Accountability
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The Nuclear Materials Management Safeguards System

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Disposition Program for Surplus, Non-Pit Plutonium

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Outline

- U.S. Disposition Program for Surplus, Non-Pit Plutonium
- 2016 Record of Decision to Downblend 6 MT of Pu unsuitable for MOX for disposition at WIPP
- SRS K-Area Implementation of Downblend Process
- Priorities for Material Selection
- Characterization for WIPP
- Programmatic Value Determination
- Tracking and Reporting Pu Inventories and Status

U.S. Excess Plutonium

- *Note: Plutonium quantities are based on NEPA documentation and public records. They are program design basis numbers and do not represent actual current inventories at any specific location.*
- 38.2 metric tons (MT) of weapons-grade plutonium (Pu) declared excess to weapons (1994-1995)
- 9.0 MT more Pu to be removed from weapons programs (2007)
- 14.3 MT of accountable non-weapons-grade Pu (1996 Openness)
- Pu declared as waste prior to 1994
  - Recognized in U.S. Pu Balance reports, but not tracked against Excess declarations or in the NA-20 and EM fissile materials disposition programs

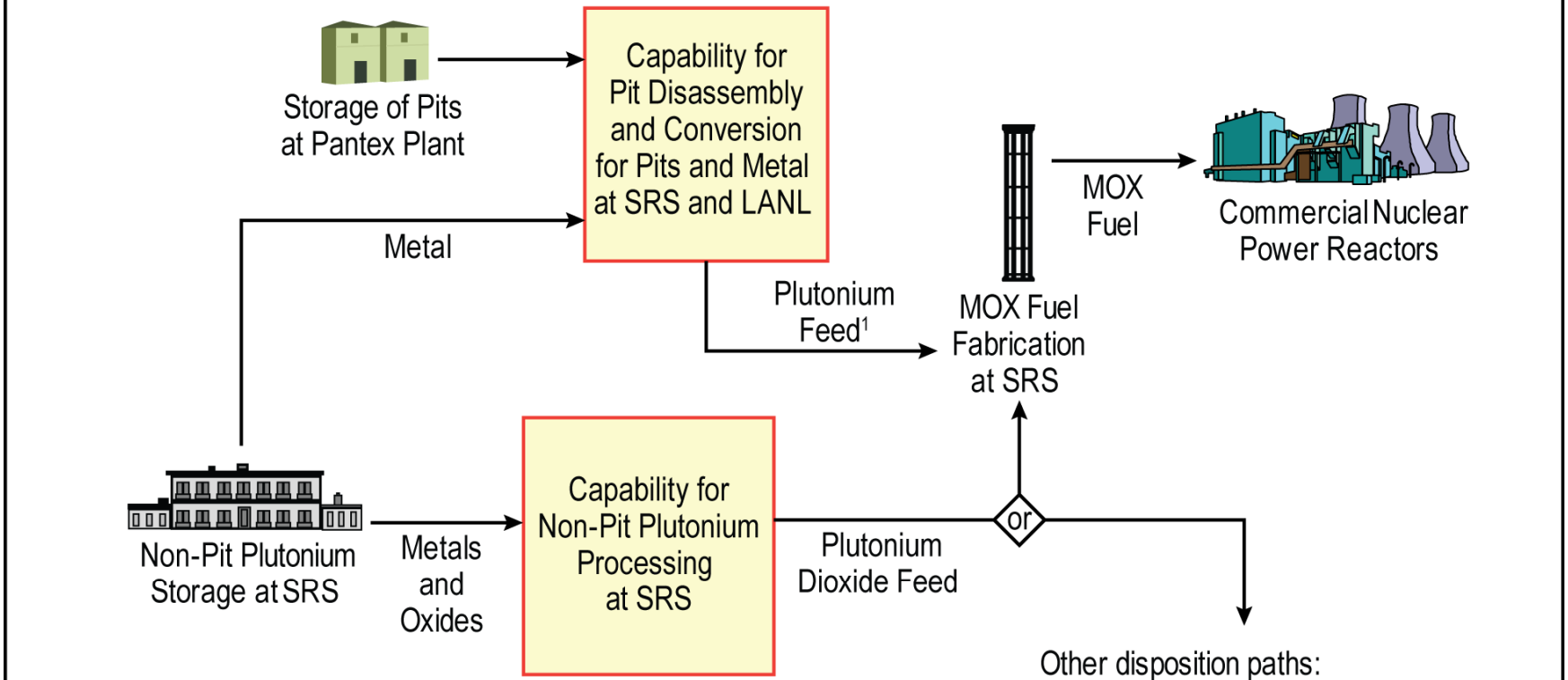
Pu Disposition Program through 2001

- 2000 Decision for "Hybrid" Program: Up to 50 MT of plutonium
  - Up to 33 MT dispositioned through Mixed-Oxide (MOX) fuel, with spent fuel disposed to High-Level Waste (HLW) repository
  - Up to 17 MT dispositioned through Plutonium Immobilization Plant (PIP), inner cans with diluted Pu solid surrounded by HLW glass
- 2000 U.S.-Russian Plutonium Management and Disposition Agreement (PMDA): 34 MT of weapons-grade (WG) Pu
  - At least 25.6 MT to MOX from pits and clean non-pit metal, at least 8.4 MT to PIP
- PIP: Design basis up to 13 MT surplus, non-pit Pu
  - Design Basis 17 MT minus 4 MT (ZPPR) removed in 2001
  - Included both Non-WG and WG

Pu Disposition Program through 2016

- 2002 Change: Revise PMDA and NEPA ROD to Eliminate PIP
  - Nominal (Program Basis) remained at least 34 MT
  - at least 25.6 MT from pit origin, at least 6.5 MT from former PIP feeds, with 1.9 MT balance to come from "future declarations"
  - ~5-6 MT not qualifying for MOX to be retained by DOE-EM
- 2007 Report to Congress: "Plan for Alternative Disposition of Defense Plutonium and Defense Plutonium Materials That were Destined for the Cancelled Plutonium Immobilization Plant"
- 2007 Additional Declaration: 9 MT to be identified in future
  - 9 MT = 1.9 MT (in 34 MT) + 7.1 MT (No NEPA Decision)
- 2015 Supplemental Environmental Impact Statement
  - Basis for decisions on up to 6 MT (non-MOX), 7.1 MT from 2007 Excess (E07), pit disassembly & conversion methods, additional reactors
- 2016 Preferred Alternative announced to downblend 6 MT non-MOXable, terminate safeguards, and ship to WIPP

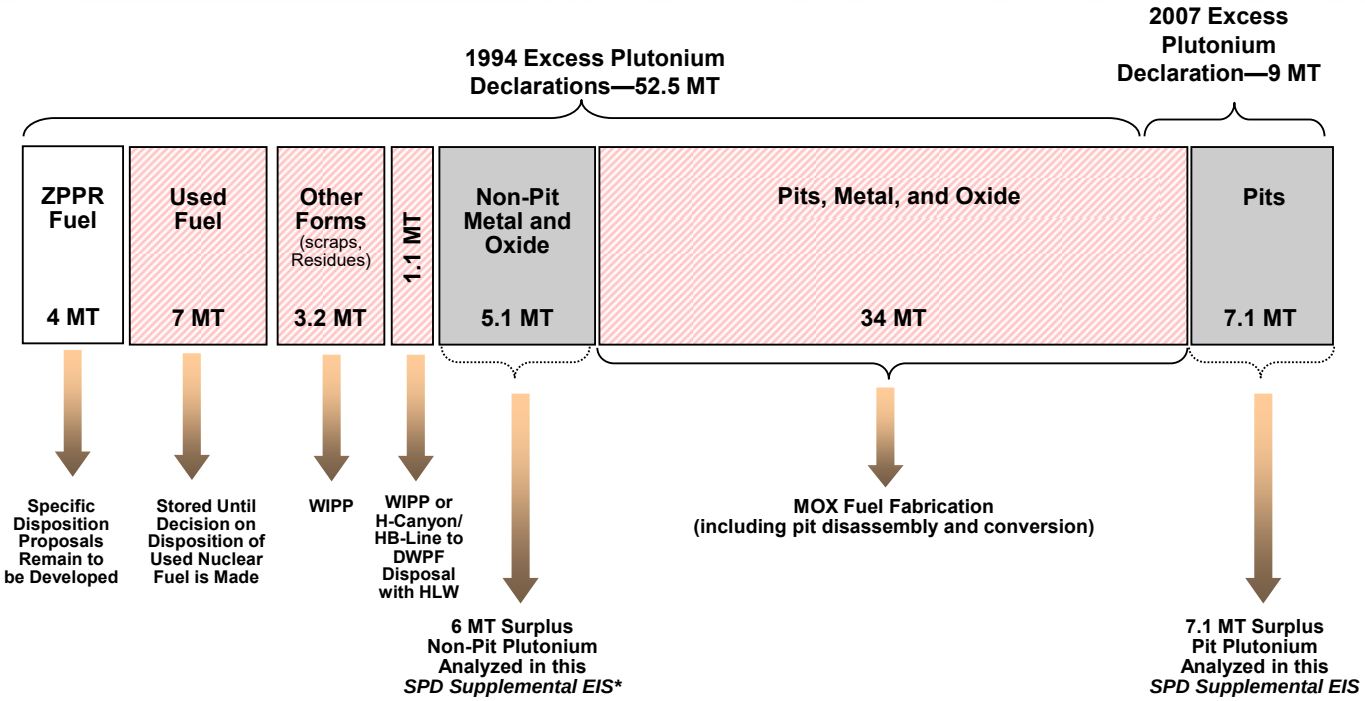
Disposition Framework (SEIS)



Other disposition paths:
- H-Canyon/HB-Line and DWPF at SRS
- Immobilization and DWPF at SRS
- WIPP disposal in New Mexico

Key:
DWPF = Defense Waste Processing Facility
LANL = Los Alamos National Laboratory
MOX = mixed oxide
SRS = Savannah River Site
WIPP = Waste Isolation Pilot Plant

Disposition Design Basis (SEIS)



- Specific disposition proposals remain to be developed for ZPPR fuel.
- Materials addressed in existing decisions and associated National Environmental Policy Act analyses.
- Surplus plutonium analyzed in this *SPD Supplemental EIS*.

DWPF = Defense Waste Processing Facility
HLW = high-level radioactive waste
MOX = mixed oxide
MT = metric ton
WIPP = Waste Isolation Pilot Plant
ZPPR = Zero Power Physics Reactor

- The analyzed quantity of non-pit plutonium is somewhat larger than the exact quantity of non-pit plutonium currently identified as surplus to allow for possible future needs to provide disposition paths for surplus non-pit plutonium.

2016 Record of Decision: Pu Unsuitable for MOX

- Design Basis for decision is 6 MT of non-pit, surplus Pu
- Includes up to 0.9 MT of additional material beyond that analyzed previously, potentially including foreign receipts
- Preferred Alternative: Blenddown and disposal to WIPP as transuranic (TRU) waste
- Newsworthy relationship to Public Law to remove Pu from South Carolina if MOX is delayed
- Program at SRS, described in Supplemental EIS, does not address legacy (00-1) Pu at LANL that will not be shipped to SRS. Blenddown for WIPP will be dominant pathway.

Previous Downblend Operations

- Rocky Flats residues
  - "Stardust" adulterant added to plutonium oxide
  - <10 wt.% Pu (target of up to 7 wt.% Pu) in Pipe Overpack Containers (POCs)
  - Pu was made difficult-to-recover from matrix (Attractiveness Level "D")
  - Met WIPP WAC and allowed Termination of Safeguards
- Hanford residues
  - Similar operations, formulation, and product
  - Total from Rocky Flats and Hanford ~4 MT
- Savannah River DOE-STD-3013 "daughter" material (90 kg)
  - Operated in HB Line under NEPA Interim Action Determination
- *Note: Other Pu materials have been sent to WIPP, including items removed from MC&A before 1994. These are not included in the programs for "declared" excess/surplus materials.*

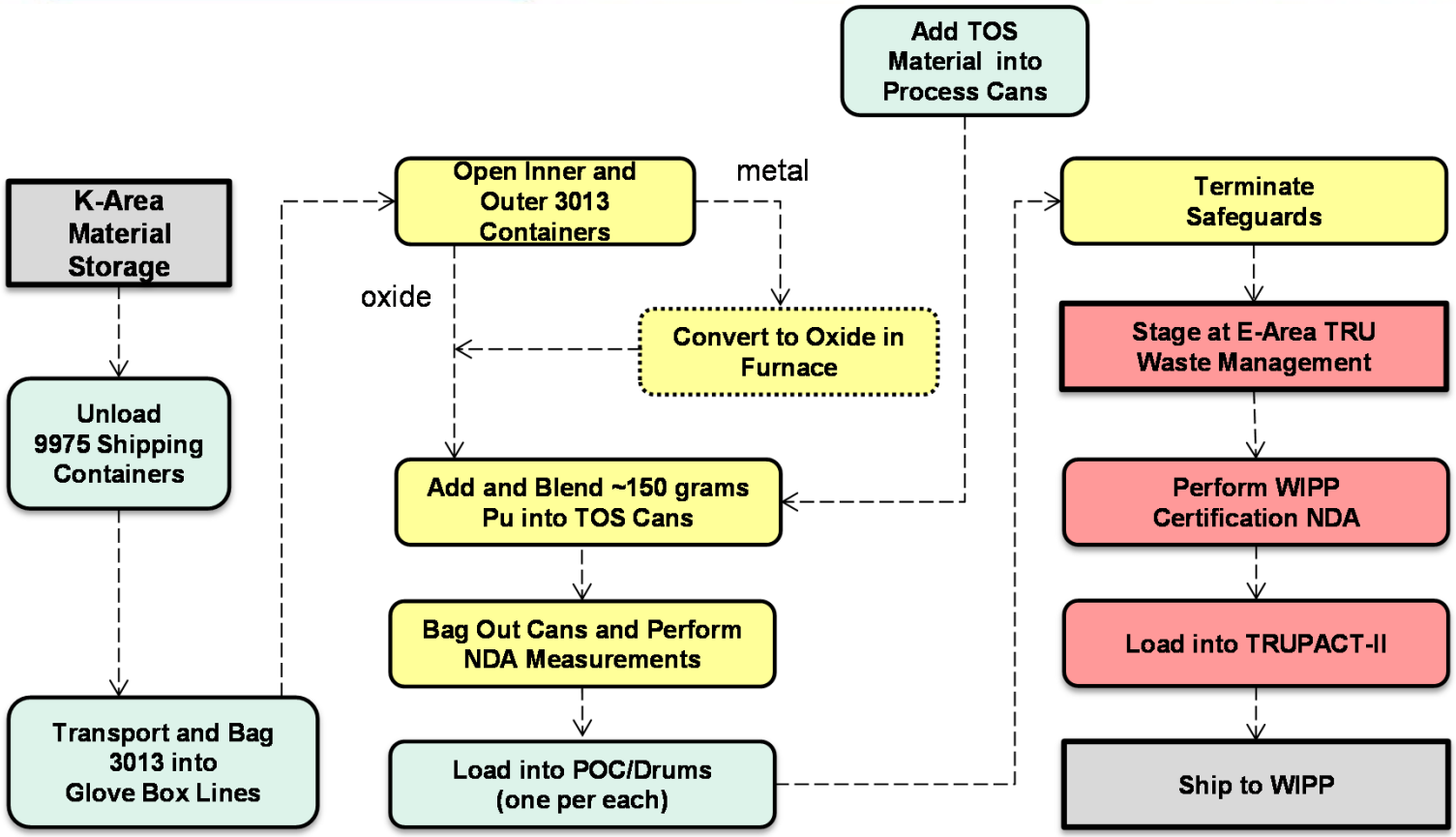
SRS Downblending in HB Line

- Approximately 90 kg of Pu was downblended in an HB-Line glove box into 670 POCs.
  - Oxides from Destructive Evaluation (DE daughters) for the DOE-STD-3013 Integrated Surveillance Program
  - Miscellaneous oxide (e.g., R&D for Vacuum Salt Distillation; also U/Np oxide from Y-12)
  - SRS does not have a current capability to re-3013 oxide from an opened container
- 409 POCs with Pu were shipped to WIPP via TRUPACT-II
- 261 POCs with Pu were ready-to-ship and will be transferred when WIPP is available to receive them

K-Area Complex Blenddown for Non-MOXable Pu

- Installing glovebox line: Ready late CY2016
- Remove 3013 containers from 9975 shipping packages
- Open inner and outer welded 3013 containers
- Blend in adulterant to achieve Attractiveness Level “D”
- Terminate safeguards
- Package and transport to E-Area Solid Waste Management
- Characterize and load TRUPACT-II for shipment to WIPP

Blending Process Flow



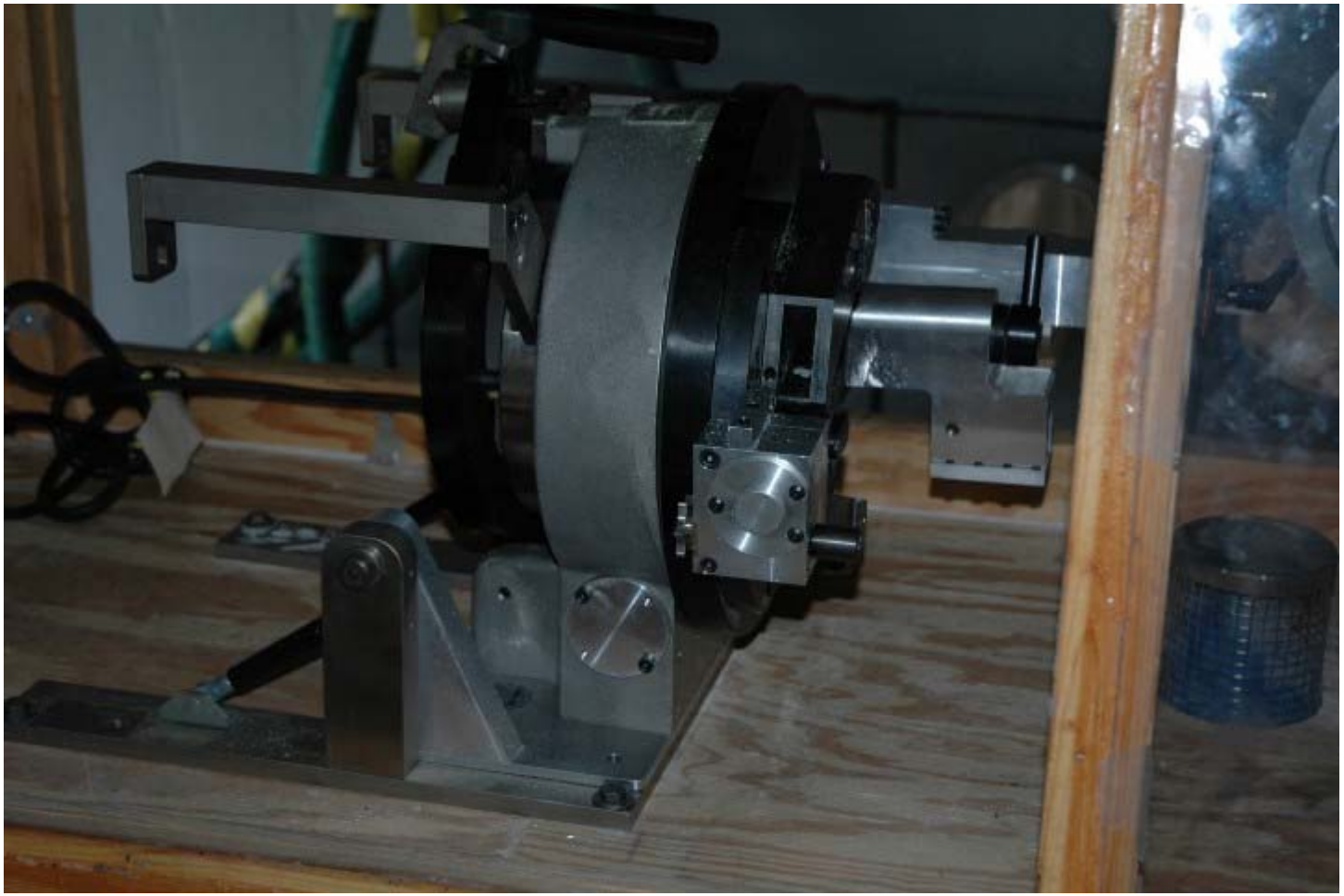
Key:
NDA = nondestructive assay
POC = pipe overpack container
Pu = plutonium

TOS = Termination of Safeguards
TRUPACT-II = Transuranic Package Transporter Model 2
WIPP = Waste Isolation Pilot Plant

KAC Glovebox Operation

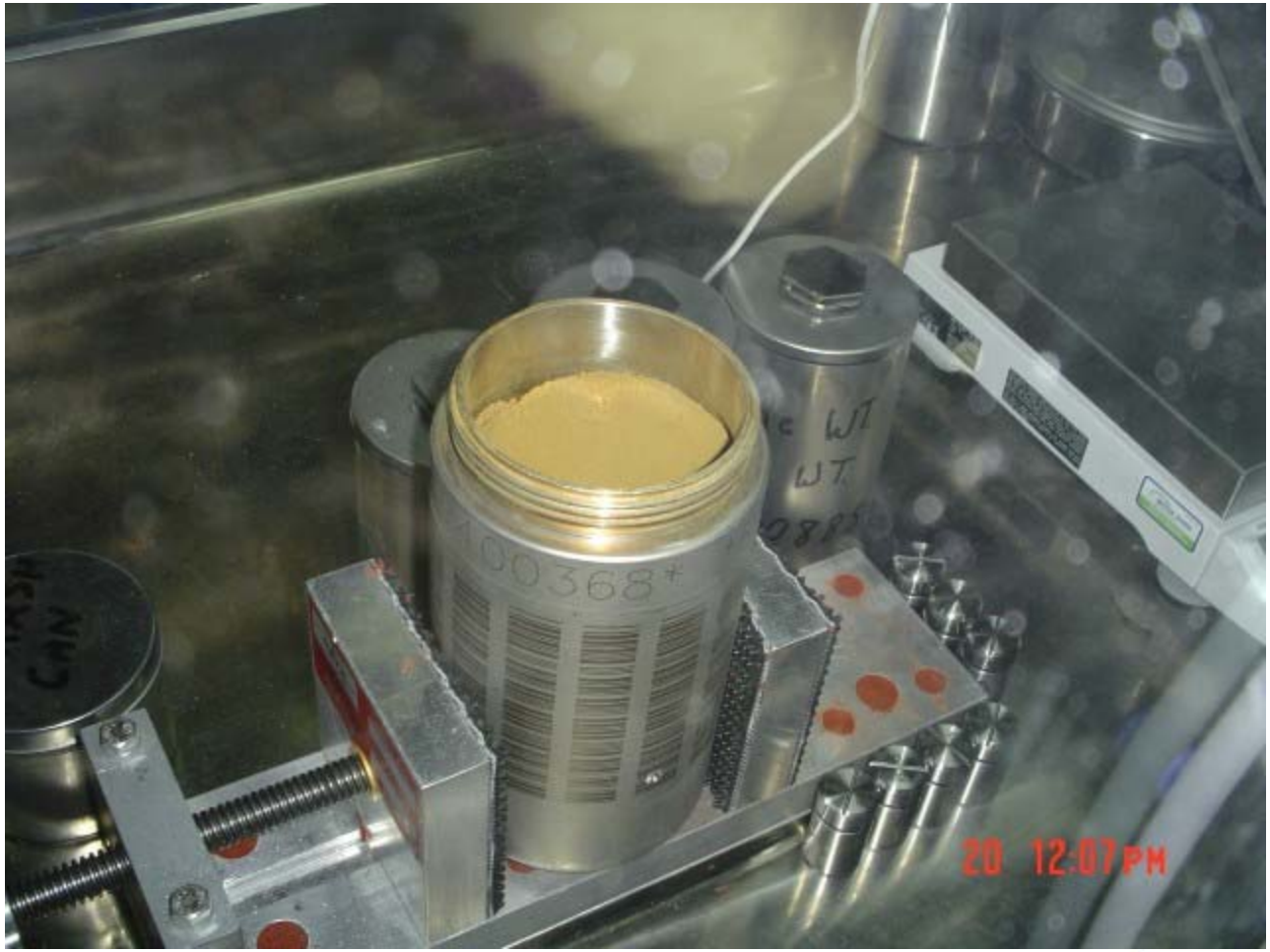
KAC New Glovebox Mockup

3013 Can Cutter in KAC Mockup



Equipment Mockup through Bagout Port

Pu Oxide in Opened Convenience Can



KAC Pu Oxide Processing Tools

Mortar and Pestle

Manual Pulverizer

Grinder

KAC Blend Can Mixer

Bagging and Canning

Inner Blend Can
In Filtered Bag-
Out Sleeve

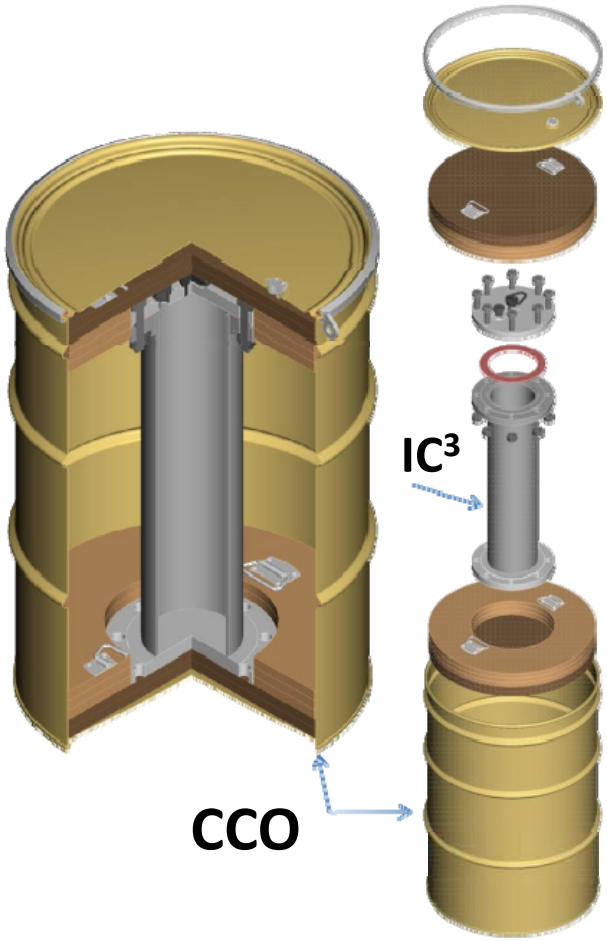
Sleeve Insertion
Into Outer
Blend Can

Containerization for Disposal

- Initial product can: Pipe Overpack Container (POC)
  - Used for Rocky Flats, Hanford, SRS HB-Line
  - Limited to 200 grams Fissile Gram Equivalent (FGE); nominal fissile loading limit of <150 grams
  - Current operating plan is to load by bulk mass: More POCs per kg Pu
  - 55-gal drum outer, NRC certified and within the current WIPP permit
  - Would require >40,000 containers for 6 MT ($140 M POC cost)
- Proposed product can: Criticality Control Overpack (CCO)
  - Limited to 380 grams FGE; nominal fissile loading limit of <300 grams
  - 55-gal drum outer, NRC certified; WIPP working into operating permit
  - Would require >20,000 containers for 6 MT ($30 M CCO cost)

Criticality Control Overpack (CCO)

- CCO designed as an improved and lower cost payload container to the pipe overpack component
- Pipe Overpack Component (POC) developed by/for RFETS limited to <200 FGE (~$3.5K)
- IC^3 designed with cost in mind (~$1.5K)
  - Eliminate unnecessary components (i.e., rigid liner)
  - Replace soft Celotex dunnage with CDX laminated plywood
  - Raise fissile limit: <480 FGE
  - ~16 kg/shipment (3 x 14 – with safeguards terminated)



POC/CCO on Turntable of Mobile WIPP Characterization Unit

Loading Drums into TRUPACT-II

Ready to Roll

Future Operations

- Follow with metal-oxidation furnace capability
- Evaluate WIPP options for unirradiated FFTF fuel
- Respond to inquiries on suitability for greater capacity or longer operation (e.g., MOX alternative) and options for disposal can loadings

Selection of Materials for WIPP Pathway

- SRS would like to maximize Pu disposition rate and reduce burdens for continued storage capacity and monitoring requirements
  - Include containers already opened for 3013 DE program
  - Items with no credible alternative disposition pathway (e.g., to MOX, HEU/Pu for blenddown to LEU)
  - Containers with long-term corrosion potential, based on characteristics (relatively high halides and moisture content when packaged)
  - Items with high Pu content (maximize removal from SC)
  - Items ready to blend (free oxide)
  - Full pallets and containers easy to retrieve

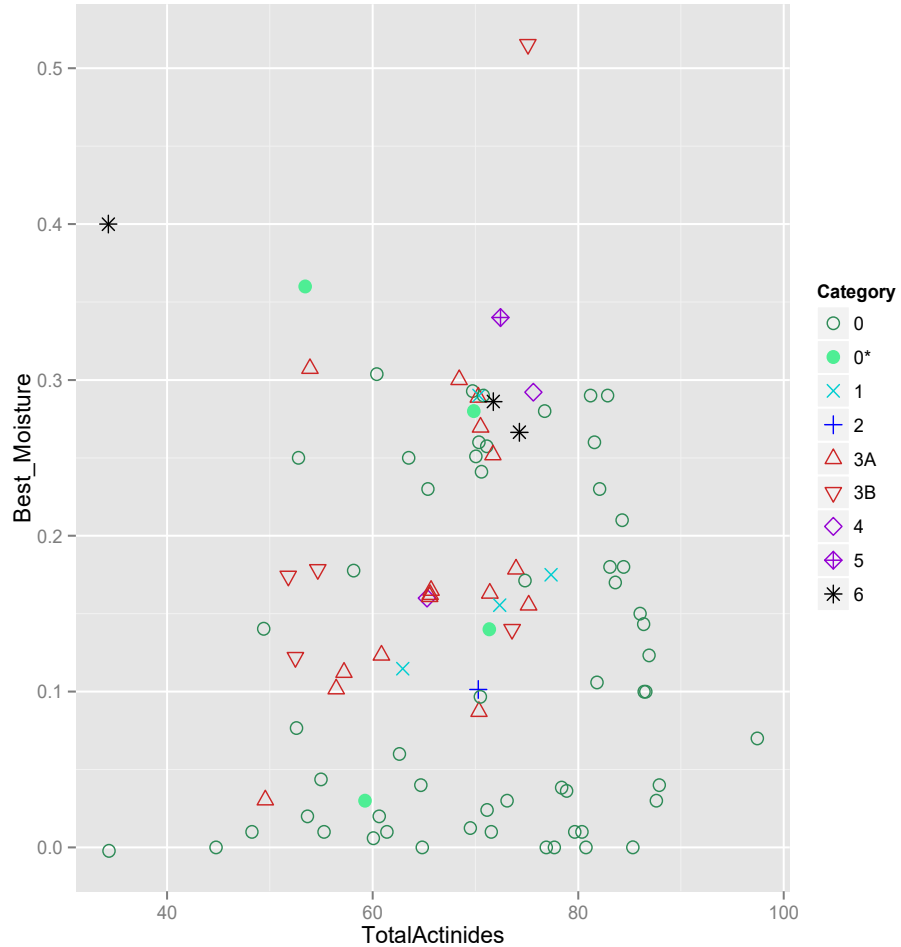
3013 Corrosion Potential

- Materials Identification & Surveillance Program: supports Integrated Surveillance Program required under DOE-STD-3013, *Standard for Long-Term Storage of Plutonium*, developed in response to DNFSB Recommendation 94-1
  - Destructive or Nondestructive Evaluation of containers after 5 years, based on “Random” selection or “Engineering Judgment” (6 DE in 2016)
  - No concern for pressurization, beyond 50-year nominal target
  - Minor corrosion identified for some items with a combination of high halide content and (relatively) high moisture content
- While considered suitable for extended storage, items in target groups could be processed early
- Future needs for surveillance and testing could be reduced

DE Analysis for Corrosion Potential

Corrosion Analysis Category Scale:

- 0 Nothing or wipeable coating
- 0* Corrosion observed in RFETS convenience can threads or lids
- 1 Adherent coating on convenience can
- 2 Pitting <50 µm on convenience can
- 3A Suspect pitting >50 µm on convenience can – pit covered with corrosion product
- 3B Confirmed pitting >50 µm on convenience can – generally confirmed with Scanning Electron Microscope
- 4 Adherent coating on inner can
- 5 Pitting <50 µm on inner can
- 6 Pitting >50 µm on inner can
- 7 Stress Corrosion Cracking on inner can



Less Attractive Items for Early Blenddown

- Metals (require installation of oxidation capability and additional process step; may be compatible with H-Canyon options)
- Items under IAEA Surveillance
- Potentially MOX-suitable items (with remeasurement, repackaging, or pretreatment)
- Pure fuel-grade oxides and pellets: Future fuel cycle R&D, but no demand has been identified
- Items with elevated concentrations of commercially important isotopes (e.g., HEU for blenddown to LEU, americium-241)
- Selected items of interest to nuclear forensics or material archives
- *Note: "attractive" versus "unattractive" attributes could conflict. No programmatic value has been identified for any significant number of items stored at SRS, but SRS routinely provides data to support inquiries.*

Characterization of Inventories for WIPP Acceptance and Planning

- Materials downblended and disposed to WIPP, using HB Line, had full Acceptable Knowledge (AK) documentation and WIPP characterization of product
- AK for the portion of the 6 MT located at SRS in 3013 containers will be bounded by the analysis for the items already covered
- SRNL recently documented radioisotopic content of categories in the 6 MT to supplement earlier, conservative planning estimates by WIPP – FGE and PEC by isotope (Pu, U, Am, Np) for individual items and category rollups
- Options for packaging of unirradiated FFTF fuel pins and pellets are under development. A separate AK may be advisable.

Programmatic Value Determination - Need

- DOE G 410.2-1, "Nuclear Materials Disposition Guidance" (Dunsworth presentation), requests integrated evaluation of potential programmatic value
  - Review by ONMI is part of life-cycle management of DOE nuclear materials, once material is defined as "No Defined Use" at its current location and under its current program ownership
  - Current DOE O 474.2, "Nuclear Material Control and Accountability," requests PV Determination before safeguards are terminated, for most materials
  - Surplus status of non-pit plutonium that is part of the NNSA and EM disposition program should be confirmed before irreversible actions are taken to degrade potentially usable items (well in advance of TOS actions)

Programmatic Value Determination - Status

- Plans for disposition of surplus plutonium have been documented and confirmed by NEPA and program analysis since the mid-1990s
- All Pu at SRS is “No Defined Use” and is within the boundaries of the 1994 or 1996 declarations (“S94”) or tagged as Excess-Other (“EOT”)
- SRS submitted PVD for surplus plutonium items at SRS in November 2014 when the DOE G 410.2-1 process was under development
- SRS revised PVD in August 2015 to cover only the portion of the 6 MT that is currently located at SRS
  - Allows timely implementation of NNSA and EM disposition program
  - Item-level tagging of materials to be confirmed annually in NMIA
- Discussion presented to Nuclear Materials Advisory Board in January 2016. Confirmation by ONMI is pending.
- Small quantities of selected items from SRS inventory have been provided to other sites and programs for programmatic R&D and nuclear forensics

Tracking and Reporting Pu Inventories and Status

- Surplus Plutonium Reconciliation (DOE O 410.2 requirement)
  - Tools include Nuclear Materials Inventory Assessments, ONMI Master Schedule, Pit Reports, NMMSS P-112, special reports on waste and foreign inventories
- Pu Characterization Reports for Disposition Options
- Pu: The First 50 Years
  - U.S. Plutonium Balance 2009 Update
  - U.S. Plutonium Balance 2014 Update
- Reporting to IAEA on U.S. plutonium management and inventories
  - Civilian separated plutonium ("U.S. Government Excess")
  - Pu in civilian spent fuel (NRC Licensees, NMMSS "Finucane Report")

Conclusion

- Questions?

- Please contact us with any requests for appropriate transfers of materials. Disposition activities will accelerate and legacy material will be removed from tracking as “nuclear materials.”