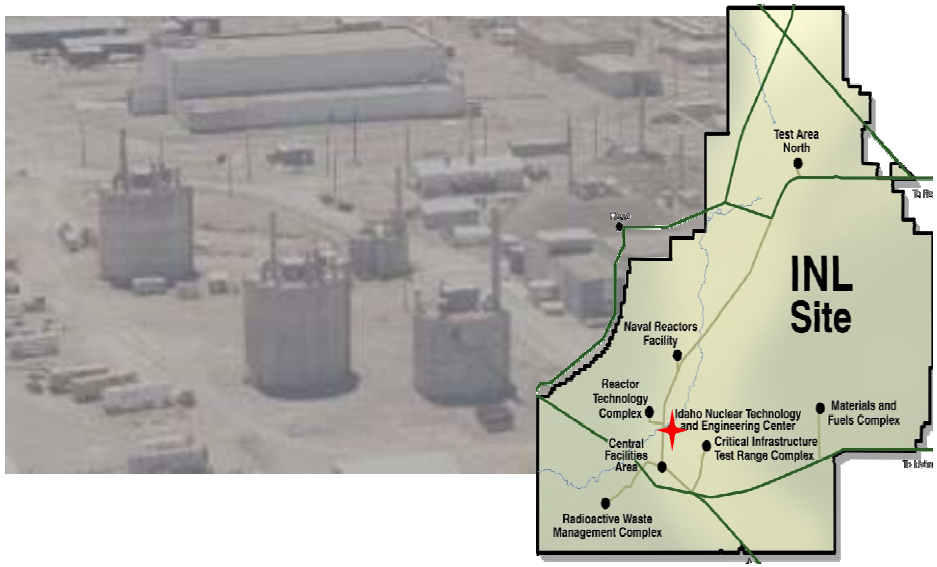
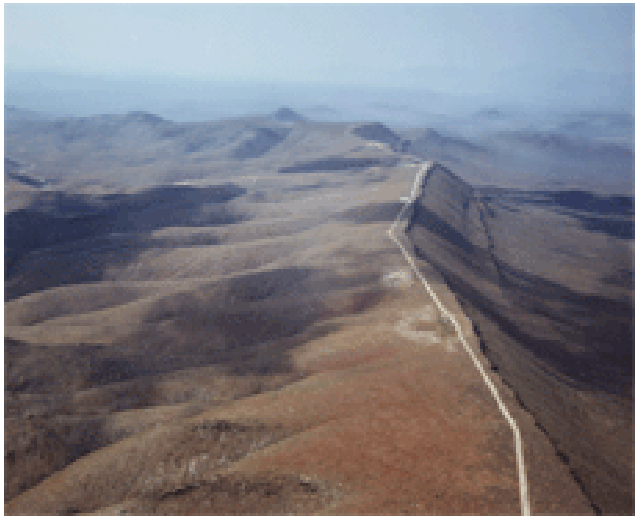
Overview of the High Level Waste (HLW) Program

at the

Idaho National Laboratory (INL) Site

Description, Challenges, Technology, Issues, and Needs



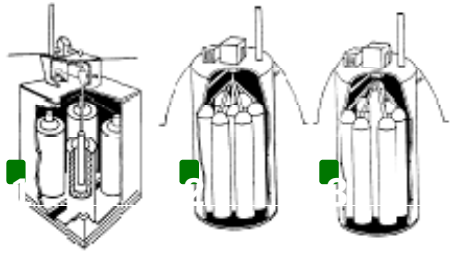


April 1, 2008

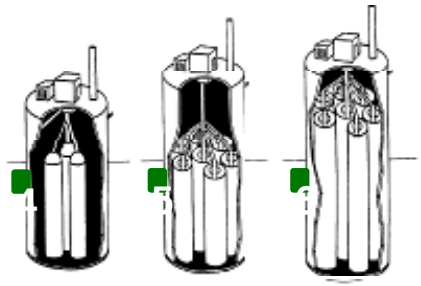
INL Site HLW is in Dry Storage in the Form of Calcine

- ***8-9M gallons of liquid HLW were converted to 4400 cubic meters of granular solid (calcine) through a fluidized bed calcination process***
  - 7 to 1 volume reduction achieved
    - *Average particle size is 0.4 cm*
    - *Bulk density is about 1.5 to 1.8 g/cc*
  - Contains roughly 44 metric tons heavy metal

- ***Calcine is stored in 43 bins in 6 concrete-shielded binsets with one spare***
  - 7th set of bins – intended for calcined SBW
  - Designed for 500 year service life



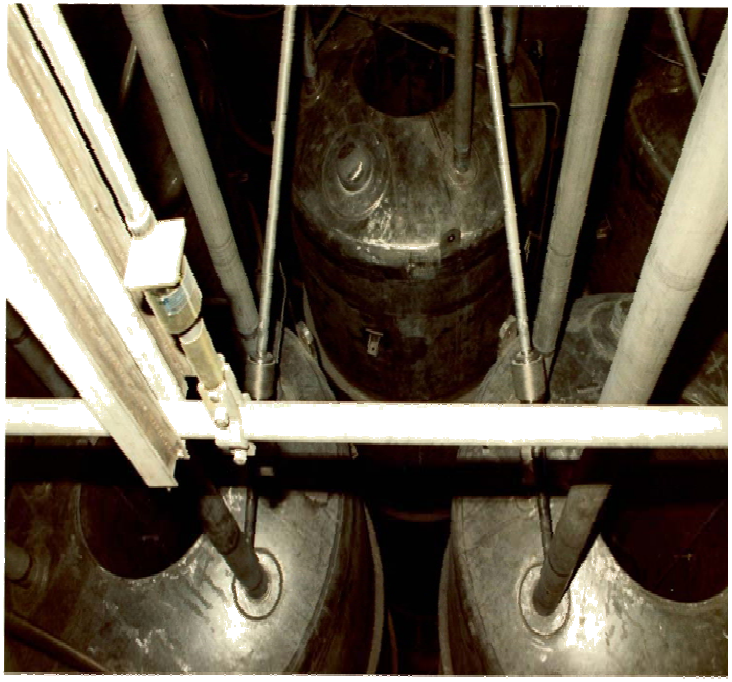
- ***Calcine is classified as hazardous waste under RCRA***
  - Exhibits hazardous waste characteristics for toxicity for meta
  - Contains listed wastes



- ***Currently stored under 10-year RCRA Part B permit issued November 2006***
  - 2007 visual inspection of bins – no adverse findings
- ***The Calcine Disposition Project (CDP) is established to meet:***
  - Settlement Agreement and Site Treatment Plan requirements

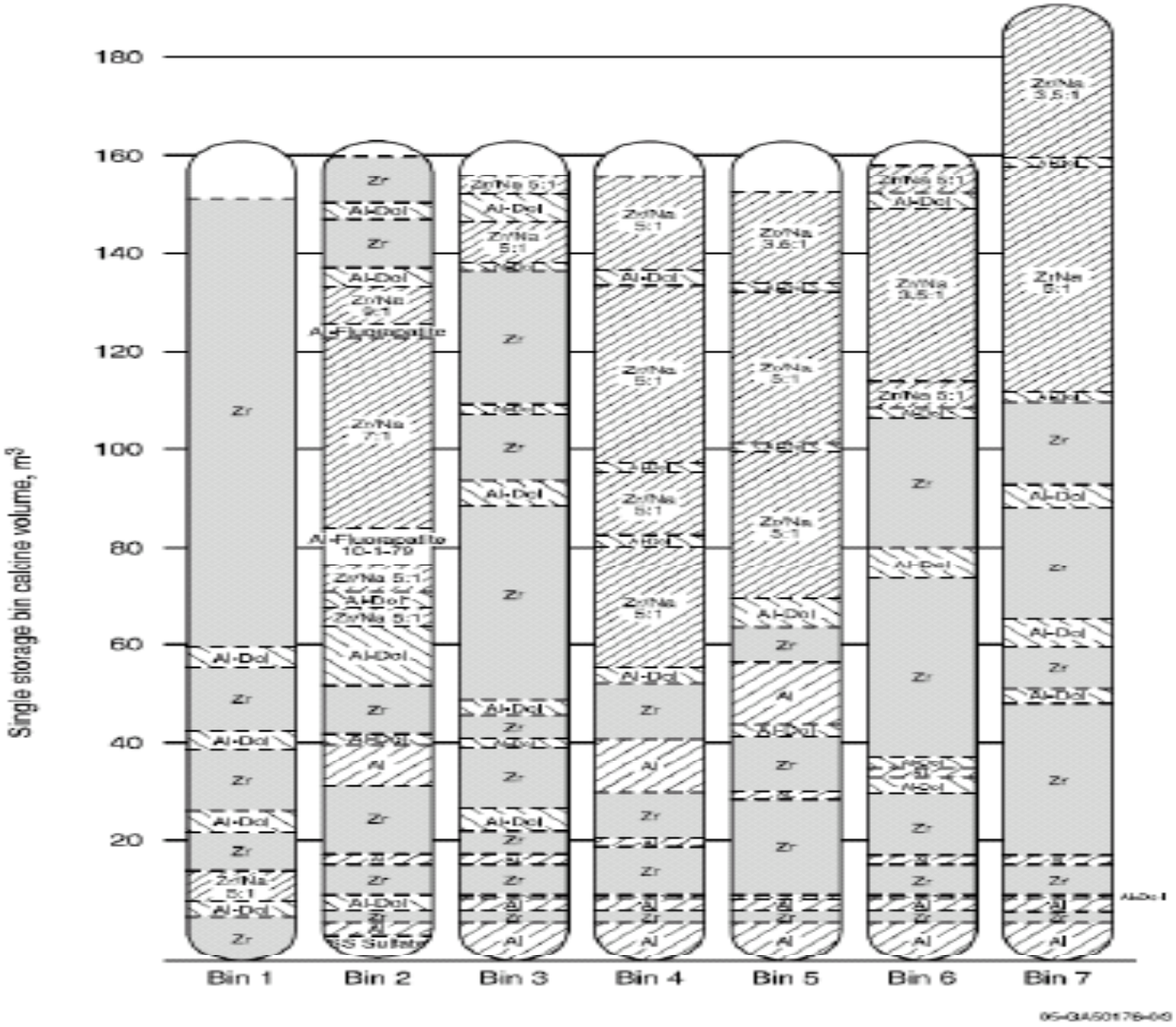
Calcine Bin Set # 6

Model of Bin Set #6



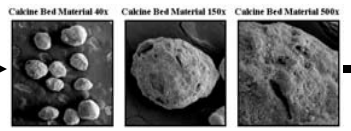
Top view of CSSF #6 bins

Technical Challenge: Layering of Calcine (Bin Set #3 shown)



Current Disposal Options for Calcine Remain as Follows:

- ***Retrieve, package and dispose of as is (direct disposal option)***
  - Idaho baseline approach – highest regulatory risk, lowest cost
  - Requires conditional exemption from RCRA
  - Granular waste form



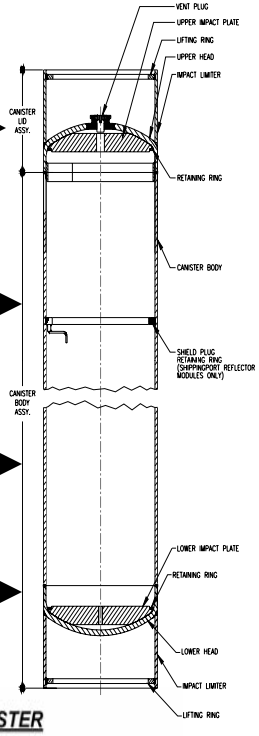
- ***Treatment by hot isostatic pressing***
  - Volume reduction – being evaluated by BEA and ANSTO, Inc.
  - Monolythic waste form – requires delisting
  - Could compact (~50% volume reduction) either of above

50% Volume reduction of granular form

30% Volume Reduction

- ***Treatment by steam reforming***
  - Maximizes re-use of IWTU
  - Requires re-dissolution of calcine in nitric acid
  - Granular waste form – requires delisting

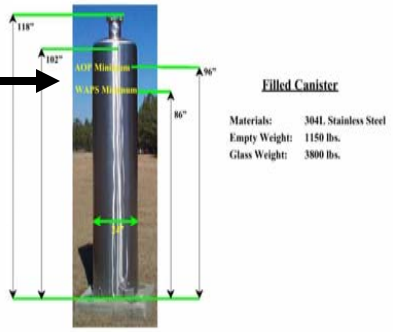
50-100% Volume Expansion



CANISTER

- ***Treatment by direct vitrification***
  - Lowest regulatory risk – highest cost and volume
  - Monolythic waste form – requires delisting

100% Volume Expansion



Basis for Pursuing the Direct Disposal Option

- ***INL conducted preliminary long-term performance sensitivity analysis using Yucca Mountain Total System Performance Assessment (TSPA) model used in the Final EIS***
  - Hazardous constituents do not migrate beyond the repository boundary in concentrations above health-based levels at the radionuclide compliance point established in 40 CFR 197 during the proposed 1,000,000-year regulatory period
- ***INL also ran EPA's Industrial Waste Evaluation model using conservative site-specific data/assumptions for Yucca Mountain***
  - Results show that health-based limits are not exceeded at the hypothetical well (1 mile away) for any hazardous constituent
- ***Modeling suggests no significant environmental benefit associated with further treatment***
- ***DOE is thus planning to petition EPA for a conditional exemption of calcined HLW from the regulatory definition of hazardous waste based on disposal at an NRC-licensed geologic repository and an exemption from land disposal prohibitions based on a no-migration demonstration***
  - Regulatory precedent is "*Conditional Exemption for Low-Level Mixed Waste Storage and Disposal"* found at 40 CFR 266, Subpart N
  - Human health and environmental protection requirements for geologic repository more stringent than requirements for low-level waste disposal

Basis for Pursuing the Direct Disposal Option (cont.)

- ***An INL petition would seek to demonstrate that an NRC-licensed repository will be as protective or more protective than a disposal unit permitted under RCRA***
  - DOE-ID **needs access** to the revision of the TSPA model supporting the NRC Yucca Mountain License Application to update the 2004 draft petition
  - NRC's confirmatory model will also be run
- ***DOE-ID has recently opened discussions with EPA (Region 10) on the regulatory feasibility of the direct disposal approach and well as the treatment alternatives***
  - Obtain feedback as to what EPA's expectations are regarding the proposed petition for direct disposal without further treatment and the three treatment alternatives
  - The impact of the state of Nevada's RCRA authority was also discussed

Further Evaluation of HIP Option Appears Warranted

Consolidation:	HIP	Vitrification (JHM)
Matrix:	glass-ceramic	borosilicate glass
Waste loading:	**60-90%**	**20-35%**
Durability (PCT-B):	10-100 x EA glass	10 x EA glass
Final volume: (relative to untreated calcine)	**15-45% reduction**	**100+% increase**
Temp:	2200ºF	2100ºF
Pressure:	4500 psi	atmospheric
Off-gas:	minimal	medium-high
Facility		
Future Mission Flexibility:	diverse/flexible	extremely limited/inflexible

Cold calcine in glass-ceramic matrix

Direct SBW compaction (no additives)

Metal encapsulation of uneconomic feeds (Swedish SNF in copper shown)

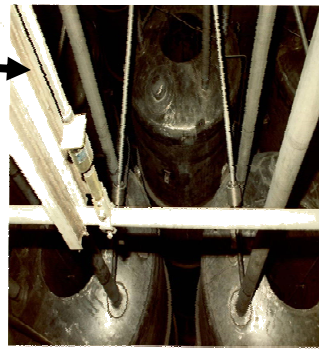
Technology Initiative: HIP Evaluation Funded by EM-20

- ***Contract between Battelle Energy Alliance and the Australian National Science and Technology Organization, Inc. was signed 2/28/2008***
  - Currently funded at $2.5M (FY-07 funds)
  - Will provide data to be used in downselection of treatment alternatives
- ***Presents opportunity to maximize return on investment by:***
  - Diversifying DOE's technology platform and reducing technical risk by producing and evaluating wasteforms with surrogate (non-radioactive) materials
    - Glass-ceramic waste forms for INL calcines
    - Direct HIPing of INL calcines and SBW (50% volume reduction plus monolith)
    - Encapsulation of corroded fuel cladding, hulls, pins etc.
    - Immobilization of other waste difficult to vitrify in conjunction with ceramic or glass-ceramic matrices such as:
      - *Technetium, U-233, impure Plutonium, Cesium, Iodine, …*

- ***DOE-ID currently has a HIP unit installed in the HFEF hot-cell at INL***
  - Will use to evaluate remote operations (filling, crimping, etc.)
- ***DOE-ID needs an additional $2.5M to complete scope***
  - FY-09 funding may not be timely if in a continuing resolution

DOE is in the Process of Meeting with EPA

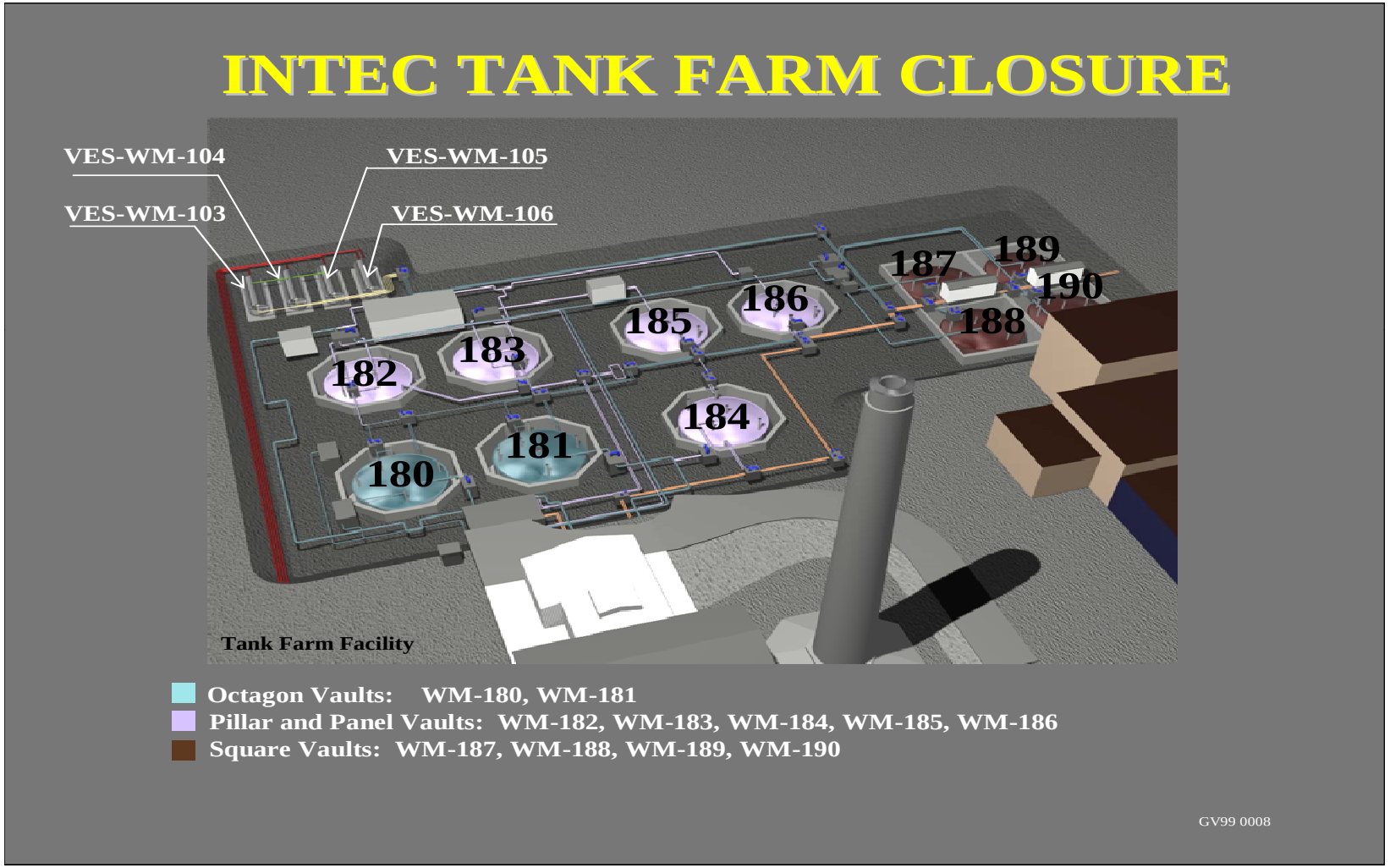
- ***EPA regulatory action will/may be needed to allow disposal of certain Department of Energy (DOE) wastes at a Nuclear Regulatory Commission (NRC) Licensed Geologic Repository***
  - Meeting with Dr. Bartus (EPA R-10) held February 5, 2008
- ***Wastes that <u>may</u> require EPA regulatory action include:***
  - Hanford Richland Office cesium/ strontium capsules
  - Idaho National Laboratory (INL) Site sodium-bonded fuel
- ***Wastes that <u>will</u> require EPA regulatory action include:***
  - Hanford Office of River Protection Immobilized HLW
  - INL HLW calcine



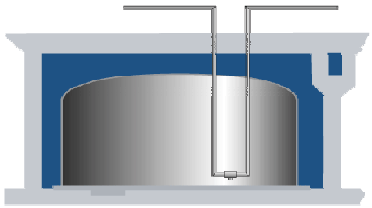
FERMI & EBR-II Sodium-Bonded Spent Nuclear Fuel (SNF)

- ***Though not HLW, the presence of metallic sodium (Na) may exhibit RCRA reactivity characteristics requiring treatment or EPA regulatory action***
  - Na is integral to the SNF (inside cladding), provides heat transfer bonding agent
  - Reaction rate of Na exposed to air or water is energetic
- ***Fermi blanket assemblies have low burn-up and cladding is intact***
  - A process (MEDEC) is being evaluated that evaporates Na off into a deactivation trap
    - The assembly is then canned (if necessary) for disposal in DOE standardized canister
  - Fermi driver assemblies are not Na-bonded
- ***EBR-II Driver assemblies are fissured and require treatment***
  - High radiation levels & burn-up caused sodium to permeate fuel meat
    - Cladding unravels in CPP-666 when storage cans (10% of which) leak
  - Pyrochemical processing is used to separate assemblies into uranium and two disposable wasteforms
    - A ceramic that stabilizes fission products that form chlorides
    - A stainless/zirconium wasteform stabilizes cladding hulls and noble fission products
  - EBR-II blanket assemblies are intact and may lend themselves to treatment similar to FERMI
- ***Treatment of FFTF SNF is similar to EBR-II***

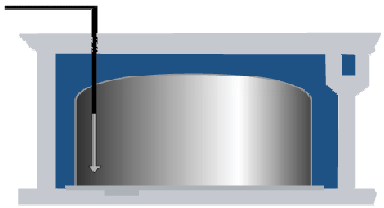
Tank Farm Closure is Progressing at the INL Site



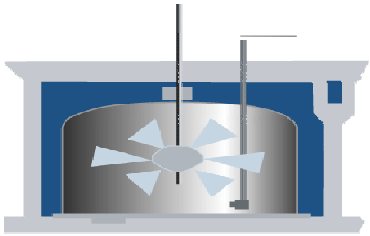
Tank Closure Sequence



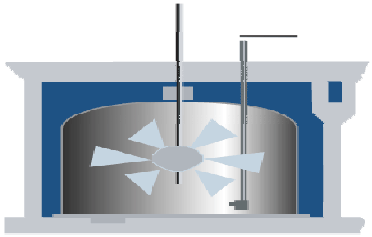
Empty to heel with existing jets



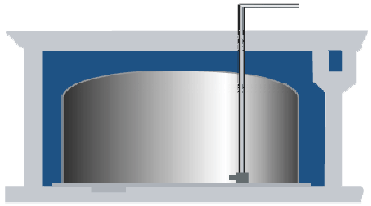
Flush piping into tanks



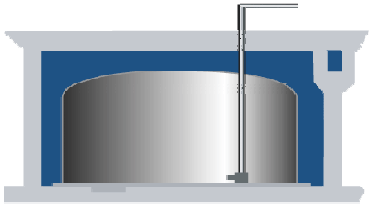
Install new steam jet and wash equipment



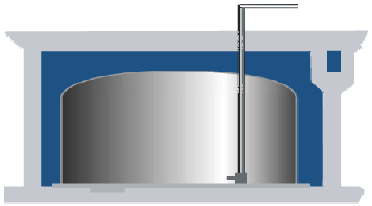
Wash tank and empty with new jet



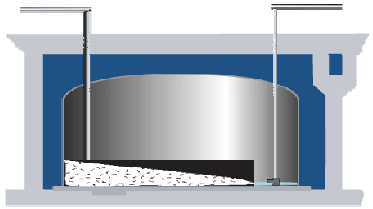
Video and sample tank residuals



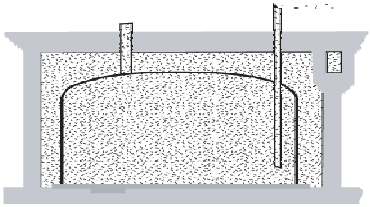
Tank evaluation



Obtain authorization to grout



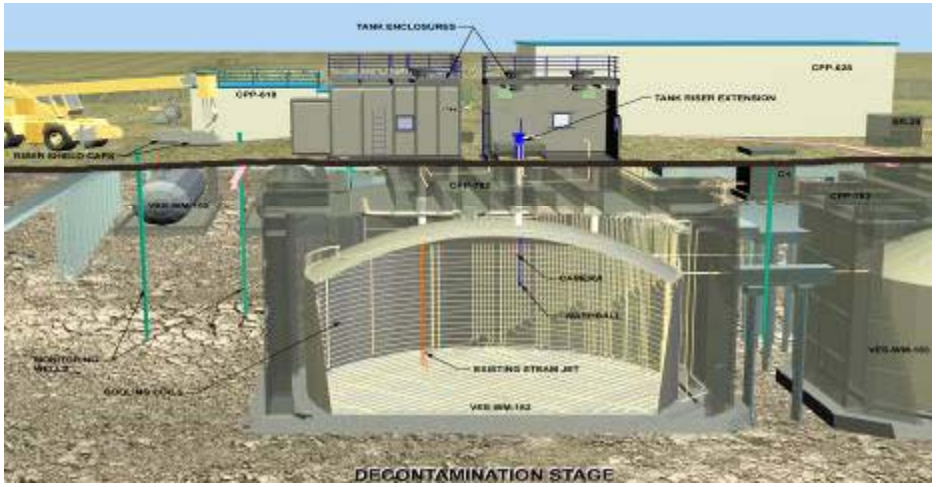
Displace heel with grout

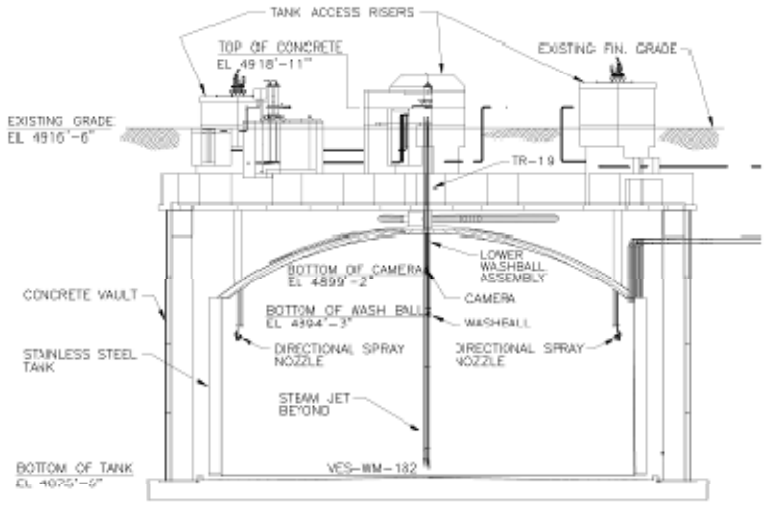


Fill tank, piping and vault with grout

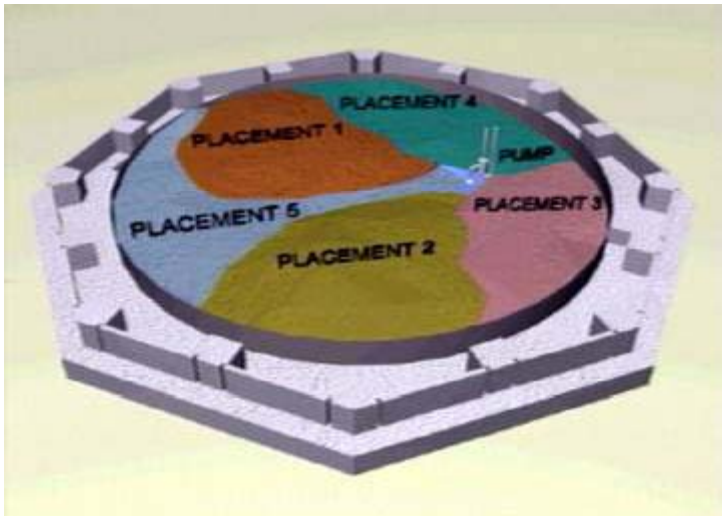
05-GA50260-05

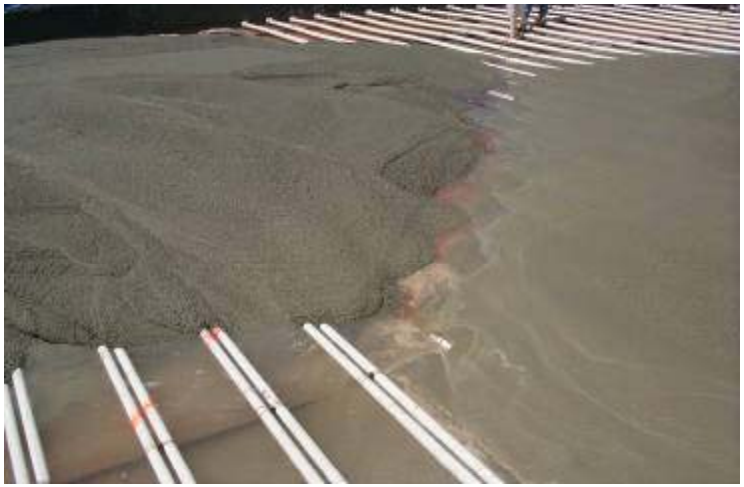
Cleaning of HLW Tank VES-WM-182





Grouting of HLW Tank VES-WM-182





Integrated Waste Treatment Unit Project

- ***Project mission is to provide treatment of approximately 900,000 gallons of liquid tank waste stored at the Idaho Tank Farm Facility to a stable waste form for disposition at the Waste Isolation Pilot Plant***
  - Became necessary due to decision to cease New Waste Calciner operations
  - Integrated with Calcine Disposition Project to support follow-on calcine mission
- ***Project is a Line Item Capital Project within the Idaho Cleanup Project (ICP) contract awarded to CH2M*WG, LLC on March 23, 2005***
- ***Steam Reforming is the treatment technology (December 2005 Record of Decision)***
  - Current flowsheet produces a carbonate waste form for disposal at WIPP
    - *Mineralized flowsheet is also developed*
  - Technology also under consideration for treatment of calcine (if necessary)
- ***Project Performance Baseline:***
  - Critical Decision (CD) -2 approved in December 2006
  - CD-3 approved in August 2007
  - Total Project Cost is estimated at $461M (includes $80M of management reserve/contingency)

Work Continues Through Idaho Winter

Weather Enclosure In Place
November 5, 2007

Shield Wall Formwork in Progress
March 10, 2008

Regulatory Challenges: Calcine Disposition & SBW Project Drivers

- ***Meet Idaho Settlement Agreement (ISA) milestones***
  - Issue a NEPA **Record of Decision (ROD) by 12/31/ 2009** to identify method to treat calcine (if necessary)
    - *Dual path ROD may carry forward both a treatment and the direct disposal option*
  - Submit a **RCRA Part B Permit application by 12/1/2012** to the state of Idaho for retrieval and treatment (includes packaging)
  - **Complete "calcination" of all SBW liquid high-level waste by 12/31/2012**
  - Have all **calcine ready for transport out of the state of Idaho by a target date of 12/31/2035**
- ***Meet RCRA 1992 Non-Compliance Consent Order for Tank Closure***
  - **Closure of all liquid HLW tanks by 12/31/2012**
- ***Meet Idaho Site Treatment Plan (STP) milestones***
  - Approval of **CD-0 by June 30, 2007**
    - *Approved June 29, 2007 by Deputy Secretary Clay Sell*
  - Approval of **CD-1 by September 30, 2009**
  - Submit an **enforceable schedule** for disposition of calcine (including design, construction, and start of operations) **by June 30, 2010**
- ***Both required to fulfill commitments in 2005 ROD from the Idaho HLW and Facilities Disposition EIS - DOE/EIS-0287***

INL Site HLW Program in a Nutshell

- ***The INL Site HLW program currently consists of 4400 cubic meters of calcine located in 6 bin sets and will require EPA regulatory action***
  - Classification of SBW waste is subject to a future Section 3116 waste determination
  - Sodium-bonded SNF may likewise require EPA regulatory action prior to disposal
- ***The INL Site HLW program is making progress in meeting the EM mission***
  - Idaho Nuclear Technology and Engineering Complex Tank Farm closure
    - *Seven large and 4 small tanks are grouted, with four large SBW tanks remaining*
    - *Upon closure, DOE-ID EM will be out of HLW, SBW, and SNF wet storage*
  - Calcine Disposition Project is working to meet regulatory/legal commitments
    - *Conceptual design of retrieval system is complete, technology downselection is on track*
    - *DOE-EM, ID, RW, and GC are engaged in the need to approach EPA on calcine disposition alternatives*
    - *Meanwhile, calcine storage is considered environmentally safe for the foreseeable future*
  - The IWTU facility is under construction
- ***DOE-ID needs the following assistance from EM-HQ***
  - Additional funding for the HIP technology evaluation initiative (2009 NEPA ROD)
  - Assistance in obtaining access to the RW TSPA model (2011 Amended ROD)