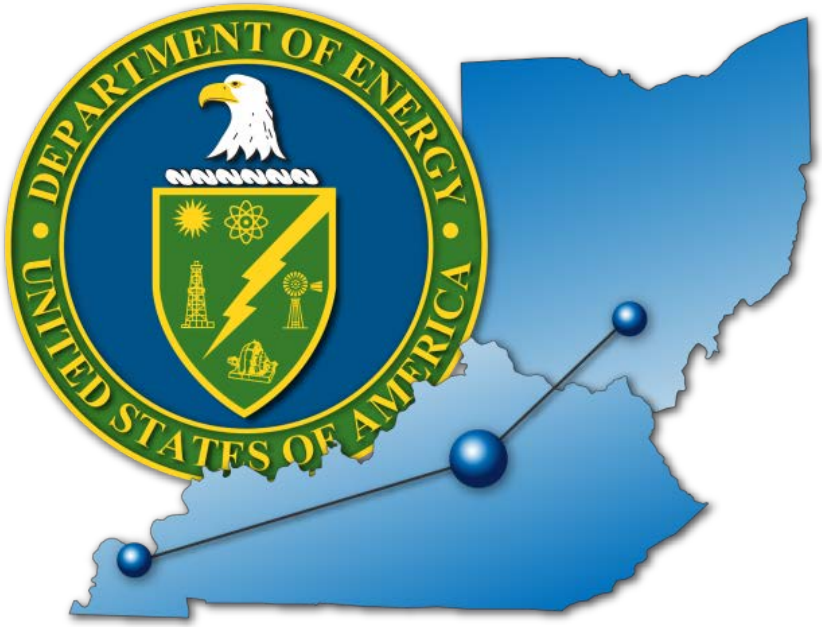
Portsmouth/Paducah Project Office (PPPO)



Midwestern Radioactive Materials Transportation Committee Meeting

Depleted Uranium Hexafluoride Conversion Project Overview

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December 14, 2017

Background

- Three Gaseous Diffusion Plants (GDP) conducted uranium enrichment activities in Portsmouth, OH, Paducah, Kentucky, and Oak Ridge, Tennessee.
  - Sites chosen for uranium enrichment for national security applications in the early 1950's
  - The sites are Cold War facilities that are nearing or at the end of their lifecycle. GDP reservations currently being analyzed for future use scenarios.
  - The East Tennessee Technology Park (ETTP) in Oak Ridge D&D is nearly complete
  - Portsmouth and Paducah Gaseous Diffusion Plants are undergoing D&D currently

COLD WAR	POST COLD WAR - Commercial Power	POST COLD WAR - Environmental
1952-1989	1989-2013	1989-Current
Nuclear Defense	Commercial Nuclear Power	• Cleanup • Decontamination & Decommissioning • Reuse

PPPO Opens

- Portsmouth/Paducah Project Office (PPPO) established in 2002 to focus on Portsmouth and Paducah site cleanup activities
- Current missions:
  - Environmental remediation
  - Decontamination & Decommissioning
  - DUF_6 conversion operations and cylinder yard/cylinder management

Senator Jim Bunning joined then-PPPO Manager Bill Murphie in PPPO opening ceremony in Lexington.

- Part of cleanup is the safe conversion and disposition of the Department's inventory of depleted uranium hexafluoride (DUF_6) stored in ~66,500 steel cylinders

Paducah Site, Paducah, Kentucky

Paducah – Former Gaseous Diffusion Plant site is located in Western Kentucky (3,556-acre federal facility)

Portsmouth Site, Piketon, Ohio

Portsmouth – Former Gaseous Diffusion Plant site is located in South Central Ohio (3,777-acre federal facility)

DUF_6 Conversion Project

DUF_6 Conversion Project Mission

- Operate conversion facilities to safely convert DUF_6 into a more stable chemical form (oxide) for beneficial reuse or disposal thus reducing immediate and future risk to workers and surrounding community

Portsmouth

Paducah

DUF_6 Inventory

- DUF_6 results from ~50 years of uranium enrichment at the Department's Gaseous Diffusion Plants
- DUF_6 placed in cylinders for future DOE use/processing:
  - Further enrichment
  - Conversion to depleted uranium metal
- Cylinders previously stored at ETTP have been shipped to Portsmouth

Remaining Inventory

DOE Facility	# DUF_6 Cylinders
Paducah Gaseous Diffusion Plant	~43,000
Portsmouth Gaseous Diffusion Plant	~19,000
Total Number of Cylinders and Weight	**62,000** (~755K MT)

What Is a DUF_6 Cylinder?

- Typical size for a cylinder is four feet high (48 inches in diameter, ~12 feet long)
- 10-ton thick-walled cylinder weighs ~4,500 lbs. empty (can hold 20,000 lbs. of DUF_6)
- 14-ton thin-walled cylinder weighs 2,600 lbs. empty (can hold 28,000 lbs. of DUF_6)

Why Convert?

- DUF_6 cylinders routinely stored at GDP sites, but represents a potential hazard to workers and the public through inadvertent release of HF in event of cylinder breach
- DUF_6 is converted to uranium oxide (predominately U_3O_8), loaded into modified cylinders for on-site storage and eventual off-site disposal
- Uranium oxide is insoluble and does not react with either water or air
- Uranium oxide is a stable chemical form optimum for long-term storage and/or disposal

DUF_6 Project Timeline

Groundbreaking

PORTS Complete Construction

PORTS First DUF_6 Flow

Complete PORTS DUF_6 Conversion

D&D Following Ops

Ports Ops (~24 yrs)
~19,000 Cylinders Remaining

Follow-on Ops?

2004 2008 2010 2011 2034 2047

Pad Ops (~36 yrs)
~43,000 Cylinders Remaining

Follow-on Ops?

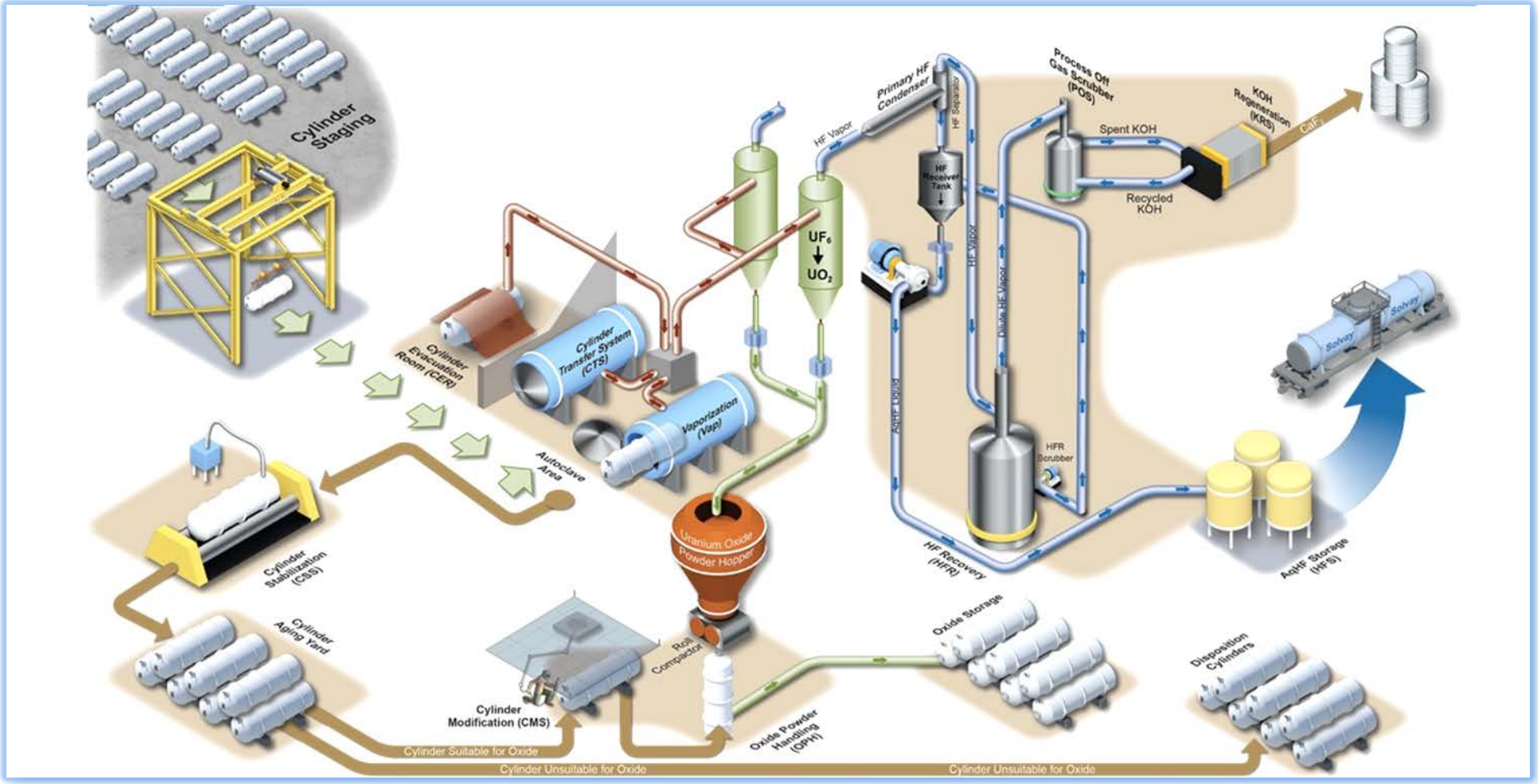
PAD Complete Construction

PAD First DUF_6 Flow

Complete PAD DUF_6 Conversion

D&D Following Ops

DUF_6 Conversion Process



DUF_6 Conversion Products

- Project conversion throughput goal - 31,500 MT DUF_6 per year:
  - 18,000 MT at Paducah
  - 13,500 MT at Portsmouth
- Conversion will generate two co-products:
  - *Oxide* which will fill approximately 3,000 cylinders per year:
    - 1,100/yr at Portsmouth
    - 1,900/yr at Paducah
  - *Aqueous Hydrofluoric Acid* which will fill approximately 145 rail tank cars per year (~2.9M gal):
    - ~55 tank cars/yr at Portsmouth (1.1M gal)
    - ~90 tank cars/yr at Paducah (1.8M gal)

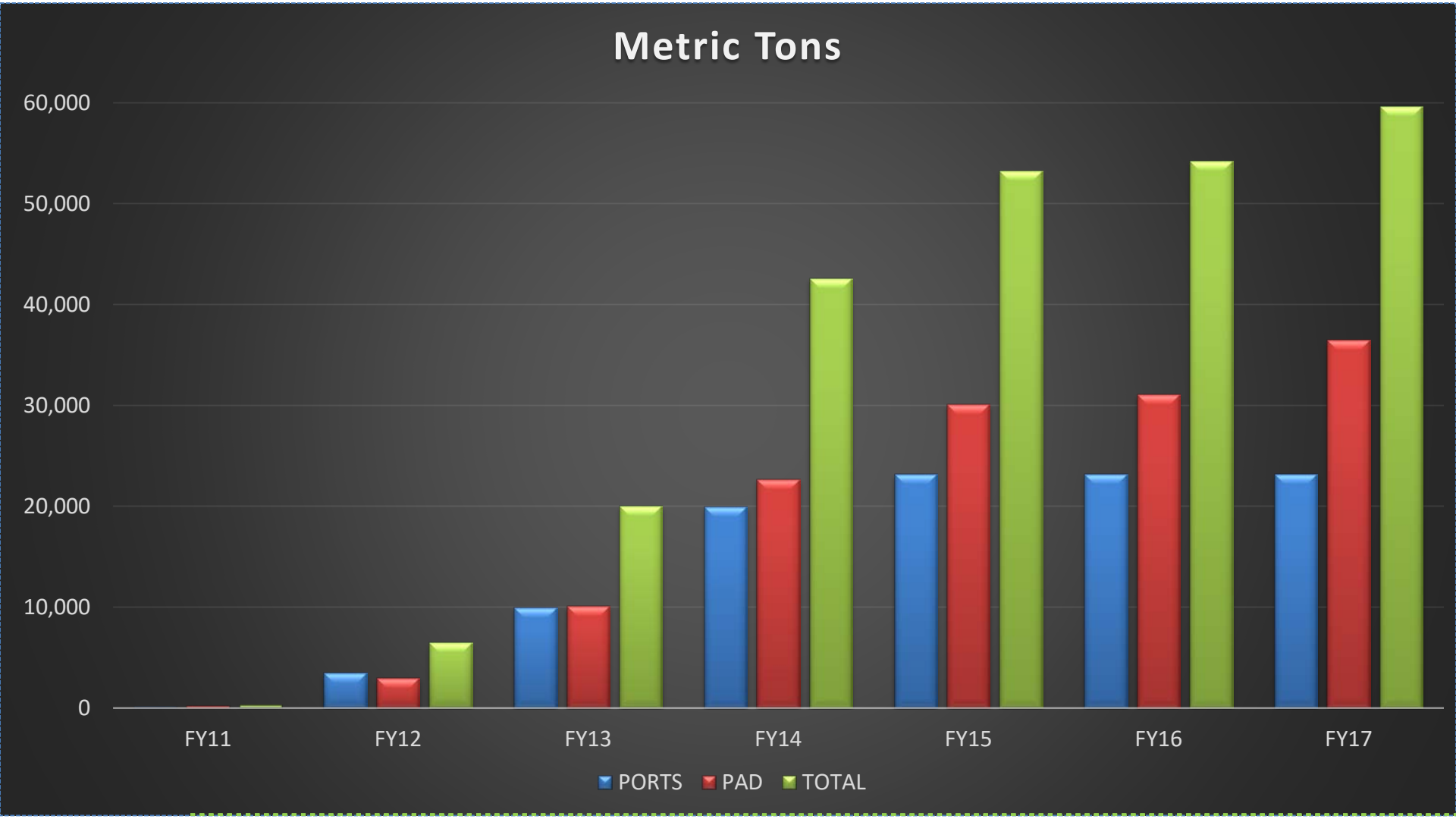
Uranium Oxide Packaging

- Cylinders used to store DUF_6 are modified with a flange on one end for filling with oxide and used as the shipping container
- Modified cylinders are inspected and certified as DOT compliant Industrial Packaging shipping containers prior to filling with oxide.
- Gondola railcars were modified for transportation of uranium oxide cylinders.

Unmodified Cylinder

Modified Cylinder

Cumulative DUF_6 Converted

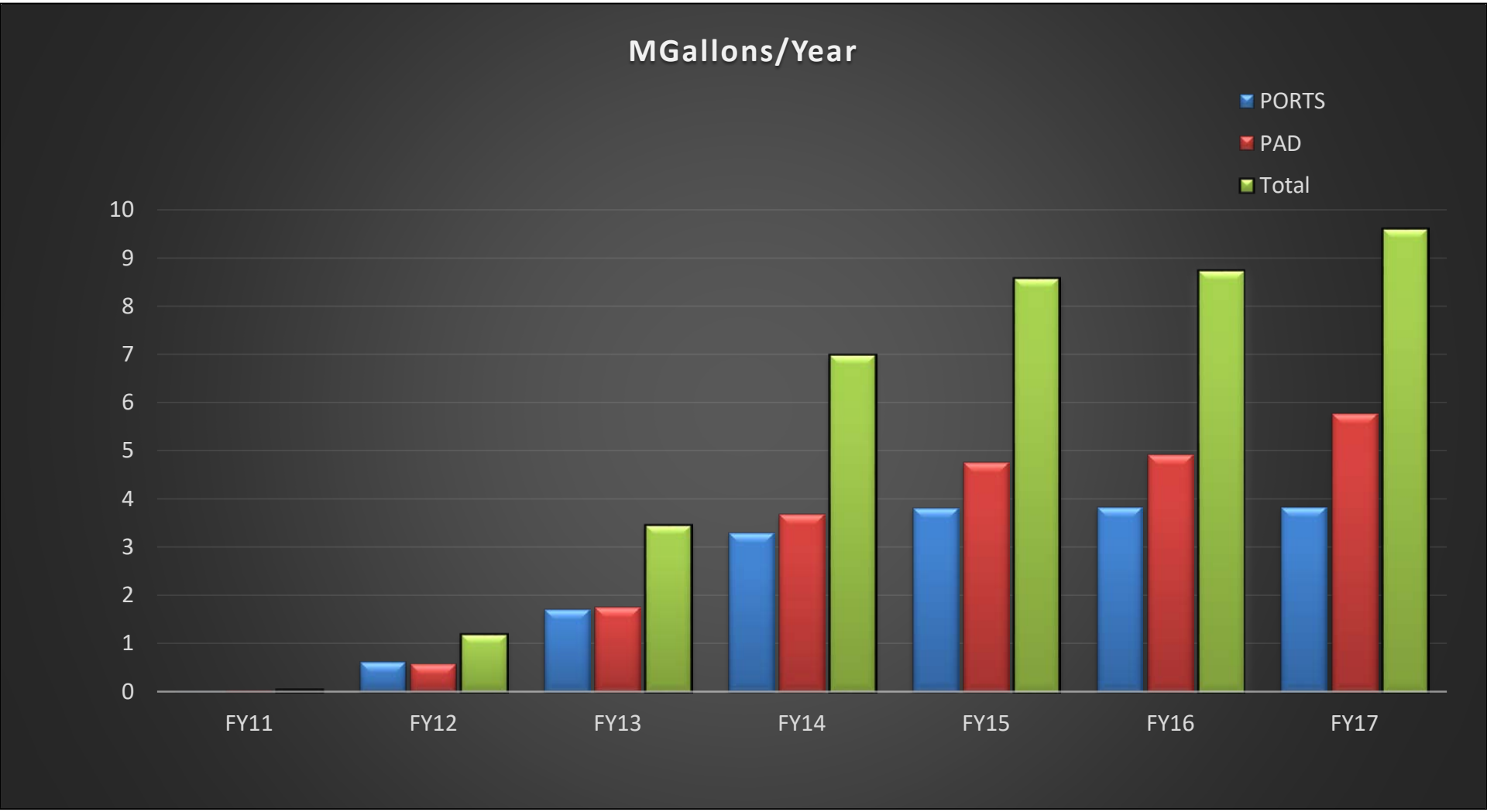


DUF_6 Converted/Oxide Cylinders Generated – Total To Date: 59,646 MT DUF_6 /~4,650 Cylinder Oxide

Aqueous Hydrofluoric Acid

- The desired form is a 49% HF/51% H_2O solution. An HF recovery system is employed to collect the HF for recycle into industry.
- Release and recycle of HF has significant benefits:
  - Avoids further processing and significant additional disposal costs of HF neutralization product calcium fluoride (CaF_2)
  - Beneficial Reuse from Resource Recovery
  - Off-sets a portion of operating costs

Cumulative HF Generated



Through September 2017 – 9,605,000 gallons of HF generated and recycled into commerce

DUF_6 Reuse

- DOE continues to seek reuse opportunities for the DUF_6 inventory, including processing to retrieve usable fissile uranium
- About 40% of the inventory is suitable for re-enrichment depending on market forces and use of current enrichment technology
- DOE has an agreement with a commercial company for re-enrichment using laser enrichment process should the company elect to proceed with construction of a facility

DUF_6 Reuse (cont.)

- DUF_6 resulting from re-enrichment would be returned to DOE inventory at Paducah which will extend conversion operations
- Conversion of DOE DUF_6 to oxide is currently restricted to that portion of the inventory that is not suitable for re-enrichment
- Converting the not suitable portion will take around 10 years at Portsmouth and 44 years at Paducah rather than 17 years and 27 years for the full Portsmouth and Paducah inventories

Regulatory - NEPA

Completion of the NEPA process is required prior to initiating transportation and disposal of converted oxide

- **Phase 1:** Programmatic Environmental Impact Statement assessed the potential impacts of alternative strategies for managing the DUF_6 – *completed 1999*
- **Phase 2:** Site-specific Final Environmental Impact Statements (FEIS) addressed potential environmental impacts from: 1) construction, operation, maintenance, and D&D of the conversion facilities; 2) transportation of conversion products to disposal facilities; and, 3) transportation, sale, use, or disposal of the HF – *completed 2004*
- **Phase 3:** Supplemental Environmental Impact Statement (SEIS) is updating the FEIS analyses to include the disposal facility Waste Control Specialist, Inc. (WCS). The original FEIS decision excluded WCS since they were not a licensed facility at the time – *ongoing*
- Following completion of the SEIS, the Project's Records of Decision will be amended

Preparing for Transportation

- Shipment information will be finalized following completion of NEPA analysis. Shipment information includes:
  - Communications Information
  - Emergency Planning/Notification/Response
  - Highway Routing
  - Rail Routing Interchange Points

Transportation Logistics

- Each filled uranium oxide cylinder weighs approximately 12 tons
- The project has 90 gondolas for transporting cylinders (40 cars/site with 10 reserve cars)
- Each gondola railcar will contain up to 6 cylinders
- Transport ~3,000 Cylinders/year
- Each gondola will be covered with hard fiberglass covers

Waste Control Specialists, LLC

Disposal facility's low level radioactive waste cell located in West Texas

- Direct rail shipment to disposal facility

Nevada National Security Site (NNSS)

Low level radioactive waste cell located in Southern Nevada

- **Requires a trans-load facility to truck in oxide cylinders.**
  - **Transfer cylinders from gondola railcars to truck for final delivery to NNSS**
  - **Due to gross weight of the uranium oxide filled cylinder, only one cylinder will be shipped per truck**

EnergySolutions

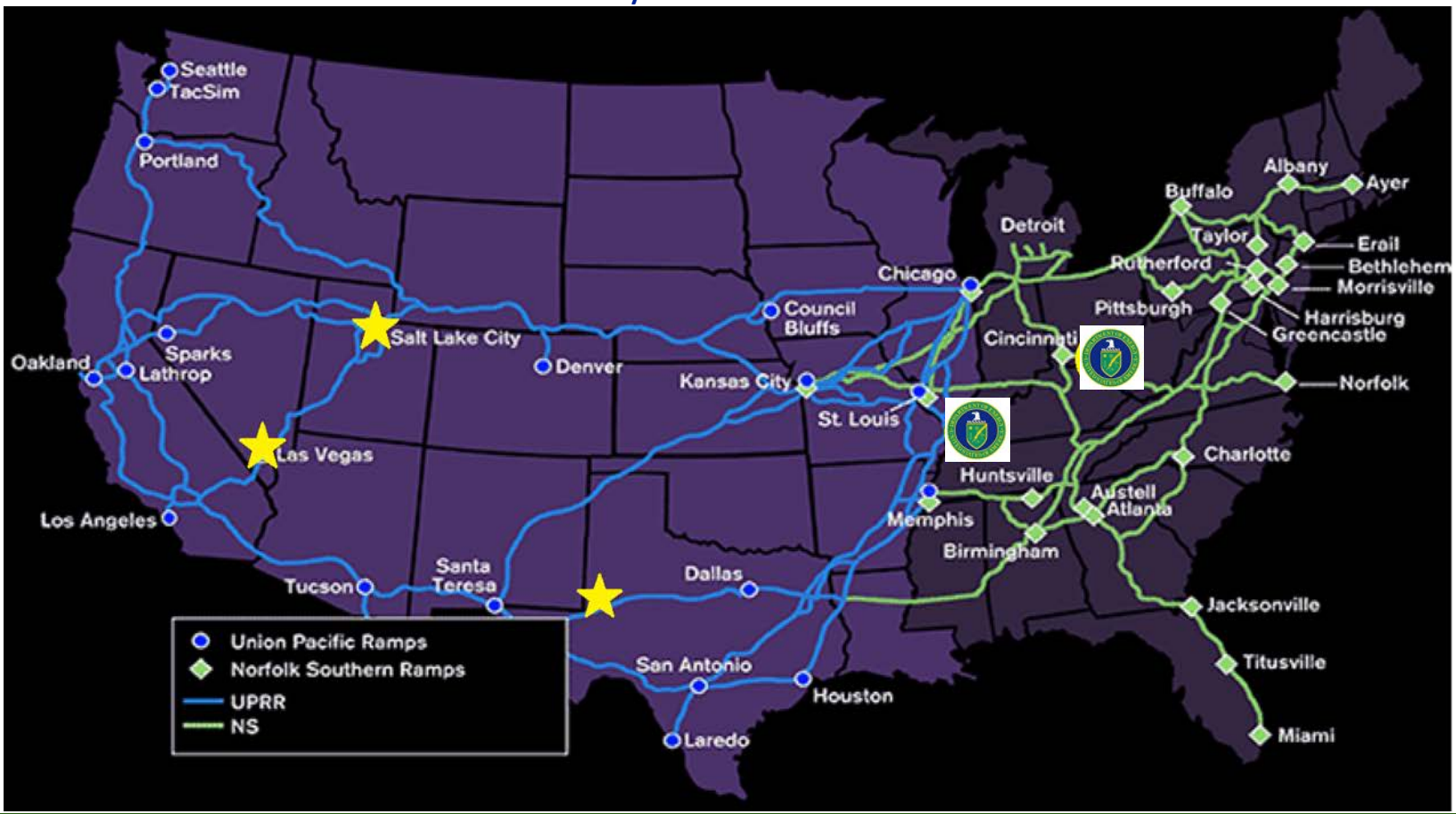
Disposal facility's low level radioactive waste cell located in Northwest Utah

- Direct rail shipment to disposal facility

Rail Routes

The DUF_6 project plans to use standard commercial rail and truck shipment routes to transport converted oxide filled cylinders to the disposal facilities. Typical rail shipment routes may pass through the following states; depending on disposal site(s). Note: shipments to NNSS will consist of rail to a trans-load facility and trucked in to Nevada

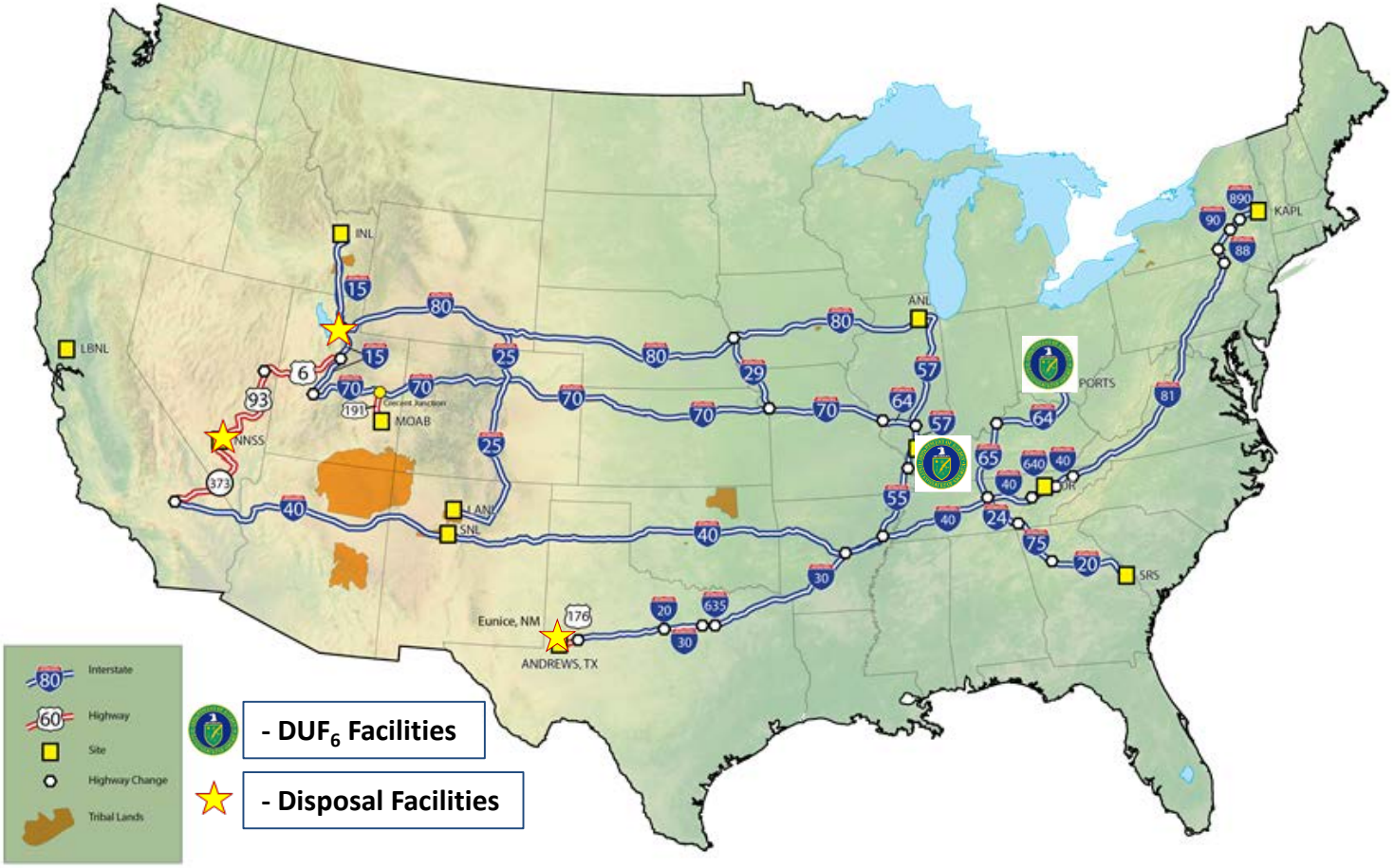
- Ohio
- Kentucky
- Tennessee
- Indiana
- Illinois
- Missouri
- Arkansas
- Kansas
- Nebraska
- Colorado
- Wyoming
- Utah
- Nevada
- Oklahoma
- Arizona



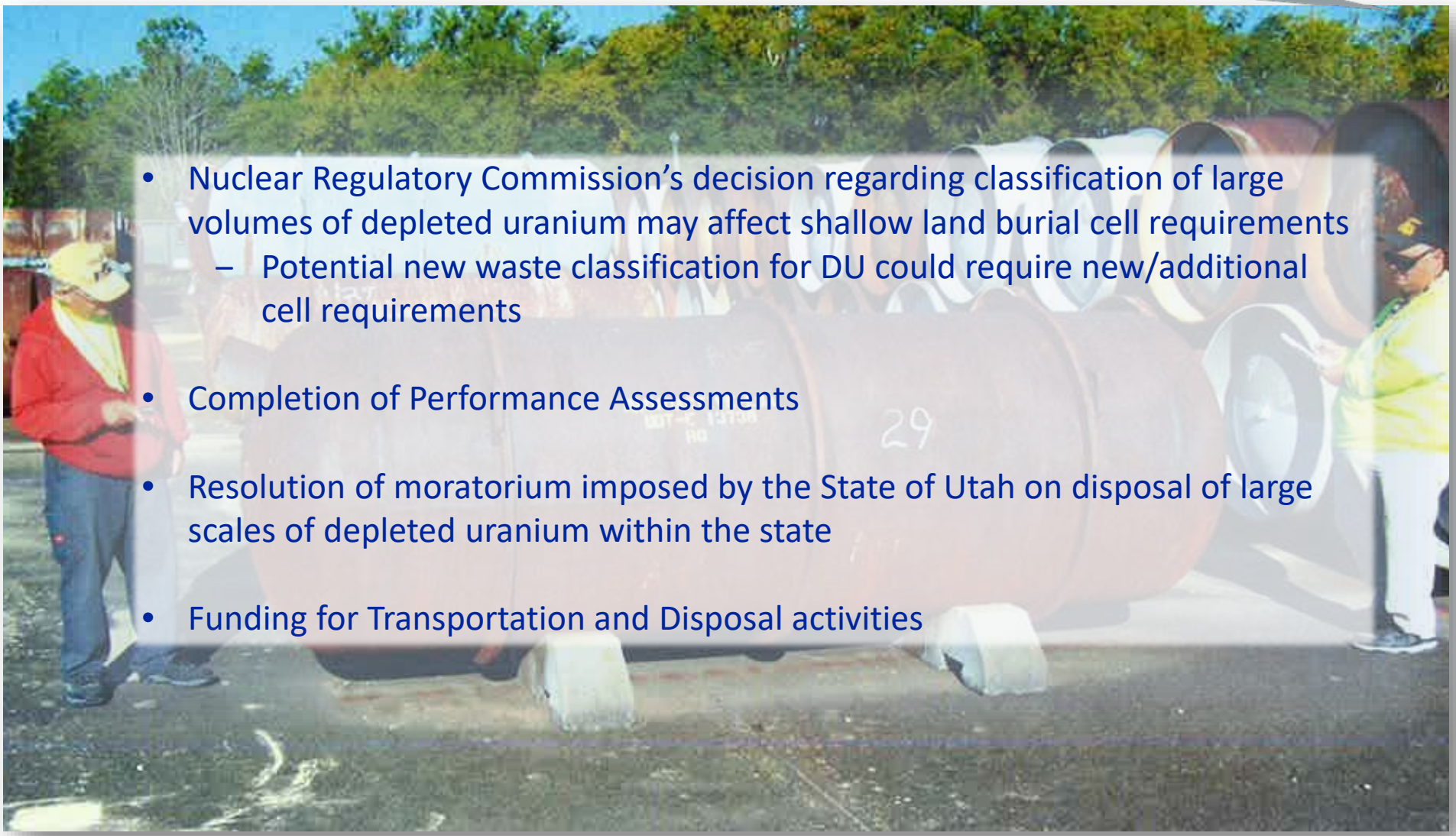
Truck Routes

The DUF_6 project plans to use standard commercial rail and truck shipment routes to transport converted oxide filled cylinders to the disposal facilities. Typical truck shipment routes may pass through the following states; depending on disposal site(s)

- Ohio
- Kentucky
- Tennessee
- Indiana
- Illinois
- Missouri
- Arkansas
- Kansas
- Nebraska
- Colorado
- Wyoming
- Utah
- Nevada
- Oklahoma
- Arizona

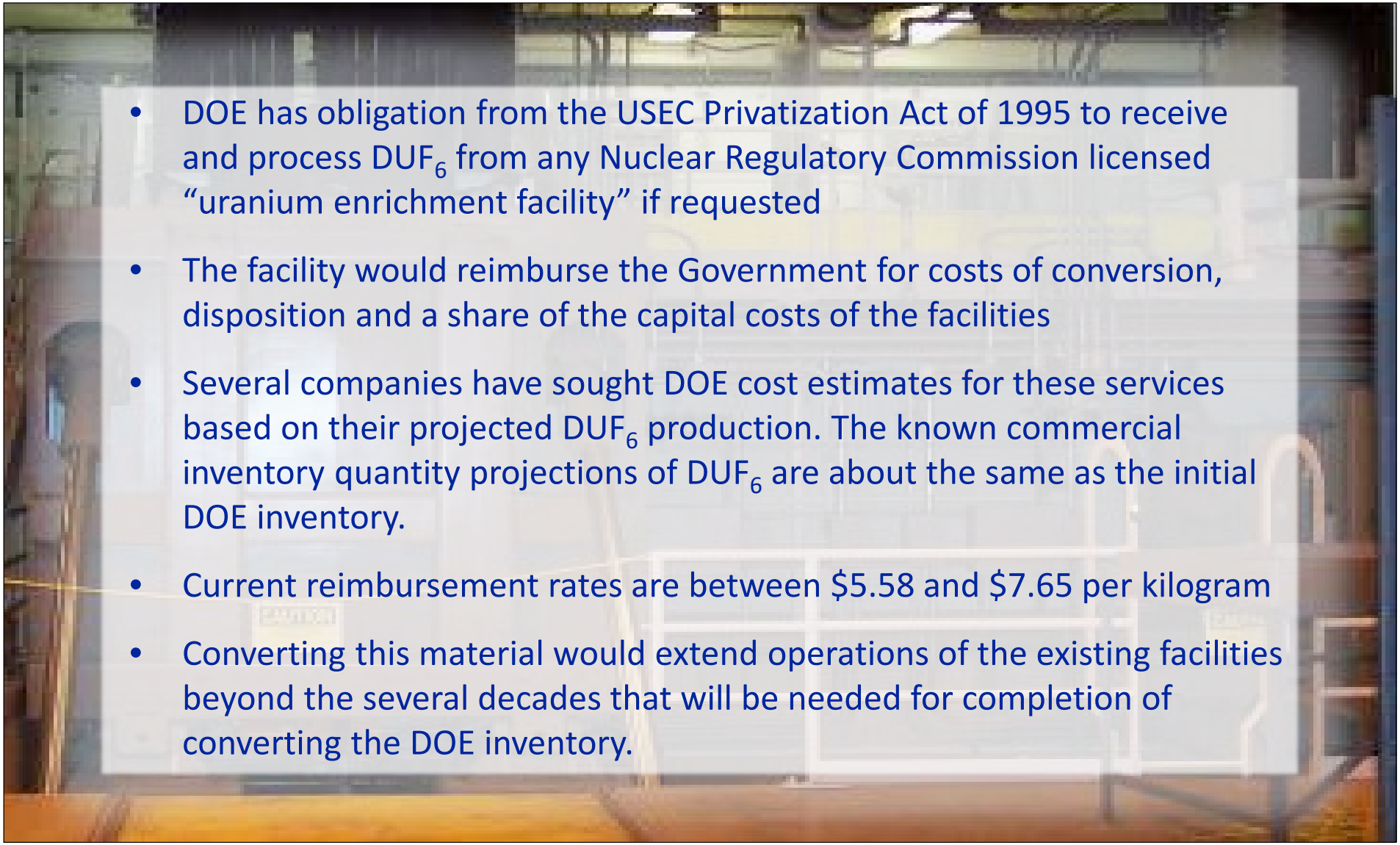


Transportation/Disposal Challenges



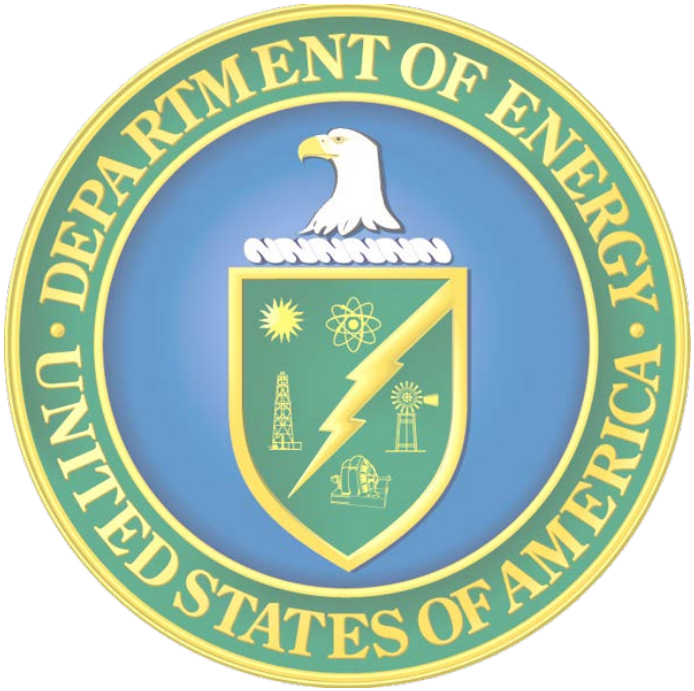
- Nuclear Regulatory Commission's decision regarding classification of large volumes of depleted uranium may affect shallow land burial cell requirements
  - Potential new waste classification for DU could require new/additional cell requirements
- Completion of Performance Assessments
- Resolution of moratorium imposed by the State of Utah on disposal of large scales of depleted uranium within the state
- Funding for Transportation and Disposal activities

Commercial DUF_6 Processing



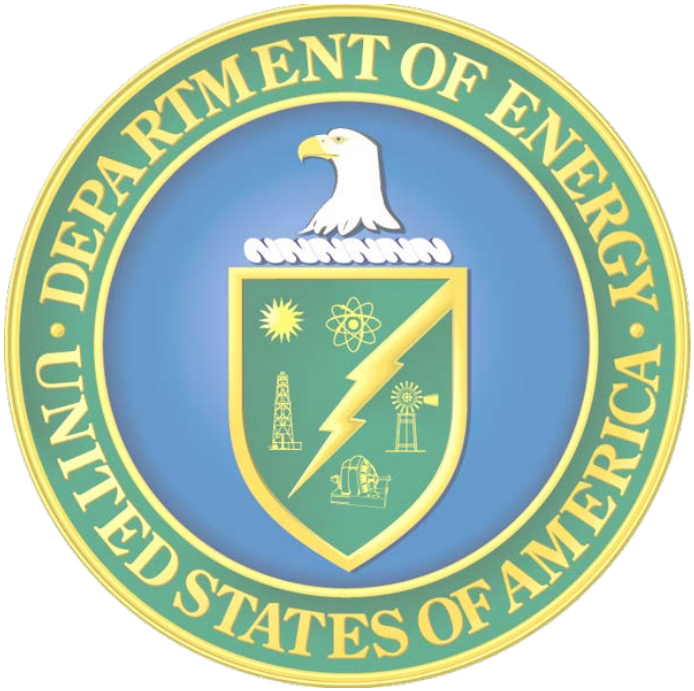
- DOE has obligation from the USEC Privatization Act of 1995 to receive and process DUF_6 from any Nuclear Regulatory Commission licensed "uranium enrichment facility" if requested
- The facility would reimburse the Government for costs of conversion, disposition and a share of the capital costs of the facilities
- Several companies have sought DOE cost estimates for these services based on their projected DUF_6 production. The known commercial inventory quantity projections of DUF_6 are about the same as the initial DOE inventory.
- Current reimbursement rates are between $5.58 and $7.65 per kilogram
- Converting this material would extend operations of the existing facilities beyond the several decades that will be needed for completion of converting the DOE inventory.

DUF_6 Project



Questions?

DUF_6 Project

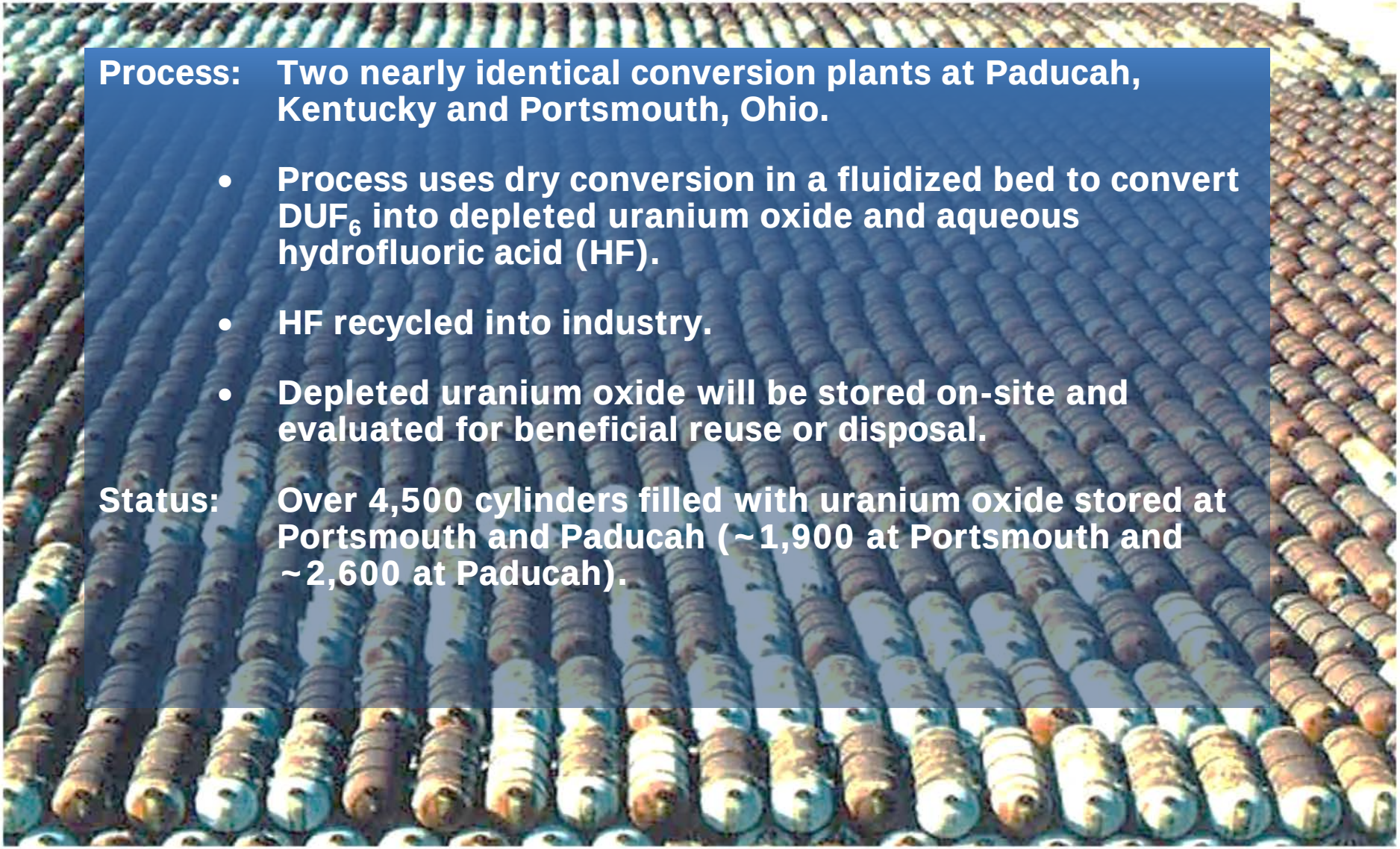


Backup Slides

DUF_6 Conversion Project

Initial inventory - approximately 800,000 total metric tons contained in ~66,500 steel cylinders

DUF_6 Project Overview



Process: Two nearly identical conversion plants at Paducah, Kentucky and Portsmouth, Ohio.

- Process uses dry conversion in a fluidized bed to convert DUF_6 into depleted uranium oxide and aqueous hydrofluoric acid (HF).
- HF recycled into industry.
- Depleted uranium oxide will be stored on-site and evaluated for beneficial reuse or disposal.

Status: Over 4,500 cylinders filled with uranium oxide stored at Portsmouth and Paducah (~1,900 at Portsmouth and ~2,600 at Paducah).

Cumulative DUF_6 FY Results

Conversion Totals		HF Shipped	
2011	270 metric tons	2011	22,000 gallons
2012	6,440 metric tons	2012	1,184,000 gallons
2013	20,019 metric tons	2013	3,456,000 gallons
2014	42,615 metric tons	2014	6,983,000 gallons
2015	53,223 metric tons	2015	8,578,000 gallons
2016	54,212 metric tons	2016	8,743,000 gallons
2017	59,646 metric tons	2017	9,605,000 gallons

Note: 59,646 MT DUF_6 converted = ~ 4,650 cylinders of oxide currently stored onsite

Emergency Response

- Transportation Emergency Preparedness Program (TEPP) is the DOE radiological training program for affected state, tribal and local emergency response units.
  - https://energy.gov/em/services/waste-management/packaging-and-transportation/transportation-emergency-preparedness
- DOE's DUF6 Operations Contractor will maintain a 24-hour emergency response telephone number.
- Additional details will be provided in the transportation plan, which will be made available to the public following approval by DOE-HQ.