Recent and Ongoing Shipping and Transportation Activities at the Savannah River Site and Savannah River National Laboratory

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Savannah River Site Overview

SRS is a key DOE site responsible for environmental stewardship and cleanup, waste management and disposition of nuclear materials.

- ~803 square kilometers
- SRS workforce: Approximately 10,000
  - DOE-SR and DOE-NNSA
  - Savannah River National Laboratory
  - Savannah River Nuclear Solutions (M&O Contractor)
  - Other contractors include Savannah River Remediation, Centerra SRS, CB&I AREVA MOX Services, Parsons, and the University of Georgia (Savannah River Ecology Laboratory)
- Total Site budget approximately $2.4 billion

As seen from space, SRS is an island of green in the deforested landscape.
History of Savannah River Site

• Nuclear materials production history
  o 5 nuclear materials production reactors
  o 2 separations plants
  o Heavy water extraction plant
  o Nuclear fuel and target fabrication facility
  o Solid and liquid waste disposition processes

• Environmental legacy
  o 130 million liters highly contaminated liquid
    ▪ Stored in 47 underground tanks with very limited access
      – Liquid, saltcake, sludge
  o 6 Fuel basins
    ▪ Wide variety of fuels
    ▪ Damaged (corroded) fuel
  o Decommissioned radiological facilities
  o 515 radionuclide or chemically contaminated soil and groundwater waste sites
  o Over $2 \times 10^6$ m$^3$ contaminated groundwater
SRNL Today: Multi-Program National Laboratory

Secure Energy Manufacturing
- Hydrogen Production and Storage
- Nuclear Fuel Cycle R&D
- Renewable Energy Research

National Security
- Nuclear Defense
- Tritium Technology
- Homeland Security
- Nonproliferation
- Nuclear Forensics

Environmental Stewardship
- Waste Treatment
- Materials Stabilization and Disposition
- Remediation and Cleanup
- Assessments and Verification
Environmental Stewardship Programs

- Remediation of Contaminated Soil and Groundwater
- Nuclear Facility Deactivation and Decommissioning
- Radioactive Liquid Waste Treatment, Waste Forms, Storage, and Disposition
National Security Programs

- Nuclear Materials Management
- Tritium Expertise
- Mobile Plutonium Facility
- FBI Laboratory
- Nonproliferation International Protocols and Threat Reduction
Secure Energy Manufacturing Programs

- Hydrogen Research
- Safe Nuclear Fuel
- Wind Energy
- Natural Gas
- Solar Research
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SRNL Packaging Technology and Transportation Engineering:

Package Designs used by the DOE Complex

- **Type A Fissile**
  - Uranium
  - 105 Lbs
  - 10-Gallon
  - 5" Ø x 10" Containment Vessel
  - DOE Certified
  - Users: SRS, ANL, LLNL, NISTec, ORNL, PNNL, SNL

- **Inert**
  - 130 lbs
  - 30 Gallon Drum
  - 10-gallon
  - NNSA Certified
  - Users: SRS, Pantex

- **Type B**
  - Pu/U
  - 404 lbs
  - 35 Gallon Drum
  - 5" and 6" Ø Containment Vessels
  - DOE, NRC, DOT, and Internationally Certified
  - Users: SRS, ANL, INL, LLNL, NISTec, ORNL, PNNL, Hanford, (Rocky Flats, historically)

- **Type B**
  - Pu(U)
  - 350 lbs
  - 35 Gallon Drum
  - 6" Ø x 21" Containment Vessel (9977, H1700)
  - 5" Ø x 17" Containment Vessel (9978)
  - NNSA Certified
  - Users: SRS, ANL, SNL, LANL, NNSS, INL, PNNL, ORNL, Y-12, Pantex

- **Type A Fissile**
  - Uranium
  - 414 lbs (9979)
  - 650 lbs (9981)
  - 55 Gallon Drum
  - 30-Gallon Containment Vessel
  - DOE and NRC Certified (9979)
  - Users: SRS, LANL, LLNL

- **Type B**
  - Tritium
  - 650 lbs
  - 85 Gallon
  - 10" Ø x 31" Containment Vessel
  - NNSA Certified
  - Users: SRS, ANL, SNL, LANL, Navarro, ORNL, PNNL, SNL, Energy Solutions, Fluor-B&W Portsmouth, Bechtel Marine

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Number of Packages in Service

- **21,000**
- **750**
- **Hundreds**
- **3,000**

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Package Development and Testing

• SRNL PT&PS is developing two new packages for use within the DOE Complex

• Full Service Design, Analyses, Testing, SARP Development, Certification, Procurement, Operation, and Maintenance

  – 9981 Shipping Package
    • Package for Shipment of up to ~350 lbs. of LEU (365 lbs. total content load)
    • Testing and Analyses completed, December 2017
    • SARP submitted to DOE for Certification, February 2018
    • Anticipated Certification, September 2018

  – 9982 Shipping Package
    • Package for shipment of small gram quantities of RAM
    • Funding was received in May and design/development is underway
Testing of Type B (and Type AF) RAM Packagings
Package Development and Testing

- The 9977 Shipping Package is in wide use throughout the DOE Complex

- Tested to 10 CFR 71.71 (NCT) and 10 CFR 71.73 (HAC)

SRNL 9977 Packaging
9977 Drop Test

GPFP SN-3
HAC DROP TEST
(Chilled/Horizontal)
2005
9977 Thermal Test (Pool Fire)
Material Transfers at SRS

• Various Materials are transferred within the boundaries of SRS
  – Primarily materials being processed and sent for use at other facilities or samples
    being sent to SRNL for analysis

• One unique onsite transfer—Mk-18A Fuel Targets
  – The Mk-18A targets were part of a campaign to use the high-flux characteristics of K Reactor in
    an effort to produce isotopes for the benefit of mankind
  – Plutonium-242 targets were loaded into K-Reactor to produce Californium-252
  – A byproduct of this high-flux irradiation was Pu-244 (as well as Cm-244, Cm-246, and Cm-248)
  – Pu-244 can be used in forensics and Cm-246/248 is a feedstock for current HFIR Cf production
Recovery Efforts

- SRNL and ORNL, funded by the NNSA Office of Nuclear Materials Integration, completed a study on the recovery of these materials.
- 65 Mk-18A Targets stored in L-Basin will be transferred one-at-a-time onsite to SRNL for processing in the shielded cell facility.
- SRS Onsite Transportation is performed in accordance with the SRS Transportation Safety Document (TSD).
- An Onsite Cask is being designed to accommodate all facets of the transfer (including facility operations).
- Product will be shipped to Oak Ridge National Laboratory for isotopic separation.
Onsite Cask Design Parameters

- In addition to utilizing existing facilities without significant modifications, there are other parameters were considered:
  - SRNL overhead track crane has a 10-Ton (maximum) lift capacity
  - The bare target can not be exposed to personnel at any time (must provide shielding)
    - Contact dose of the worst case target is roughly 2,500 Rem
  - The cask and shield must interface with the shielded cell facility
  - The cask and shield must integrate with the Documented Safety Analyses (DSA) for each facility
- Neutron Radiation and Gamma Radiation must both be shielded
  - The Mk-18A Cask utilizes stainless steel for gamma shielding and Borated Polyethylene for neutron shielding
Current Design
Animation of Mk-18A Onsite Transfer

MARK18 L-AREA
BASIN
LOADING
SRNL Testing of the ES-3100

ES3100 MUNITIONS TESTING

9-16-14
M³’s U.S.-Origin Nuclear Material Removal Program

SSEB – NTSF 2018

Glen L. Jackson
U.S.-Origin Nuclear Material Removal Program Support
National Nuclear Security Administration

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Material Management and Minimization (M³)

Convert
Convert research reactors and isotope production facilities to non-weapons-useable nuclear material both domestically and abroad

- Research Reactor Conversion
- Mo-99 Production

Remove
Remove or confirm the disposition of excess weapons-useable nuclear material at civilian facilities across the globe and consolidate those materials that remain

- International Nuclear Material Removal and Consolidation
- International Nuclear Material Down-blending

Dispose
Dispose of and manage excess weapons-useable nuclear material, from both domestic stockpiles and material returned from abroad, and implement the Plutonium Management Disposition Agreement (PMDA) with Russia

- HEU and Plutonium Disposition
- Uranium Supply for Peaceful Uses
Nuclear Material Removal Programs

U.S.-Origin Nuclear Material Removal Program: Remove or dispose of U.S.-origin HEU and LEU from TRIGA and MTR research reactors worldwide.

Russian-Origin Nuclear Remove Program: Remove or dispose of Russian-origin nuclear material from research reactors worldwide.

GAP Removal: Remove or dispose of vulnerable high risk nuclear materials that are not covered under the Russian-origin and U.S.-origin nuclear material removal programs.

U.S. Origin Shipment from South Africa

Gap Shipment from Chile
U.S.-Origin SNF Removal Shipments

- 66 shipments completed
- 54 via Ocean to East Coast
- Numerous truck shipments from Canada
- 9,616 spent fuel assemblies, from 33 countries
- 10 cross-country shipments completed including one west coast origin shipment
- 282 casks safely and successfully moved by vessel, truck and rail
Shipment Coordination

• Two approved NRC routes from the Canadian/U.S. border to South Carolina (traversing NY, PA, MD, WV, VA, NC, SC).

• M³ has been working with the Council of State Governments - Eastern Regional Conference and the Southern States Energy Board. We have used DOE’s National Transportation Stakeholders Forum to meet with our Tribal and State partners and share information about these campaigns.

• The Remove Program has been providing free Transportation Emergency Preparedness Program (TEPP) training along the two highway routes for several years.

• The Remove Program could not perform its function without the close communication and cooperation with our Tribal, State and Federal partners and their coordinating representatives.
Overview the Spent Nuclear Fuel program
Overview of L-Basin

- L-Basin capacity was expanded from the original reactor basin in the 1990s
  - ~3.4 Million gallons of water
  - Pool Depth 17 to 50 feet
  - Receives typical Foreign Research Reactor (FRR) / Domestic Research Reactor (DRR) Material Test Reactor Fuel Assemblies
  - One transfer bay for receipts/shipments

- Spent Nuclear Fuel is Safely and Securely Stored in a Reinforced Concrete Facility, Underwater Basin (L-Area)
- Continuous Surveillance and Maintenance is projected to achieve at least 50 additional years of safe storage
L-Basin Stored Fuels and Capacities

- L-Bundled fuel
  - Typical FRR/DRR Material Test Reactor Fuel Assemblies
  - Capacity = 3650 bundles
  - Current inventory = ~3000 bundles (~80% full)
  - Amended Record of Decision (AROD) processing decision eliminates need for new racks in the future

- High Flux Isotope Reactor (HFIR) Fuel Racks
  - 108 Cores current inventory
  - 120 Cores maximum storage capacity
  - AROD processing decision eliminates need for new racks; expected to start by 9/30/2017
• Over 400 individual isolation cans stored in 12 oversized cans

Isolation Can and Storage Racks

70 Ton Cask and railcar used for onsite transfers Removal from rail car in Transfer Bay

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Receipt Cask Handling in L-Basin

- Receive Cask/Removed Impact Limiters
- Cask Placed Under Water
- Lid Removed
- Fuel Removal & placed in bucket for transfer to Basin from Transfer Bay
- Cask with fuel ready for verification
- Decon, Reassembly & Ship Empty Cask
H-Canyon Spent Nuclear Fuel Processing

- H-Canyon is the only hardened nuclear chemical separations plant still in operation in the US.
- H-Canyon processes spent nuclear fuel to recover the highly enriched uranium and blend it to low enriched uranium for the Tennessee Valley Authority, who turns it into fuel for electricity production
- Current Campaigns:
  - 1. Target Residue Martial (TRM)
  - 2. MTR 1000 Fuel Bundles
  - 3. HFIR 200 cores (Oak Ridge)
Defense Waste Processing Facility (DWPF)

- Produced more than 1,500 canisters and poured 6 million pounds of radioactive glassified waste at the Defense Waste Processing Facility

- Designed and executed the DWPF Canister Double Stack Project
Excellence in Project Management: Melter 2

- Melter 2 reached its end of life in February 2017 - about five times longer than its design life.
- Over its 14-year lifetime, Melter 2 poured more than 10.4 million pounds of glassified waste, totaling 2,678 canisters.
Melter 2 is now encased in a 75-ton, one-inch-thick carbon steel storage box in an underground storage vault ~300 yards from DWPF
Shielded Canister Transporter

Melter 3
Stabilized and disposed of more than 10.9 million gallons of low-level liquid waste through the Saltstone Production Facility (SPF)
Designed and built SRS’ first mega-volume (32 million gallons) Saltstone Disposal Unit (SDU) from the ground up.

Completion of SDU 6 construction, which cost $120 million, came in 16 months ahead of the target schedule and more than $25 million under the target cost.
Conclusion

Michael3's removal programs thank our partners for continued outstanding and successful collaboration.

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Questions