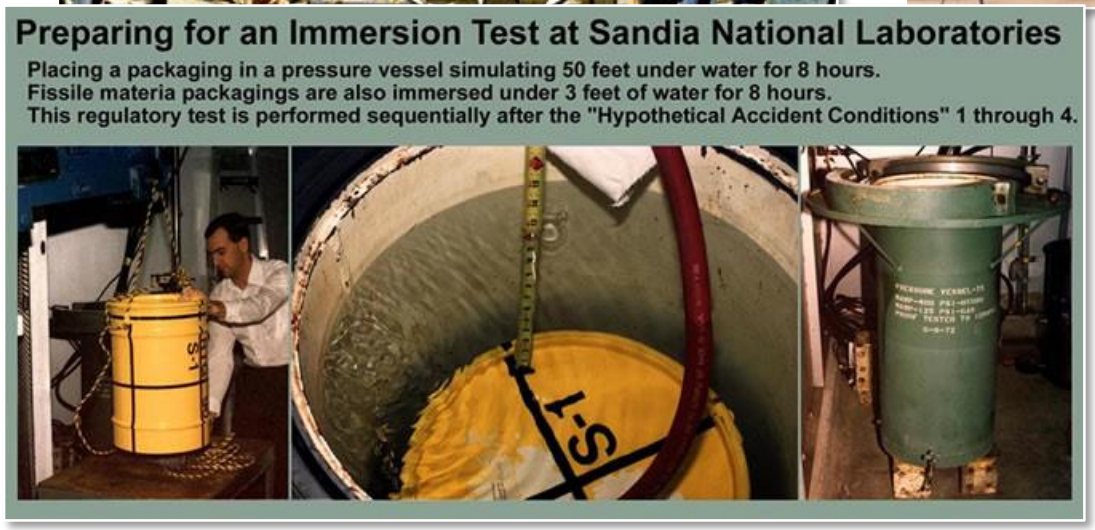
The inside of the NAC-LWT ISO container showing the substantial cradle that holds the cask.

Transportation

NAC-LWT loaded for transport. Not shown are the impact limiters that cover the two ends (the top and the bottom of the cask)

Transportation Cask Testing





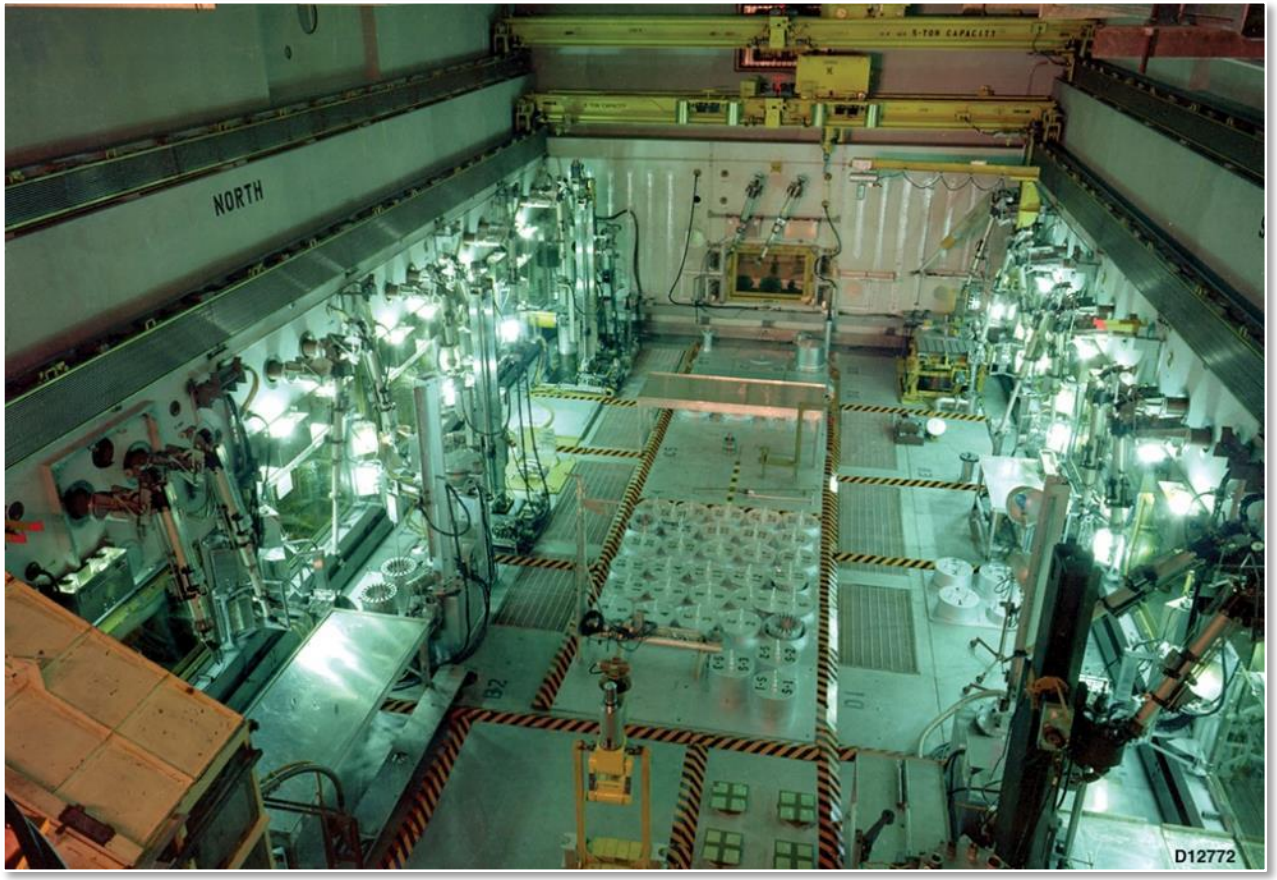
http://www.mcnucprojects.com/transportation.htm

Transportation

This picture shows the cask being loaded (or unloaded) from the ISO container in the HFEF truck lock.

Hot Cell

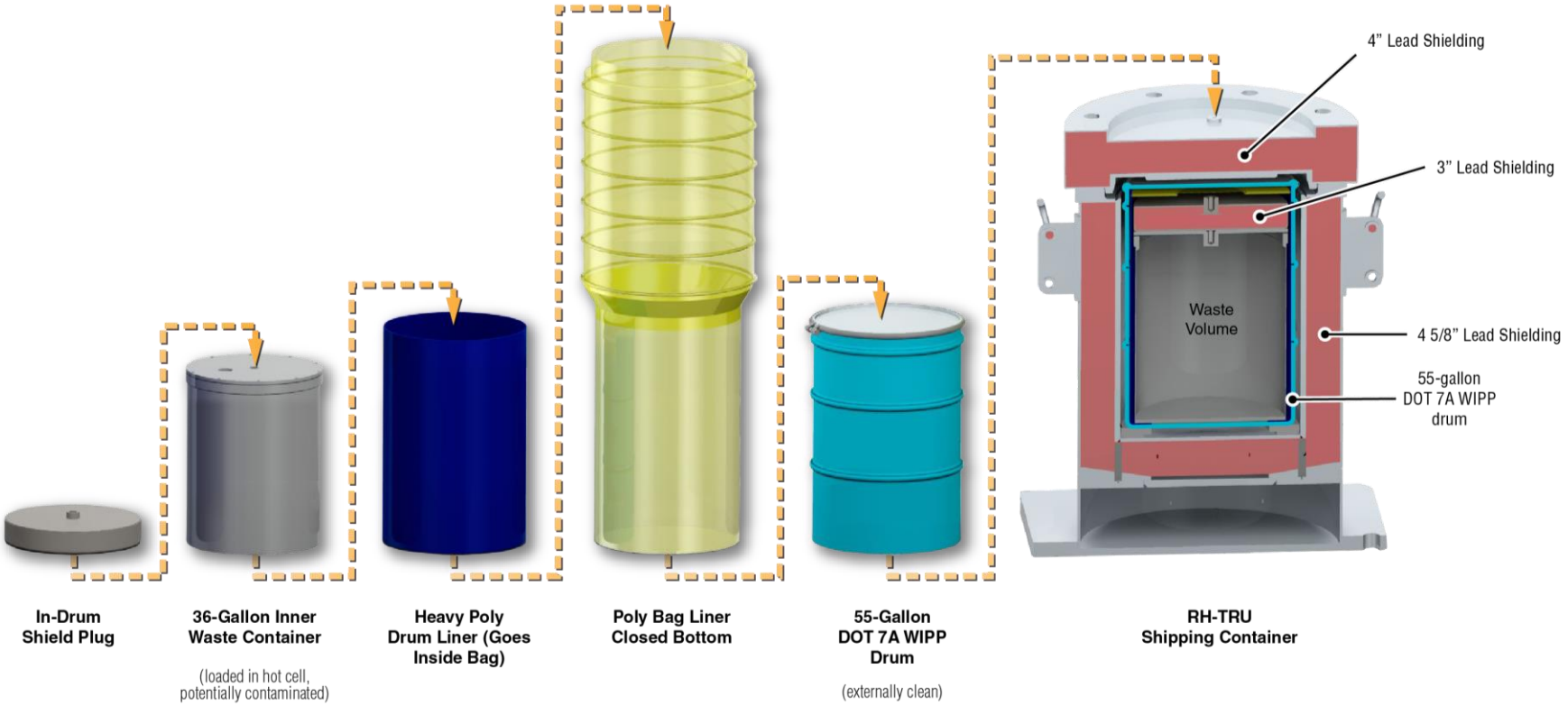
- **Fuel is examined in a hot cell**



Hot Fuels Examination Facility

Moving Radioactive Material Example

Remote-handled transuranic waste (RH-TRU) packaging



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