Idaho Cleanup Project

Calcine Disposition Project

Presented To: U.S. Nuclear Waste Technical Review Board

Presented By: Joel Case
Federal Project Director
Calcine Disposition Project

January 9, 2012

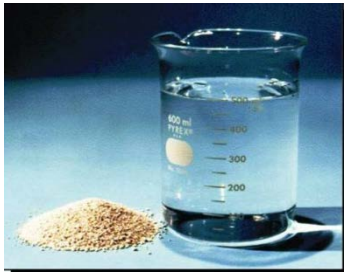
Presentation Objectives

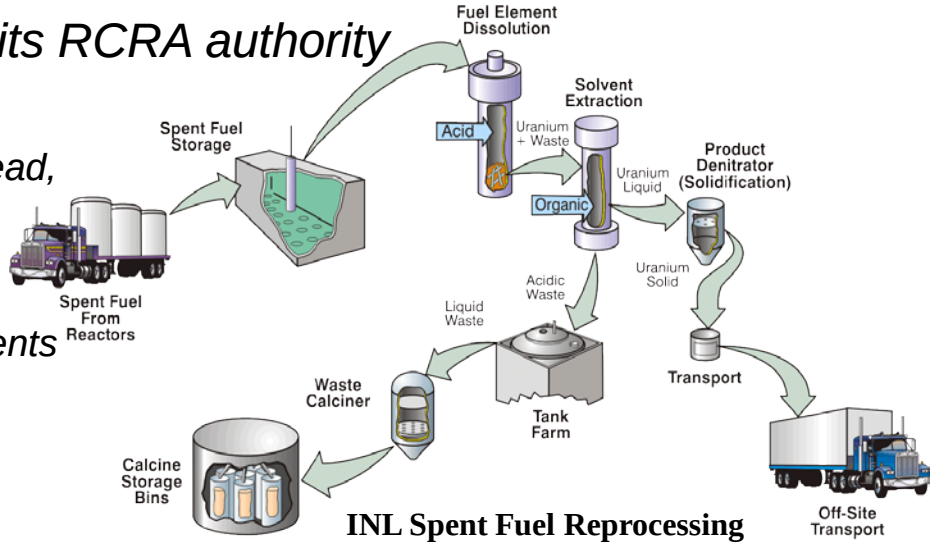
- *Project Background*
- *Project Drivers*
- *Project Scope*
- *Current Status*

Background - Calcine

Calcine is Solidified radioactive waste from Spent Fuel Reprocessing

- *Converted the liquid high level waste into a granular solid using a thermal process referred to as calcination*
- *Resulted in a 7 to 1 volume reduction*
- *Calcine Properties*
  - *Mixed hazardous/high-level waste*
  - *Dry, friable powder that is dispersible and can be mobilized in both air and water*
  - *Stable noncorrosive form*
- *Regulated by the State of Idaho under its RCRA authority*
  - *Eight RCRA Metals*
    - *Arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver*
  - *Four RCRA Listed Waste Codes*
    - *F001 & F002 – Spent halogenated solvents*
    - *F005 – Non-halogenated solvents*
    - *U134 – Unused hydrofluoric acid*

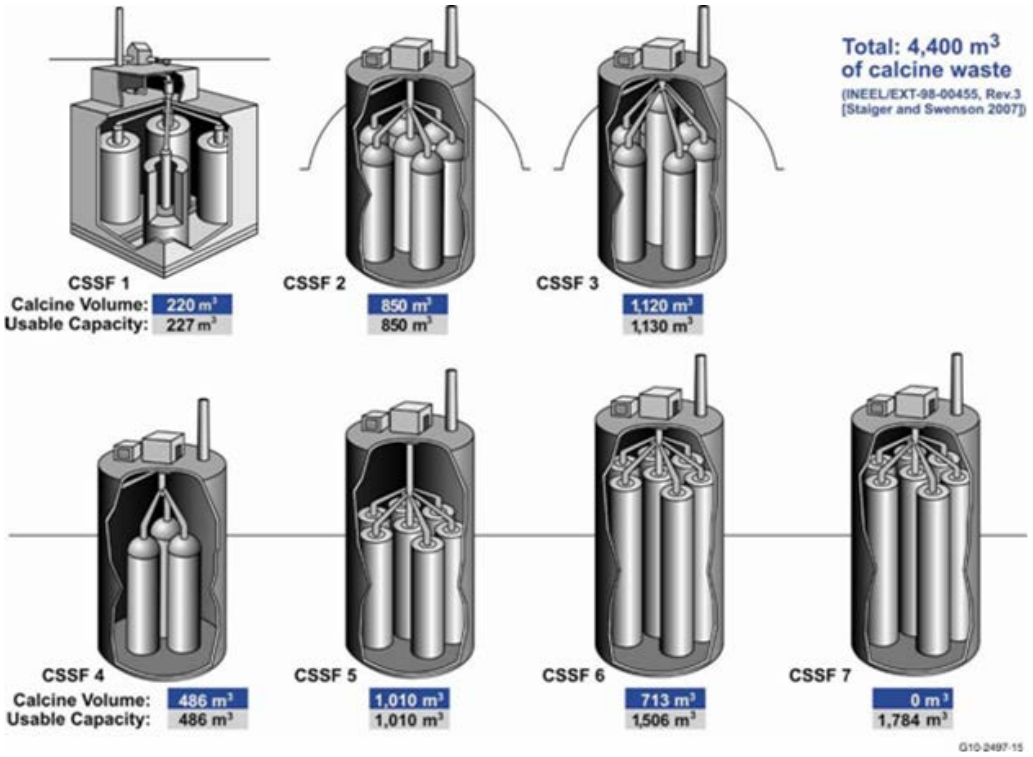




INL Spent Fuel Reprocessing

Background - Calcine Solids Storage Facility (CSSF) Inventory

- *Stored in 43 stainless steel bins*
- *Regulated under a 10-year RCRA Part B Permit Issued November 2006*
- *Compliance is based on a State-approved exemption from RCRA double containment requirement that requires periodic State approval to remain valid.*



Calcine Solids Storage Facility

Project Drivers

- ***Idaho Settlement Agreement milestones***
  - *Issue a Record of Decision (ROD) by December 31, 2009 to identify method to treat calcine (issued December 23, 2009, identified Hot Isostatic Press as calcine treatment process)*
  - *Submit RCRA Part B Permit Application or Permit Modification Request for HIP process and calcine retrieval to the State of Idaho by December 1, 2012*
    - *May include SBW HIP processing schedule*
  - *Calcine road ready for transport out of Idaho by December 31, 2035*

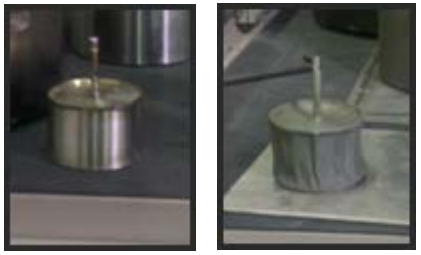
- ***Idaho Site Treatment Plan Milestones***
  - *Submit project milestones by December 31, 2012*

Calcine Disposition Project Scope

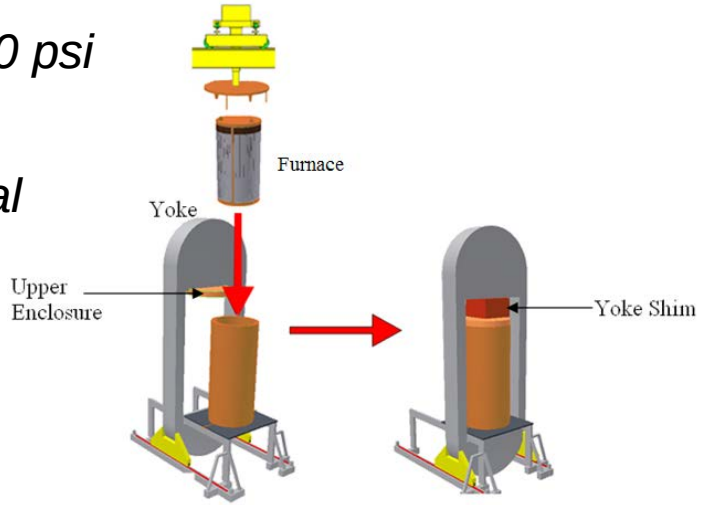
- *Design and construct processing system using the Integrated Waste Treatment Unit (IWTU) facility to the maximum extent practical*
- *Retrieve calcine from bin sets and process using hot isostatic pressing (HIP) technology*
  - *4,400 m^3 (155,000 ft^3) or 5.5 million kg (12.2 million lbs) of calcine*
- *Utilize Waste Acceptance System Requirements Document (WASRD) for Yucca Mountain*
- *Package treated waste form in canisters*
- *Ship off-site or place canisters in interim storage pending off-site shipment for disposition*
- *Current Project TPC cost range is $0.9 B to $2.0 B*

Hot Isostatic Pressing

- *HIP in commercial use since 1941*
  - *Commercial temperatures to 2,550 degrees C and pressures to 60,000 psi*
- *Technology consists of a pressure vessel containing an electrically heated furnace.*
- *Components are placed in a sealed can inside the furnace and isostatically pressed with argon gas to maximum density*
- *Temperature range for Calcine treatment 1,050-1,200 °C*
- *Pressure range for Calcine treatment 7,200-15,000 psi*
- *Produces glass-ceramic waste form*
- *Results in large life-cycle cost savings through final disposition*
- *Volume reduction expected to be 40% to 60%*

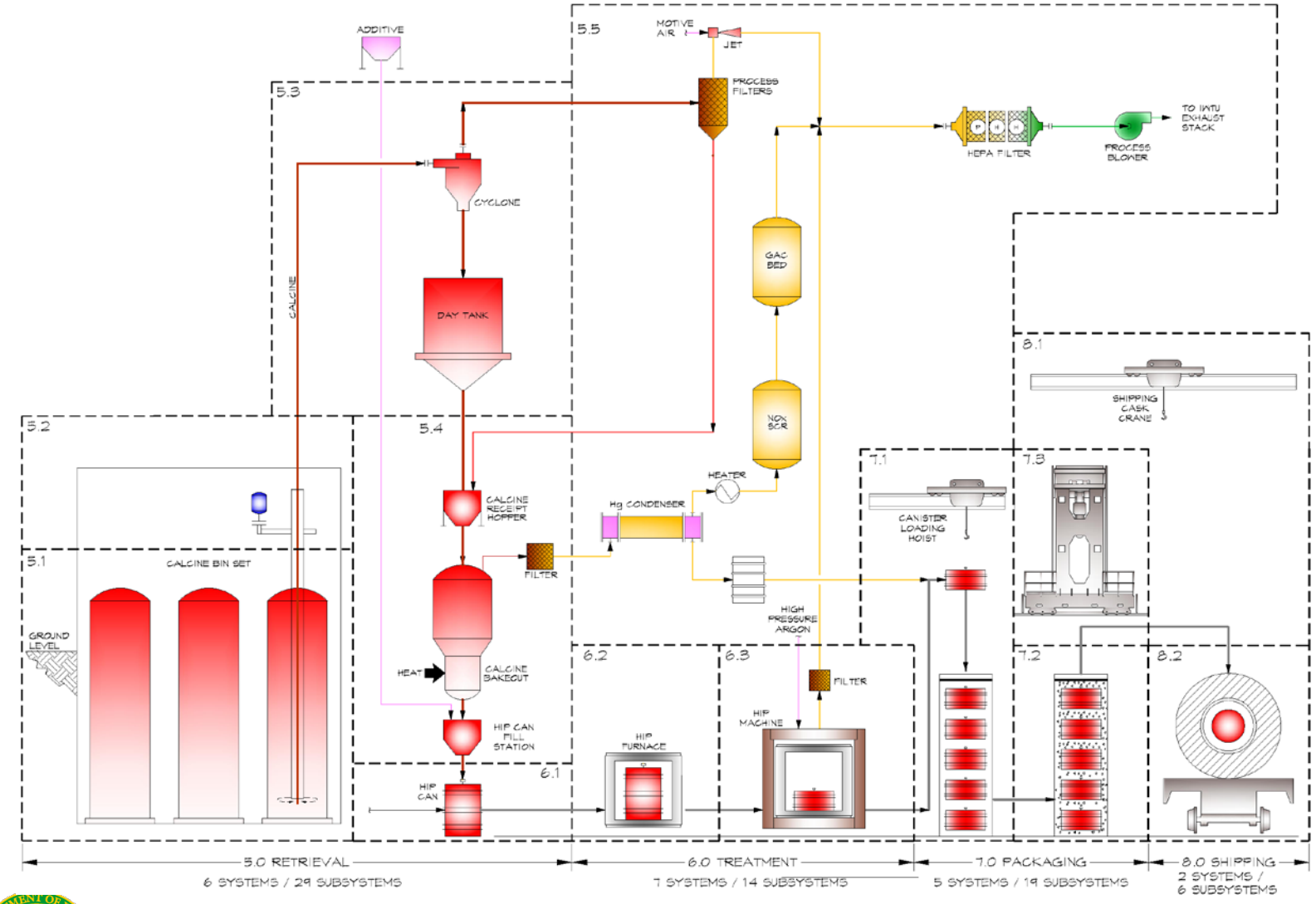


Lab Scale HIP Can Testing Before and After (AVURE June 2011)



HIP Machine Loading Sequence

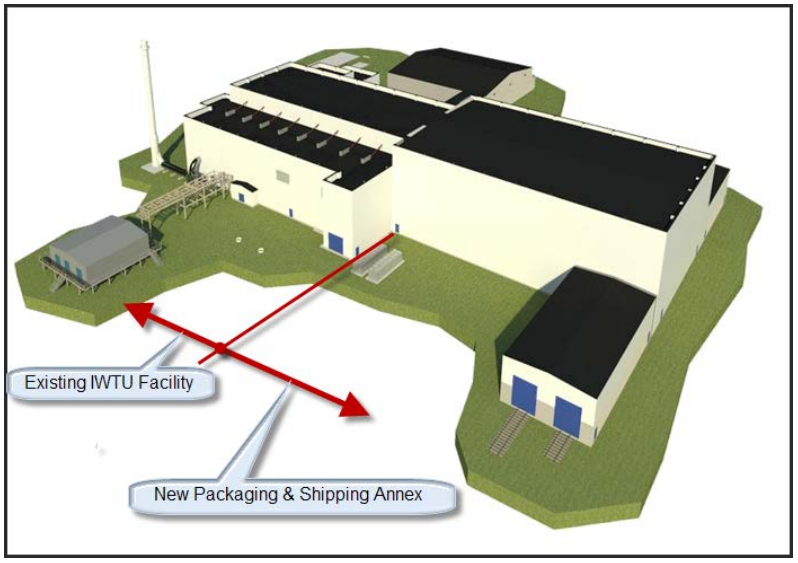
Process Overview



IWTU Facility

Facility Overview

- *Fully utilizes existing IWTU PC-3 cells for HIP machines*
- *Re-uses the existing IWTU canister fill cells for HIP Can fill*
- *Calcine Surge (day) storage and bake-out cell within IWTU footprint*
- *Packaging and shipping located in new east annex*



PERSPECTIVE VIEW OF EXISTING IWTU WITH EAST ANNEX

SECTION VIEW OF IWTU'S PROCESSING CELLS

Project Focus

- *Project priority for FY2012 is activities leading to submission of RCRA Part B Permit Modification Requests (Calcine Retrieval & HIP Treatment Process) to State of Idaho by December 1, 2012*
  - *Conceptual Design*
  - *Technology maturation to support treatment process permit needs*

- *Advanced the CDP design*
  - *Completed Integrated Test Facility (ITF) technical and functional requirements*
  - *Revised System Design Descriptions (30%)*
    - *Developed supporting engineering files, drawings, and reports*

- *Technology Development*
  - *Commenced waste form testing*
  - *Completed furnace (filter) testing and analysis*
  - *Commenced HIP Can testing at Avure*
  - *Awarded master contract for HIP Can profile testing (ANSTO and Bodycote)*

Technology Risks & Technology Readiness Levels (TRL)

- *System Engineering Per DOE G 413.3-1*
- *Technology Development Per DOE G 413.-4A*
- *DOE-HQ TRA Assessment of CDP Process June-July 2010*
  - *11 Critical Technical Elements (CTE)*
  - *Testing currently underway to achieve TRL-4 for CD-1 Review*
  - *HCC Filter Testing recommended by TRA team to achieve TRL-4 is complete (Oct-2011)*

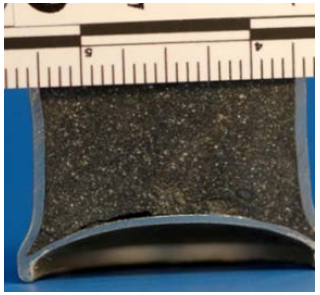
Critical Technology Element (CTE)	TRA Evaluation (7/10)	Current TRL Level
Retrieval/Pneumatic Transfer System	4	4
Batching and Mixing System	4	4
Ceramic Additive Formulation (Waste Form)	3	3
Hot Isostatic Pressing HIP Can Design	3	3
Hot Isostatic Pressing HIP Can Confinement (HCC)	2	4
HIP Can Filling and Closure	4	4
Bakeout System	4	4
Canister Loading/Closure	4	4
Remote Operation and Maintenance	4	4
Characterization (feed, admixture, product)	4	4
Simulant Formulation	3	*3

Objectives for Waste Form Technology Development

- *What defines "success" for a glass-ceramic waste form*
  - *Retention of radionuclides*
    - *Meet WASRD PCT requirements*
  - *Retention of RCRA hazardous metals*
    - *RCRA permitted disposition may not be available*
    - *WASRD states accepted waste forms shall not be subject to regulation as hazardous waste under RCRA*
    - *Meet RCRA LDR nonwastewater UTS*
    - *Allows RCRA delisting, if required*
  - *Support Designation of HIP treatment as BDAT for HLW Calcine*
    - *Provide data for BDAT rulemaking*

Technical Readiness Approach – Waste Form

- *Fiscal Year 2012*
  - *Demonstrate immobilization (mineralization) of RCRA constituents in glass-ceramic matrix*
    - *Develop individual formulations for the 3 general calcine types*
    - *Test at 100 g and 1 kg sample sizes*
    - *Successfully completed three CWI developed recipe tests*
      - *One recipe test met all requirements (ANN/SBW)*
      - *Two recipe tests met all requirements except TCLP for Cadmium*



Recent Project Reviews

- *Consortium for Risk Evaluation with Stakeholder Participation (CRESP) – May 2011*
  - *Purpose - carry out an independent technical review regarding the planned implementation of hot isostatic pressing (HIP) for treatment of calcine waste, and the potential for cold-crucible induction melting to be a back up treatment technology as a project risk reduction strategy*
  - *Conclusion - HIP processing of calcine should be pursued and that vitrification to produce both a borosilicate glass or glass ceramic should be pursued as an alternative.*
- *Environmental Management -Technical Evaluation Group (EM-TEG) – July 2011*
  - *Purpose - determine the level of technology maturation development and if this would support a project CD-1, and identify project risk.*
  - *Conclusion - the HIP process is the most attractive approach for processing INL calcine waste; however, identified two risks in regards to waste acceptance of the glass-ceramic waste form*

Look Ahead FY12 – FY15

- *Complete PMR Development and issue PMR as scheduled*
- *Continue waste-form testing*
  - *Demonstrate scale-up at 25-kg sample size*
  - *Develop a single formulation suitable for all calcine types*
  - *Initiate BDAT sample data collection*
- *Continue HIP can testing*
- *Complete furnace filter testing*
- *Integrated Test Facility (ITF) Test Design*
  - *Calcine & Additive Mixing System*
  - *Bake-Out System*
  - *Fill & Seal System*
- *Proposal to issue CD-1 on June 30, 2014 for approval by December 31, 2014*
- *Proposal to achieve TRL-4 for all critical technology elements by CD-1 submittal*