INL Spent Fuel Management Observations

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INMM Spent Fuel Management Seminar XXX January 2015

INL Spent Fuel Storage Facilities (~290MTHM)

- **CPP-666 –Fuel Storage Area (Basin)**
- **CPP-603 –Irradiated Fuel Storage Facility**
- **CPP-1774 –TMI-2 Independent Spent fuel Storage Installation (NRC licensed)**
- **Ft. St. Vrain, Independent Spent fuel Storage Installation (NRC licensed), Colorado**
- **CPP-2707 –Cask Storage Pad**
- **CPP-749 –Underground Fuel Storage Facility**
- **MFC Radioactive Scrap and Waste Facility**
- **Advanced Test Reactor Canal**

- **Inventory includes 2lb-1/2ton specimens; Al, SS, Zr clad; sodium-bonded, epoxy-bonded; Be and carbon matrix fuels; intact and damaged fuel; various enrichment**

Path Forward for SNF Management

- **Inventory is expected to grow slightly**
  - Domestic and Foreign Research Reactor (D/FRR) receipts will continue
  - ATR will continue to generate SNF – DOE-NE
  - Some fuel may be received and stored for research
- **Idaho will continue to safely manage SNF in existing facilities**
  - Authorization basis through 2035 (continuous surveillance and maintenance)
  - Ft. St. Vrain (CO) and TMI NRC regulated facilities continue operation
  - License renewal for TMI ISFSI will be submitted in 2019
  - Storage of fuels for research will continue
- **Focus on aging management and management alternatives**

Key State Drivers/Court Order

- **1991 - Idaho files suit asserting DOE violated NEPA by not analyzing environmental impacts of spent fuel storage and transportation**
- **1995 – 1995 Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (DOE/EIS-0203) and RODs**
- **October 1995 – Lawsuit settled. DOE, Navy, and State of Idaho execute a Settlement Agreement [*Consent Order in United States of America v. Batt, Civil No. 91–0054–S–ELJ (D.Id.)***
  - E.8., "DOE shall complete the transfer all spent fuel from wet storage facilities at INEL by December 31, 2023."
  - C.1., "DOE shall remove all spent fuel including naval spent fuel and Three Mile Island spent fuel from Idaho by January 1, 2035." (Removal of FSV fuel from CO)
  - F.1 "DOE shall establish INEL as the DOE Spent Fuel Lead Laboratory to direct the research, development and testing of treatment, shipment and disposal technologies for all DOE spent fuel.."
  - E.5. DOE shall complete calcination of sodium-bearing liquid high-level wastes by December 31, 2012.

Consent-No single definition

- **Environmental Impact Statement (EIS) /Records of Decision (ROD) is a sound consent-based process that includes considerable host jurisdiction input from scoping through final decision**
  - RODs drive waste management approach/technology at INL-not usually date certain
  - NEPA process under continuous improvement
  - EIS does not result in BRC recommended consent-based process governed by legally-binding agreements between federal government and host jurisdictions
- **The Settlement Agreement is a court-ordered legally-binding agreement between the federal government and the State of Idaho**
  - Specific Agreement milestone dates drive schedule/budget requests for waste management operations
  - Ability to meet milestone dates may be affected by the unanticipated

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DOE Storage Facilities Need a Standardized Approach for Aging Management

- **Lacking a repository, Idaho will manage SNF in existing facilities, possibly beyond the authorization basis (2035). Facilities are aging and there is a need to understand and mitigate the vulnerabilities of these facilities.**
  - Recommend post-2012 contract(s) SOW include a set of life-cycle extension studies for all DOE-regulated SNF storage facilities.
  - Recommend more attention be paid in post-2012 contract SOW to S&M necessary to maintain Idaho Site infrastructure.
  - Studies would be similar to the NRC license renewal required life-cycle extension studies.
  - Have identified major upgrades needed for CPP-603.

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National Spent Nuclear Fuel Program: Successful Model to Integrate SNF Management

- **1992 – Secretary of Energy directs development of an integrated SNF Management program**
- **1994 – DOE publishes SNF Strategic Plan**
- **1995 – Settlement Agreement directs INEL as the DOE Spent Fuel Lead Laboratory to direct the research, development and testing of treatment, shipment and disposal technologies for all DOE spent fuel..”**
- **1995 –Today National Spent Nuclear Fuel Program directed to perform these duties for DOE. Highlights include:**
  - Development of standardized canister design for all DOE fuel
  - Single POC for repository technical analyses and issues for DOE SNF/HLW
  - Maintenance of detailed SNF database
  - Perform waste package thermal, structural, and radiation analyses
  - Staff serve as bridge to EPRI, NEI, DOE labs, technical organizations

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Summary

- **Consent does not have a single definition**
- **DOE can learn from NRC’s efforts for aging management**
- **The National Spent Nuclear Fuel Program is still a component of the Settlement Agreement though funding is limited. Funds projected for FY15 are to update and migrate to a modern system, the spent fuel data base to include all DOE SNF. Other activities under discussion.**

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Background slides

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Characteristics of DOE SNF

- **Fuel forms**
  - Rod array, element, plate array, annulus, blocks, pins
- **Fissile radionuclides**
  - U-233, U-235, Pu based fuels
- **Fissile enrichments**
  - Ranges from depleted Uranium to 93%
- **Cladding types**
  - Aluminum, Stainless Steel, Zircalloy, Hastelloy, Inconel, Nichrome
- **Fuel compounds**
  - Alloy, oxide, carbide, nitride, hydride, metal, silicide

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Characteristics of DOE SNF cont.

- **Matrices**
  - Aluminum, graphite, ceramic, and stainless steel
- **Condition**
  - Intact, cropped, corroded, disassembled
- **Dimensions**
  - 0.06 inch to several inches wide
  - 4 inches to nearly 15 feet long
- **Burnups**
  - From less than1,000 to over 500,000 MWd/MTHM
  - 0.1% to over 70% of original fissile material

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Spent Fuel Facilities

SNF storage configurations

- **CPP-666 –Fuel Storage Area (Basin)**
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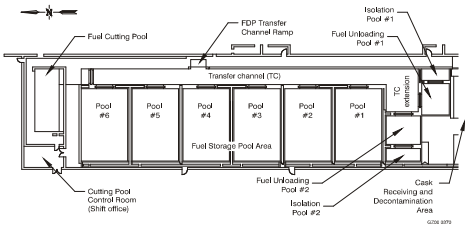
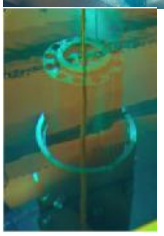
Fuel Storage Area (FSA) CPP-666

- **First fuel received 1984**
- **Fuel storage to support processing through 1992**
- **Fuel storage mission since 1992**
- **Current Inventory, based on storage positions**
  - <30% filled, 70%> empty positions
  - Of the positions filled, Navy 60% , ATR 10% ,EBR-II 30%
  - 2 spent fuel casks store 208 cans of miscellaneous fuel

Loading a basket in a dry storage cask



South



Loading a basket in a dry storage cask

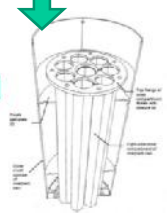
Fuel Storage Area (FSA) CPP-666 cont.

- **Current Scope**
  - Routine Surveillance & Maintenance
  - Navy Returns project thru 2017/2018 (+103 cans)
  - Receive Advance Test Reactor (ATR) SNF; 15 shipments/yr. through 2020; Send EBR II to Materials and Fuels Complex (MFC) for treatment
  - Resin Bed Replacement: $7M
- **Future (through 2023)**
  - ATR Transfers out of wet storage in CPP-666 by 2023 (?)
  - EBR II 3,624 total bottles 227 shipments total, 12 complete leaving 115 to complete by 2023, 6 planned in FY15.

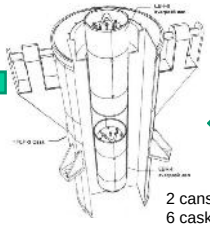
Experimental Breeder Reactor II (EBR II)

EBR II Fuel packaged in stainless steel bottles at MFC and sent to INTEC in1997 and 1988, stored 8 bottles per basket

8 bottles removed from basket and loaded in shipping can (underwater @ 30')



2 cans loaded in HFEF 6 cask, underwater



16 bottles per shipment INTEC to MFC

EBR II Transfer from CPP-666 Wet Storage to MFC for processing

Irradiated Fuel Storage Facility CPP-603

- **Commissioned 1974**
  - Constructed for Fort St. Vrain graphite fuel
  - Shielded dry storage area
  - Shielded Cave for maintenance
  - Conditioning Station to dry fuel

- **Current Inventory**
  - 91% capacity (w/o CSE and fuel consolidation)
  - 18.6 metric tons
  - ~ 20 types of SNF/ fissile material
- **Current Scope**
  - Routine surveillance & maintenance
  - DRR/FRR Fuel Receipts (suspended until SBW treatment is complete)
  - Project for NE in CPP-603
  - Austria fuel swap (2012)
- **Future Work**
  - Upgrades to support fuel retrieval for Settlement Agreement driven off-site shipments
  - Opportunity for optimization of storage array through analysis, fuel consolidation and investment in equipment modification
  - Conditioning Station – if ATR is sent to CPP-603 (repairs required)

DOE Facilities Licensed By the NRC

- **DOE-ID holds 3 NRC licenses granted under 10 CFR Part 72**
  - SNM-2504 Fort Saint Vrain (FSV), expires 2031 located in Platteville Colorado
  - SNM-2508 Three Mile Island (TMI) expires 2019 located at INTEC
  - SNM-2512 Idaho Spent Fuel Facility (ISFF, not constructed) expires 2024

NRC – Fort Saint Vrain

- NRC licensed Ft. St. Vrain Independent Spent Fuel Storage Installation (ISFSI) is located in Platteville, CO
- License SNM-2504
- Constructed in 1989 by public Services of Colorado
- Licensed in 1991
- License transferred to DOE in 1999
- 20-year license renewal granted in July 2011 extending through 2031 included an development of an aging management program
- Stores 1,464 graphite high temperature gas cooled reactor elements in 244 fuel storage canisters.
- Recent significant changes including request in May 2014 for FY 15 LICP
- Security upgrades, cost risk

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NRC - Three Mile Island Unit 2 (TMI-2)

(DOE leased the shipping cask shown here)

- **Licensed March 19, 1999**
- **Started loading March 30, 1999, Completed April 20, 2001 (Settlement Agreement)**
- **Current Inventory**
  - 29 of 30 HSMs loaded
  - TMI-2 debris
  - 81.4 metric tons
- **Current Scope**
  - Routine surveillance & maintenance
  - Prepare license renewal application– NRC License Renewal Application due by March 2017; 20-year renewal
  - Aging management program development
  - Technology development (EM funded)

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TMI-2 NRC Relicensing

Crack in HSM Wall

$CaCO_3$ On HSM Floor

Discoloration

Weld

- Tested the scope and delivery system to view several SSCs Important to Safety including concrete surfaces, Dry Shielded Canister (DSC) overpack, and support structure.
- Provided value in assessing for the first time aging conditions in a normally inaccessible area of an HSM to support license renewal/life extension.
  - Gradient of discoloration on protective coating of DSC
  - Accumulation of calcium carbonate
  - Discoloration on DSC overpack
  - Concrete cracks
  - Good hardware/weld conditions

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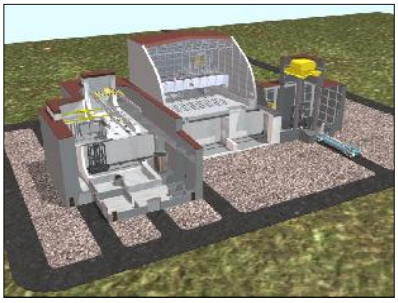
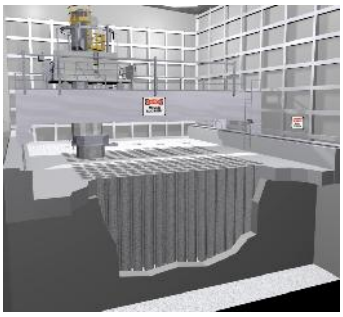
Idaho Spent Fuel Facility Concept





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SNF Characterization, Packaging, Packaged Storage and Load-out

- **The current ISFF design is licensed by NRC. It has not been constructed.**
- **Its mission is to receive Idaho SNF; examine/characterize SNF, as necessary for repository, interim storage or process facility acceptance; package SNF in standard canisters; store enough packaged SNF to prevent transport system impacts; and load packaged SNF into truck casks for transport off site.**
- **The facility may be redesigned to:**
  - Provide additional unpackaged SNF storage.
  - Accommodate SNF not currently assigned to Idaho (Oak Ridge HIFR).
  - Provide additional packaged storage.
  - Provide load-out to truck and rail transport systems.

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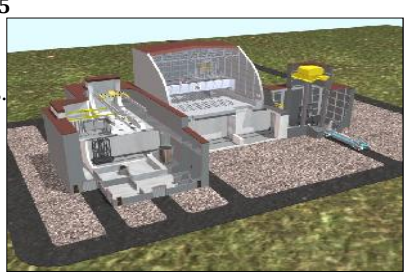
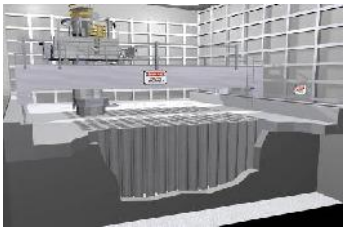
Idaho Spent Fuel Facility (ISFF)

- **ISFF – provide capability to package and ship all SNF from Idaho and Colorado by January 1, 2035**
  - Cask receipt, Characterize (NDE only) and condition (dry),package SNF in DOE standardized canisters, add poisons when required, seal weld and back-fill with an inert gas.
  - Store 300 canisters of SNF for transfer to repository.
- **CD-0 Mission Need November 20, 2007.**
- **CD-0/1 – 2017 through 2019**
  - Develop and evaluate alternatives including alternate fuel disposition paths, treatment recommendations and reuse of existing facilities
  - Conceptual design report including a cost estimate and schedule
- **CD-2 – 2021 Design to support project baseline approval**
- **CD-3 2023 Project approved for construction**
- **ISFF - Current NRC License includes only Shippingport, Peach Bottom, and TRIGA fuel**
- **LCB TPC: $1B**
- **LCB OPEX: $1.058B**
- **LCB D&D: $ 35M**





CPP-2707 Dry Cask Storage (DCS)

- **Pad commissioned Oct. 2004**
- **West Valley rail cars/ casks received July 2003**
- **NE periodic interest – Demonstration to support high burn-up fuel performance (2707 & CPP-603)**

- **Current Inventory, Pad**
  - Bolted lid cask
  - 10 types of “commercial” fuel SNF
  - 42 metric tons heavy metal
- **Current Inventory, Rail Cars**
  - 25.7 metric tons
- **Current Scope**
  - Routine surveillance & maintenance
  - Pressure & Temperature Trending
  - Gas Sampling
  - Relocate WV cask to pad by 9/30/2014
  - Additional Storage space available on concrete pad.

Background CPP-749 Underground Fuel Storage

- Storage vaults, variety of diameters
  - First Generation Vaults
    - Commissioned 1970
    - 54 of 61 vaults loaded (88%)
  - Second Generation
    - Commissioned 1984
    - 74 of 157 vaults loaded (45%)
- 5 fuel types stored 35.8 metric tons heavy meal
- Current Scope
  - Routine Surveillance & Maintenance
  - Pressure & Temperature Trending
  - Gas Sampling
  - Fuel retrieval/cask transfer beginning after 2025
  - Empty storage positions are available.

Materials and Fuels Complex SNF/HLW Storage

- **Sodium-bonded SNF from the Experimental Breeder Reactor-II is stored in dry, in-ground shielded steel cylinders in the Radioactive Scrap and Waste Facility.**
- **Sodium-bonded SNF from the Hanford Fast Flux Test Facility is stored in the Hot Fuel Examination Facility shielded hot cell.**
- **These SNF will be treated in the electrometallurgical treatment process in the Fuel Conditioning Facility.**
- **The uranium product, ceramic HLW form and metal HLW form from electrometallurgical treatment are stored in in-ground shielded steel cylinders in the Radioactive Scrap and Waste Facility.**