

Calcine Disposition Project (CDP)

Update and Proposed Path Forward

for the

National Spent Nuclear Fuel Program

March 4, 2008



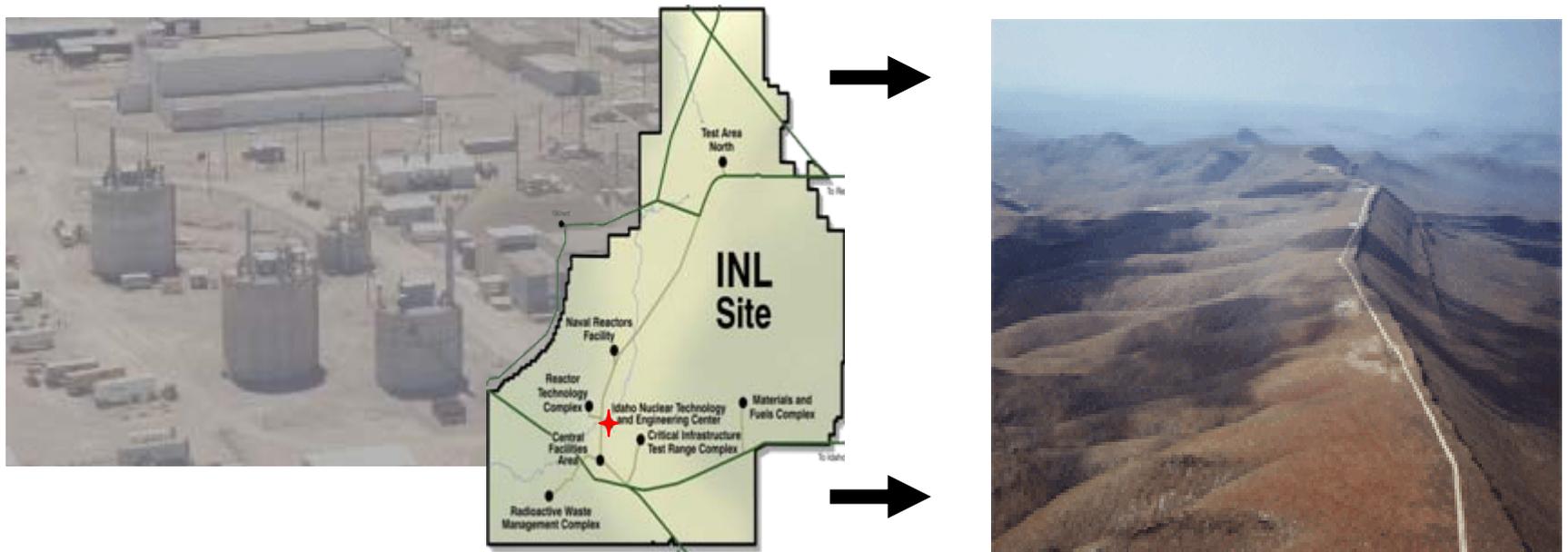
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Need for Calcine Disposition Project

Environmental Management (EM) has identified a need to establish the Calcine Disposition Project to disposition high level waste (HLW) calcine including characterization, retrieval, treatment (if necessary), packaging, and onsite interim storage pending shipment to a geologic repository or offsite interim storage facility.



Current Calcine Disposition Project Drivers

- **Meet Idaho Settlement Agreement (ISA) milestones**
 - Issue a NEPA **Record of Decision (ROD)** by **December 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 **December 1, 2012** to the state of Idaho for retrieval and treatment (includes packaging)
 - Have all **calcine ready for transport out of the state of Idaho** by a **target date of December 31, 2035**
- **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**
- **Fulfill commitments in 2005 ROD from the Idaho HLW and Facilities Disposition Environmental Impact Statement (EIS) - DOE/EIS-0287**

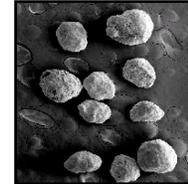


Calcine Specifics

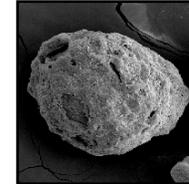
- **Calcine product is a dry granular material**

- Average particle size is 0.4 cm
- Bulk density is about 1.5 to 1.8 g/cc
- Currently stored in 43 bins in 6 bin-sets

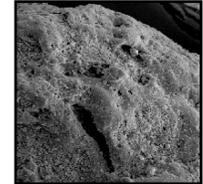
Calcine Bed Material 40x



Calcine Bed Material 150x



Calcine Bed Material 500x



- **Calcine is high level waste (HLW) by definition**

- First cycle raffinate from reprocessing of spent nuclear fuel

- **Calcine is also classified as hazardous waste as it:**

- Exhibits hazardous waste characteristics for toxicity for metals
 - Waste numbers D004 through D011
- Contains listed wastes
 - Spent solvents (hazardous waste numbers F001, F002, and F005)
 - Discarded hydrogen fluoride (hazardous waste number U134)
- Therefore, all INL calcine waste forms require regulatory action



- **Organic constituents are not detected in calcine except at very low levels**

- Levels anticipated to meet LDR treatment standards

- **Chemical analysis has been performed on calcine samples from:**

- New Waste Calcining Facility (NWCF) Campaign H-4 (1998)
- NWCF Campaign H-3 (1993)
- Alumina and zirconia calcine from CSSF 2 (1978)



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Background on Calcine Disposal Path

- ***Original path forward for calcine disposal:***
 - Retrieval and dissolution
 - Separation to concentrate radioactive constituents into high-activity fraction
 - Vitrification of high-activity fraction (approximately 1100 canisters)
 - Another option was direct vitrification of calcine without separations
- ***Prior to 2004, INL conducted preliminary long-term performance sensitivity analysis using Yucca Mountain Total System Performance Assessment (TSPA) model***
 - Model was used in the Final Environmental Impact Statement for Yucca Mountain
 - Hazardous constituents in calcine were represented using comparable TSPA data
 - Used same radionuclide regulatory compliance point as EPA public health and environmental radiation protection standards for Yucca Mountain (40 CFR 197)
- ***Results showed that hazardous constituents do not migrate beyond the repository boundary in concentrations above health-based levels at the Point of Compliance established in 40 CFR 197***
 - Direct disposal of calcine, taking NO credit for waste package performance, showed health-based standards are met at the accessible environment boundary (the regulatory point of compliance) during the proposed 1,000,000-year regulatory period
 - In the more realistic case, where waste packages fail over time, no hazardous constituents came within 5 orders of magnitude of health-based standards



Background on Calcine Disposal Path (continued)

- ***DOE is thus considering petitioning 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
- ***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***
 - Using best available DOE TSPA model and/or NRC’s confirmatory model
- ***INL also ran EPA’s Industrial Waste Evaluation model using Yucca Mountain site-specific data and conservative data/assumptions for Yucca Mountain design***
 - Results show that health-based limits are not exceeded at the hypothetical well (1 mile away) for any hazardous constituent
- ***DOE-ID has recently opened discussions with EPA on the regulatory feasibility of the direct disposal approach (and treatment alternatives)***
 - Obtain feedback as to what EPA’s expectations are in a resultant petition

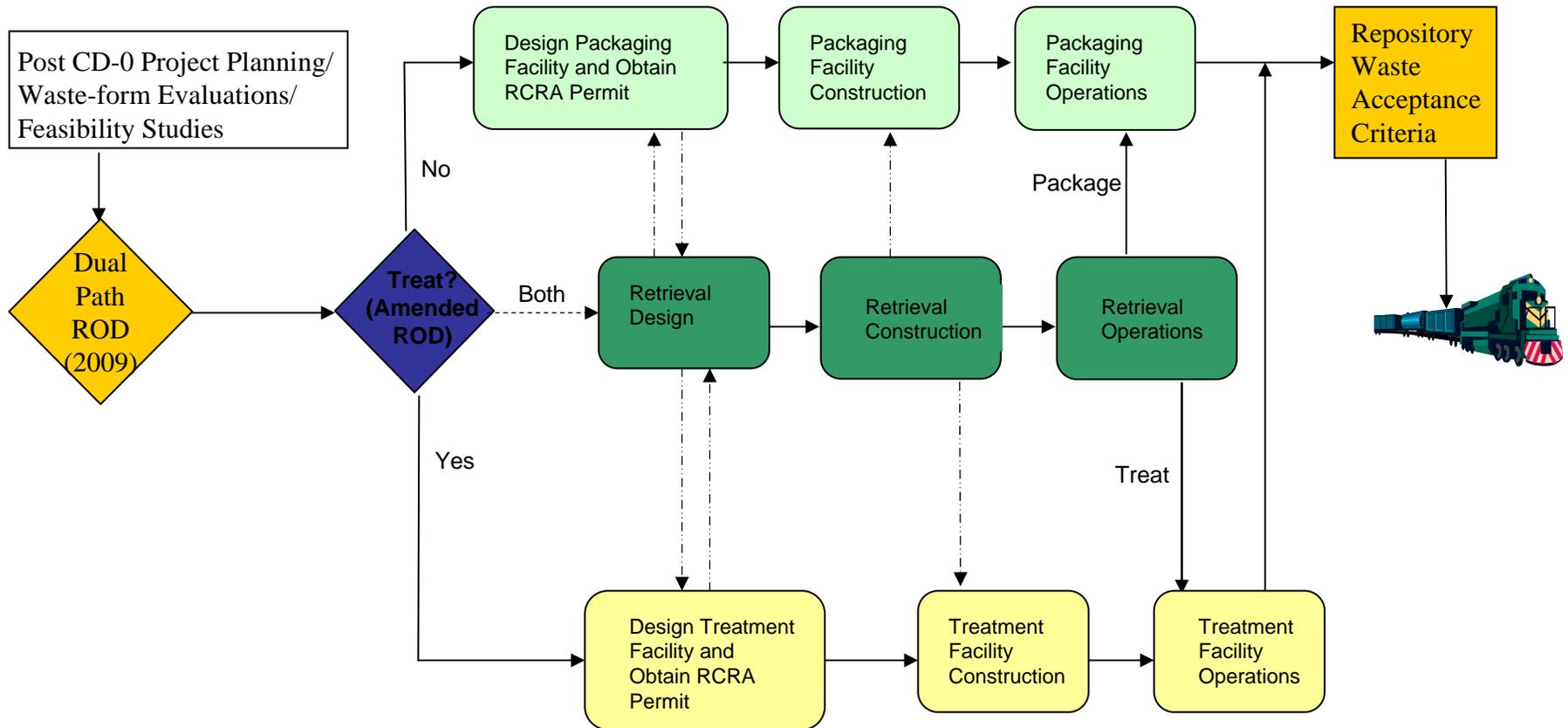


Accomplishments Since Last NSNFP Meeting:

- **Modified the Idaho Cleanup Project contract to align with project drivers and repository schedule evolution**
 - Contract was placed when repository availability was expected in 2010
- **Completed inspection of the calcine bins as required by the RCRA Part B storage permit**
 - No adverse findings
- **Placed RFI in FedBizOps to solicit vendor data on three treatment alternatives to support downselection for 2009 dual-path ROD**
 - Quite a bit of response to the no-cost initiative to date
 - Also accumulating DOE complex-wide historical data
- **Retrieval design progressing including evaluations of:**
 - Materials erosion, bin obstructions, overhead/underground transport options, etc.
- **Hot isostatic pressing (HIP) technology, waste form performance and deployment feasibility studies ready to start in earnest**
 - Contract is now in place between BEA and ANSTO, Inc. (funded by EM-21)
 - Initial focus is calcine, additional applications will be evaluated as funding permits
- **Met with EPA Region 10 to discuss DOE HLW regulatory challenges and calcine disposition path forward**



CDP Project Dual Path Approach



Note: Project will re-use the Integrated Waste Treatment Unit to the maximum extent practicable upon completion of the Sodium Bearing Waste Project mission

Current Disposal Options for Calcine Remain as Follows:

- **Retrieve, package and dispose of as is (direct disposal option)**

- Idaho baseline approach – highest regulatory risk
- Requires conditional exemption from RCRA
- Granular waste form

- **Treatment by steam reforming**

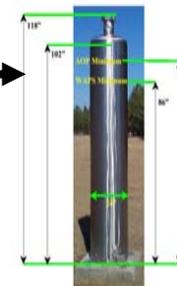
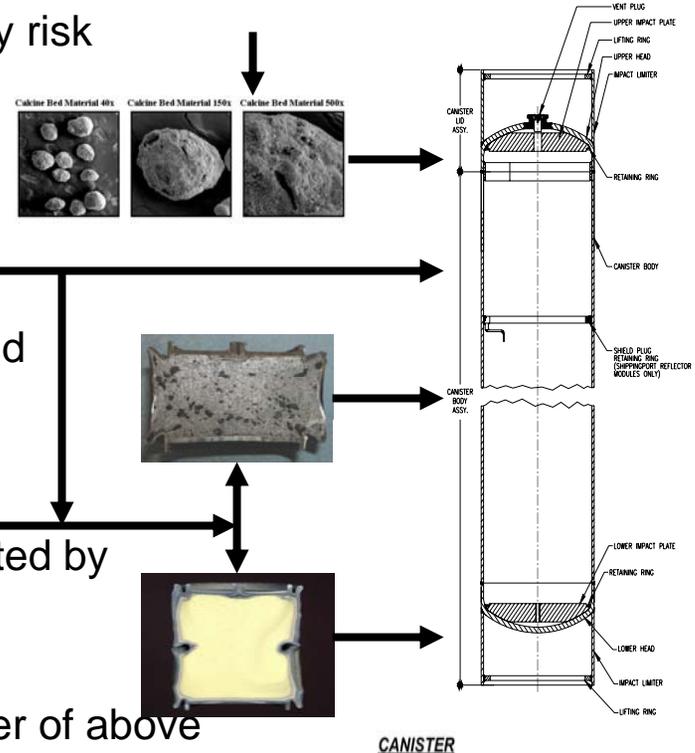
- Maximizes reuse of IWTU
- Requires re-dissolution of calcine in nitric acid
- Granular waste form – requires delisting

- **Treatment by hot isostatic pressing**

- Volume reduction advantage – being evaluated by BEA/ ANSTO, Inc.
- Monolithic waste form – requires delisting
- Could compact (50% volume reduction) either of above

- **Treatment by direct vitrification technology**

- Lowest regulatory risk – highest cost and volume
- Monolithic waste form – requires delisting



Filled Canister
 Materials: 304L Stainless Steel
 Empty Weight: 1150 lbs.
 Glass Weight: 3800 lbs.

Independent Life Cycle Cost Estimate Results *

Treatment Technology (project contingency)	Retrieve, Process, Store (1), D&D	Estimated Number of 10' Canisters	Repository Shipping & Disposal Charge (2)	Total Estimated Life-Cycle Cost (3)
Direct Disposal (40%)	\$2.319B	6,660	\$4.129B	\$6.448B
Direct Vitrification (50%)	\$16.307B	11,200	\$6.944B	\$23.251B
Steam Reforming (60%) See Note 4	\$5.679B <i>(understated)</i>	6,660 <i>(understated)</i>	\$4.129B <i>(understated)</i>	\$9.808B <i>(understated)</i>
Hot Isostatic Pressing (50%) See Note 4	\$13.324B <i>\$4-5B</i>	3,300/4,400	\$2.046B/\$2.728B	\$15.370B <i>\$7-8B</i>

* 85% confidence level and 2006\$s

- Notes:
- (1) Cost estimate does not include storage cost beyond reuse of limited IWTU storage
 - (2) Repository disposal charge based on current estimate of \$620K per canister (includes shipping cost)
 - (3) Total estimated cost impact to DOE (2006 \$'s)
 - (4) Differing professional opinions from conclusions in the ICE report



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Further Evaluation of HIP Option Appears Warranted

Consolidation:

Matrix:

Waste loading:

Durability (PCT-B):

Final volume:

(relative to untreated calcine)

Temp:

Pressure:

Off-gas:

HIP

glass-ceramic

60-90%

10-100 x EA glass

15-45% reduction

2200°F

4500 psi

none

Vitrification (JHM)

borosilicate glass

20-35%

10 x EA glass

100+% increase

2100°F

atmospheric

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)



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EM-20 Funded HIP Evaluation Finally Set to Start

- ***Contract between BEA and ANSTO, Inc. was signed 2/28/2008***
- ***DOE-HQ has taken personal interest in this initiative***
 - Weekly update provided to EM-20
- ***Funded at \$2.5M (FY-07 funds)***
 - Remaining funding (\$2.5M) not likely until FY-09
 - *Scope has been “adjusted” to place priority on calcine evaluations due to need for data to support treatment down-selection to support NEPA ROD in FY-09*
 - DOE-ID pushing for some additional funding to be provided in FY 08 due to potential for continuing resolution halting project at critical juncture
 - *Difficult to get priority as FY-07 funding has largely not been used due to late start*
- ***BEA was working on critical path activities prior to contract signing***
 - Reconfiguration of STAR Center to produce calcine surrogate nearly complete
 - Working on safety prerequisites related to the HIP unit in the HFEF hot-cell



DOE is in the Process of Meeting with 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**
- **Wastes that may require EPA regulatory action include:**
 - Hanford Richland Office cesium/ strontium capsules
 - Idaho National Laboratory (INL) Site sodium-bonded fuel
- **Wastes that will require EPA regulatory action include:**
 - Hanford Office of River Protection Immobilized HLW
 - INL HLW calcine



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Summary of EPA Region 10 Meeting Held February 5th 2008

- ***DOE presented brief overview of potential regulatory action to allow disposal of certain DOE wastes at the NRC-licensed HLW repository***
 - Particular emphasis was placed on disposal of calcine in the repository with no further treatment (direct disposal) and alternative treatment options under consideration
- ***Discussion focused on the need for EPA regulatory action for all calcine disposal scenarios***
 - Either conditional exemption from RCRA for direct disposal with no further treatment based on demonstration of no migration, or
 - Delisting of wastefrom pursuant to treatment to eliminate characteristic
- ***Discussed if there would be any potential value in soliciting public comment as a matter of due diligence by an “Advanced Notice of Proposed Rulemaking”***
 - Prior to expenditure of significant resources on petitions and/or committing resources on calcine waste form preparations



Meeting with EPA Region 10 (cont.)

- ***DOE-ID indicated that it still needs to obtain and run the current TSPA model and/or the NRC confirmatory model***
 - Validate/update the draft conditional exemption petition prepared in 2004
 - Meet Settlement Agreement schedule commitments
- ***Discussed the need for a follow-on meeting with EPA-HQ to:***
 - Provide a similar overview to that given to EPA Region 10 on February 5, 2008 and meeting summary
 - Discuss DOE's intent to submit a petition supporting the disposal of calcine with no further treatment in the NRC-licensed repository
 - Solicit EPA-HQ feedback



In Summary, DOE-ID is Proceeding as Follows:

- ***DOE-ID plans to seek a conditional exemption from RCRA definition of hazardous waste for mixed high level waste calcine conditional upon disposal in the Yucca Mountain geologic repository licensed in accordance with NRC regulations at 10 CFR 63 and associated demonstration of no-migration based on:***
 - Demonstration of no migration of hazardous constituents above health-based levels from the waste disposal site for the 10,000 year period (and the 1,000,000 year period)
 - Demonstration that public health and the environment will be protected from hazardous constituents in the waste when disposed of in an NRC-licensed repository at least as effectively as if the waste were disposed of in a hazardous waste landfill
- ***DOE-ID is currently continuing working on:***
 - Setting up up a meeting with EPA-HQ
 - Conceptual design of the retrieval system and interfacing with IWTU design
 - Evaluating treatment alternatives to support a ROD in CY 2009
 - Obtaining CD-1 in FY 2009

