U.S. DEPARTMENT OF ENERGY | OFFICE OF ENVIRONMENTAL MANAGEMENT

Presentation to the
Governor's Nuclear Advisory Council

Potential Acceptance and Disposition of German Pebble Bed Research Reactor Highly Enriched Uranium (HEU) Fuel Environmental Assessment

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Presentation Outline

- **National Environmental Policy Act (NEPA) process for the German Pebble Bed Reactor fuel.**

- **Background and status of EM's efforts on the study regarding the feasibility of acceptance and disposition of German graphite-based used nuclear fuel at the Savannah River Site (SRS)**

- **Public comments**

Background

- **US Policy is to reduce the amount of HEU available in the world thus, eliminating the potential for the material to be used for an improvised nuclear device, a radiological dispersal device, or other radiological exposure device.**

- **German Pebble Bed Reactor Fuel under consideration is approximately 1 million graphite spheres stored in Jülich and Ahaus, Germany containing ~900 kg of highly enriched uranium (HEU) from US**

- **At request of German government, EM is conducting a feasibility evaluation for possible acceptance, return to SRS, and alternatives for disposition**
  - German government has urgency to de-inventory fuel at Jülich by June 2016; de-inventory of fuel at Ahaus also under consideration
  - Research and Development (R&D) at Savannah River National Laboratory (SRNL), in collaboration with Forschungszentrum Jülich (FZJ), provides a means for graphite removal from the fuel kernels without the development of graphite fines as seen in mechanical graphite removal methods.

- **Environmental Assessment is being conducted to evaluate impacts of return of this US Origin material at the Savannah River Site and alternatives for disposition.**

NEPA Process for German HEU Fuel Environmental Assessment (EA)

- **This EA is being prepared as required by NEPA**

- **Published Notice of Intent to prepare the German HEU Fuel EA (DOE/EA-1977) in June 4, 2014 *Federal Register;* this begins the NEPA process**

NEPA

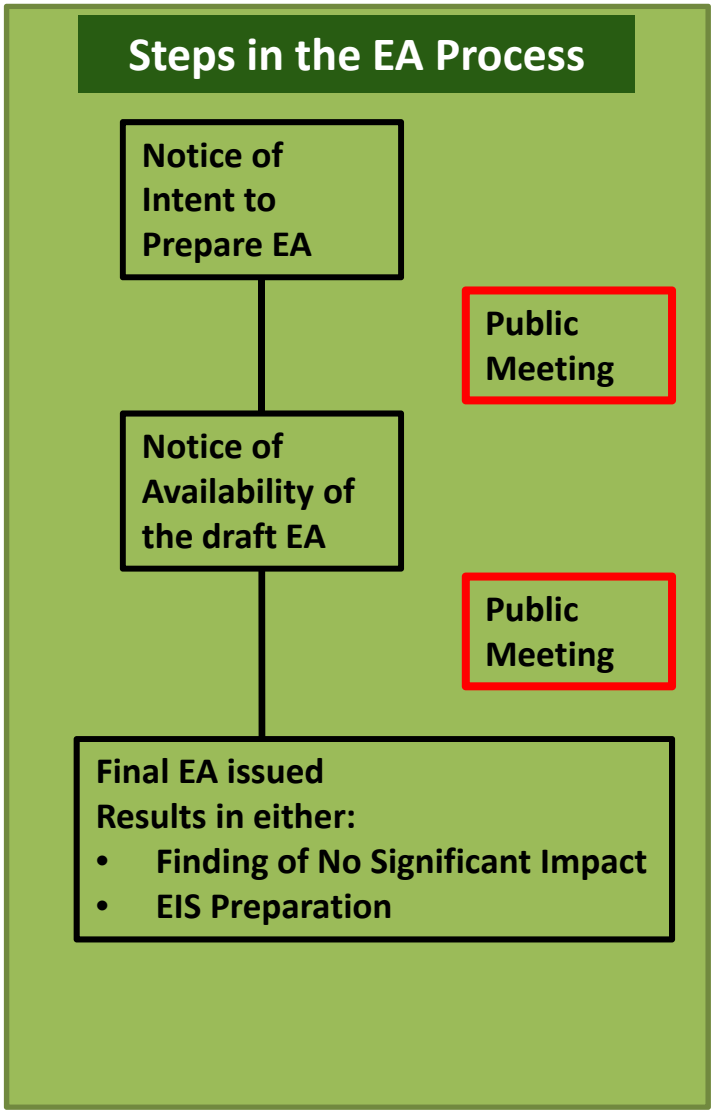
The National Environmental Policy Act establishes a process for decisionmakers to use in considering the potential environmental impacts (both positive and negative) of major actions before making decisions.

It requires a Federal agency to consider the potential environmental, human health, and socioeconomic effects of a proposed action and a range of reasonable alternatives for implementing the action, including the option of taking no action at all.

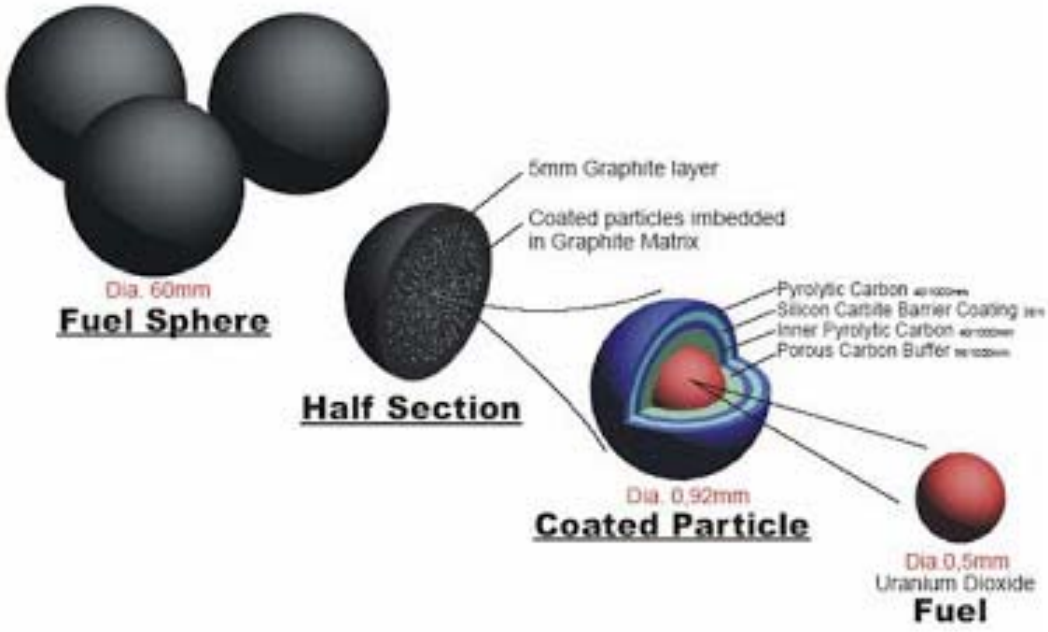
About Tonight's Meeting

- **DOE is taking the opportunity to collect public comments for consideration in the development of the EA for the German HEU Fuel**

- **Another public meeting will be held after the draft EA is released for comments.**



Composition of German HEU Fuel



- **Approx. 1 million, 60mm graphite spheres**
- **Characteristics of a Sphere:**
  - ~ 200 g of A3-3 graphite
  - 1g of Uranium, ~93% enriched
  - 10g of Thorium
- **Currently Stored in 455 CASTOR casks:**
  - AVR, (Jülich
  - THTR-300 (Ahaus)

Source of Material

- **US origin HEU material was provided for purposes of peaceful uses and development of nuclear energy**
  - Explored the use of coated fuel particles embedded in graphite spheres, used in pebble-bed reactors, cooled by helium (high temperature gas-cooled reactor, HTGRs)
- **Used in two reactors in Germany**
  - AVR Reactor (*1967-1988*) was the first high temperature reactor in Germany to test the technology of graphite spheres
  - THTR-300 (*1983-1989*) was a demonstration research reactor to prove the AVR concept design to produce electricity

AVR Research Reactor, 15MW(e), Jülich

THTR-300, Prototype Research Reactor, 300 MW(e), Hamm-Uentrop

graphite UNF spheres

CASTOR Cask

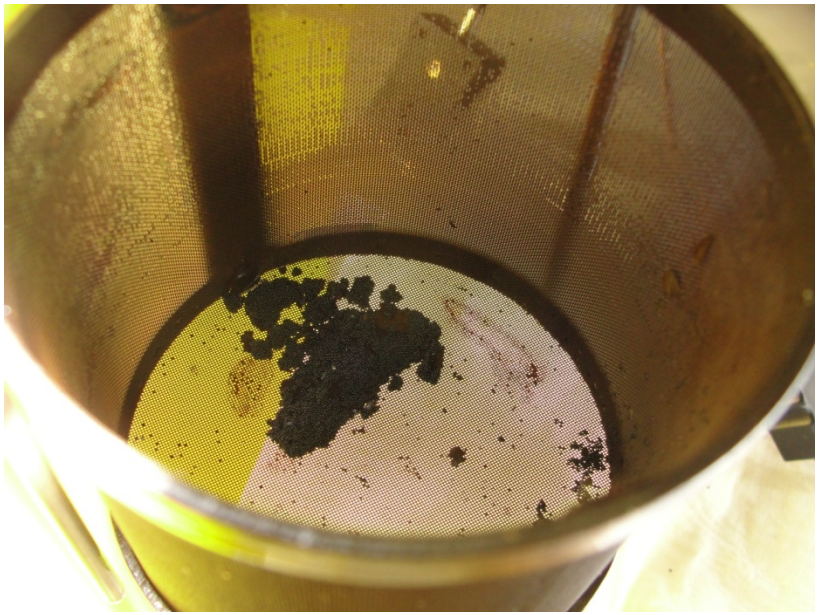
- Casks are certified in Germany by the German equivalent to the US Nuclear Regulatory Commission (NRC)
- Casks are being reviewed for acceptance as DOE/US Department of Transportation (DOT) - certified Type B Casks.

CASTOR Cask cut away

Efforts to Date

- **Separation of fuel kernels from the graphite matrix was a concern for processing**
- **Funding for Research and Development (R&D) was provided by Forschungszentrum Jülich (FZJ).**
- **Savannah River National Laboratory (SRNL) R&D focused on chemical digestion of the graphite, results to date are very successful**
- **Next research steps are to validate the technologies for scale-up and optimization.**
- **Environmental Assessment will be conducted on the options for the German Pebble Bed Reactor fuel if it is returned to the United States.**

SRNL R&D Results



Basket with Recovered Fuel

Recovered Fuel from Digested Pebble

Alternatives being evaluated

- **No action**

- **Options for Disposition of the Uranium after receipt, storage and chemical digestion of the graphite:**

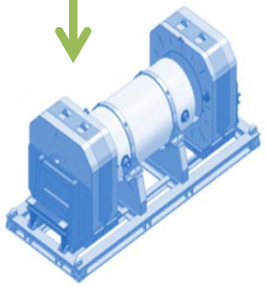
  1) **Dissolution, purification, and down blending the highly enriched uranium to low-enriched uranium for reuse as a reactor fuel**

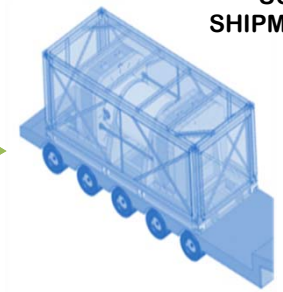
  2) **Vitrification in a High Level Waste Processing Facility at SRS with disposal of waste without down blending**

  3) **Separating the uranium, down blending to LEU, solidifying, and sending the uranium as waste to an appropriate uranium disposal site**

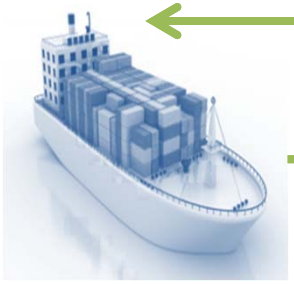
German Research Reactor HEU Fuel Potential Disposition Options
Common Processes

GRAPHITE SPHERES STORED IN CASTOR CASKS (GERMANY)





TRANSPORTATION CONTAINERS FOR CASTOR CASKS USED FOR SHIPMENT TO U.S.

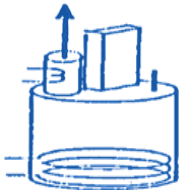


SHIP TO U.S.

CONTAINERS TRANSPORTED BY RAIL TO SAVANNAH RIVER SITE FOR SAFE STORAGE

CARBON DIGESTION VESSEL (SEPARATES FUEL AND GRAPHITE MATRIX)

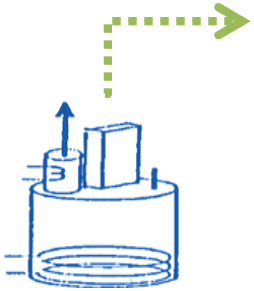
HEU KERNELS; >95% Vol. REDUCTION



KERNEL DISSOLUTION /PURIFICATION

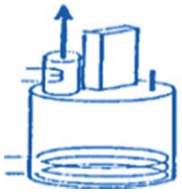
DISPOSITION OPTIONS

Option 1: Downblend for Reuse

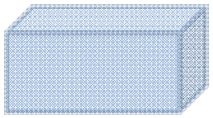


KERNEL DISSOLUTION
/PURIFICATION

FISSION PRODUCTS



HLW PROCESSING
FACILITY



STORAGE AWAITING REPOSITORY

HEU +

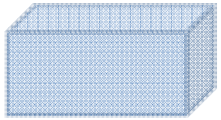
NATURAL or DEPLETED
URANIUM
(DOWNBLENDING)

LEU PRODUCT

VENDOR

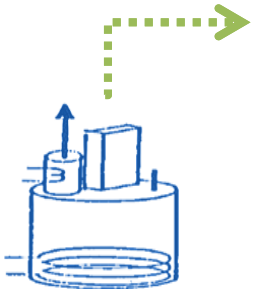
THORIUM

SALT SOLUTION



WASTE DISPOSAL FACILITIES

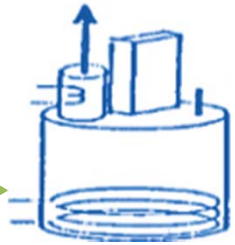
Option 2: Vitrification in a HLW Facility - No Downblend



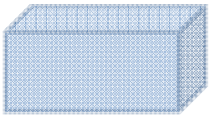
KERNEL DISSOLUTION /PURIFICATION

HEU + THORIUM +

FISSION PRODUCTS

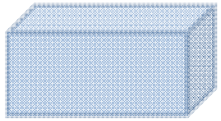


HLW PROCESSING FACILITY



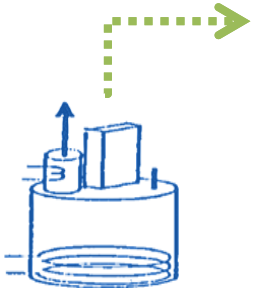
STORAGE AWAITING REPOSITORY

SALT SOLUTION



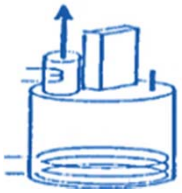
WASTE DISPOSAL FACILITY

Option 3: Separate Uranium, Downblend, Solidify and Disposal

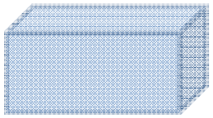


KERNEL DISSOLUTION /PURIFICATION

FISSION PRODUCTS



HLW PROCESSING FACILITY



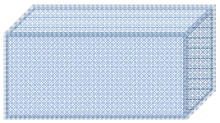
STORAGE AWAITING REPOSITORY

HEU +

NATURAL or DEPLETED URANIUM **(DOWNBLENDING)**

LEU

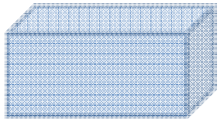
SOLIDIFY



WASTE DISPOSAL FACILITY

THORIUM

SALT SOLUTION



WASTE DISPOSAL FACILITIES

Scope of the German HEU Fuel EA

- **German HEU Fuel EA will consider:**
  - Transportation
  - Receipt and storage of the UNF
  - Carbon digestion (SRNL technology)
  - Processing of the fuel kernels
  - Material Disposition
  - Waste Management

Areas to be Analyzed

(not all inclusive - listed only to facilitate comment on the scope of the EA)

- **Impacts to general population and workers**
- **Impacts of emissions on air and water quality**
- **Impacts on ecological systems and threatened and endangered species**
- **Impacts on waste management activities**
- **Impacts on transportation of radioactive materials, including transport across the ocean**
- **Impacts that could occur as a result of postulated accidents and intentional destructive acts (terrorist actions and sabotage)**
- **Potential disproportionately high and adverse effects on low-income and minority populations (environmental justice).**
- **Short and long term land use impacts, including potential impacts of disposal**
- **Cumulative impacts**
- **Socioeconomic effects**

Summary

- The return of this material supports the US HEU minimization objective by removing the US origin HEU from Germany and returning it to the US for safe storage and disposition in a form no longer usable for an improvised nuclear device, a radiological dispersal device, or other radiological exposure device.
- This work would be done at SRS and funded by Germany
- Public involvement is an important component in DOE's decision making process

How to Provide Your Comments

Court Reporter

If you provide oral comments tonight, a court reporter will record your comments

Comment Form

Comment forms are available in the registration area. If you would like to provide written comments on the scope of the German HEU Fuel EA, please use the comment form and drop it off at the registration table when you leave. Alternatively, you may mail, e-mail, or fax your comments to the Department of Energy at the addresses below.

E-Mail

You may submit your comments electronically to drew.grainger@srs.gov

Fascimile

The toll-free fax number to submit your comments is 1-800-865-0277

U. S. Mail

Written comments on the scope of the German Pebble Bed Reactor Fuel Environmental Assessment should b e submitted to the Department of Energy at the following address:

Drew Grainger, NEPA Compliance Officer
German HEU Fuel Environmental Assessment
U. S. Department of Energy
P.O. Box A
Aiken, South Carolina 29802