SRS Spent Nuclear Fuel Program Overview and Status Update

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Nuclear Materials Committee requested a 2017 Work Plan topic on Spent Nuclear Fuel:

- Provide an overview of Spent Nuclear Fuel
  - Status of L-Basin Capacity - Storage
  - Status of Shipments to H-Canyon - Processing
Acronyms

AI – clad – Aluminum clad
AROD – Amended Record of Decision
CFR – Code of Federal Regulations
CNLL – Canada Nuclear Laboratories Limited
DRR – Domestic Research Reactor
DSA – Documented Safety Analysis
FY – Fiscal Year
FRR – Foreign Research Reactor
HEU – Highly Enriched Uranium
HFIR – High Flux Isotope Reactor
IAEA – International Atomic Energy Agency
ISO – International Standards Organization
LWT – Legal Weight Truck

MTR – Material Test Reactor
NRU – National Research Universal
NRX – National Research Experimental
NNSA – National Nuclear Security Administration
PBS 11C – Performance Baseline Summary for Nuclear Material Stabilization and Disposition
PBS 12 – Performance Baseline Summary for SNF Stabilization and Disposition
SNF – Spent Nuclear Fuel
SRE – Sodium Reactor Experiment
STS – Shielded Transfer System
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
  • 100% full
  • 120 Cores
  • 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
Receipt Cask Handling in L-Basin

Receive Cask/Removed Impact Limiters

Cask with fuel ready for verification

Cask Placed Under Water

Fuel Removal & placed in bucket for transfer to Basin from Transfer Bay

Lid Removed

Decon, Reassembly & Ship Empty Cask
Casks Handled in L-Basin

- **F-257**: 7,000 lbs, Max Capacity = 1 Slowpoke Core
- **JRF-90Y-950K**: 2,100 lbs, Max Capacity = 10 MTR
- **18.5T**: 41,000 lbs, Max Capacity = 30 MTR
- **20T**: 52,000 lbs, Max Capacity = 40 MTR
- **TN-MTR**: 52,000 lbs, Max Capacity = 52 MTR
- **GNS-16**: 34,000 lbs, Max Capacity = 33 MTR
- **GE-2000**: 33,550 lbs, Max Capacity = HFIR, 1 inner, 1 outer
- **BRR**: 32,000 lbs, Max Capacity = 8 MTR
- **TN-7/2**: 54,400 lbs, Max Capacity = 64 MTR
- **LWT**: 52,000 lbs, Max Capacity = 42 MTR
Processing in H-Canyon

- Provides a method to recover the uranium for reuse and eliminates potential issues with stability of the fuel form after long term storage
- Amended Record of Decision (AROD) allows:
  - Processing up to 1000 bundles and 200 High Flux Isotope Cores
- Current status of AROD campaign:
  - 60 bundles shipped to H-Canyon thus far in FY2017
  - 180 bundles shipped to H-Canyon since the beginning of the AROD campaign
  - Amount shipped and processed is dependent on funding amounts received
- H-Canyon continued processing of the L-Basin Aluminum Cladded Fuel past the AROD amounts is possible but no decision has been made to pursue this at this time
- H-Canyon currently cannot process the Stainless and Zircaloy cladded fuels stored in L-Basin (~ 10% of the inventory by volume)

Dry Storage

- Removes fuel from wet storage and places into a dried container awaiting a final repository
- Technical questions exist on how long to dry and how dry is dry for aluminum clad fuel need to be addressed
H-Canyon is the only hardened nuclear chemical separations plant still in operation in the United States.

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 Spent Fuel processing campaign for recovery of uranium began in September 2014
- Dissolving, Head End, 1st cycle, and 2nd Cycle are all operational
- Blend-down to Low Enriched Uranium is expected to begin in FY 2019
H Canyon
Highly enriched uranium process operations

1. Charge
   Spent nuclear fuel processed at SRS is from domestic and foreign reactors.

2. Dissolver
   Dissolve fuel bundles by heating nitric acid to boiling
   Converts solids to a liquid solution

3. Head End
   Clarity dissolver solution

4. First Cycle
   Process solution to separate uranium into individual streams for further processing
   Mixture-sheeter
   Uranium separated from fission products and chemical impurities
   Centrifuge separates gelatin and clarifies solutions
   Uranium separated from neptunium
   Uranium stripped from solvent into dilute nitric acid
   Evaporator
   Uranium stripped from solvent stream into aqueous stream

5. Second Cycle
   Further decontaminate uranium solution
   Mixture-sheeter
   Solution decontaminated
   Evaporator

6. Blend Down
   Resumption of blend down operations expected in fiscal year 2019

310 metric tons of low enriched uranium have been sent to the Tennessee Valley Authority since March 2003. That’s enough to power all U.S. homes for 47 days.

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Assumes FY17-FY33: Total 721 bundles in.
Receive extended Japan through 2029.
FY18: HFIR processing in the 6.4 dissolver.
MTR fuel processing switched to the 6.1 dissolver.
2QFY24: Complete 1000 bundles out.

Data based on projections which are subject to change
L-Basin HFIR Storage Capacity, Receipts, Canyon Processing

Assumes FY17-FY32 Total 174 HFIR Cores in.
FY18 HFIR processing in the 6.4 dissolver,
MTR fuel processing switched to the 6.1 dissolver.
FY29 HFIR converts to LEU and ships only remaining HEU to SRS through FY32.

Data based on projections which are subject to change
SNF Accomplishments in Fiscal Year 2017

• Received 5 FRR casks and 1 DRR cask through April 30, 2017

• Transferred 6 casks of SNF to H-Canyon for processing in FY17 as of April 30, 2017. Anticipating three more cask transfers of SNF to H-Canyon before the end of FY17

• Continued safe storage of SNF

International Standards Organization (ISO) Container containing a Legal Weight Truck (LWT) Cask

Shielded Transfer System (STS)
• Fuel is safely stored in L-Basin

• SNF is being safely transported around the US and is governed by DOT and NRC. Regulations and safeguards are in place to ensure material remains contained even during hypothetical accident conditions.

• SNF processing is occurring in H-Canyon

• Departmental Decision is needed on future direction for SNF management (i.e., fuel storage versus processing)