Calcine Disposition Project

Status, Issues, and Challenges

Idaho Cleanup Project

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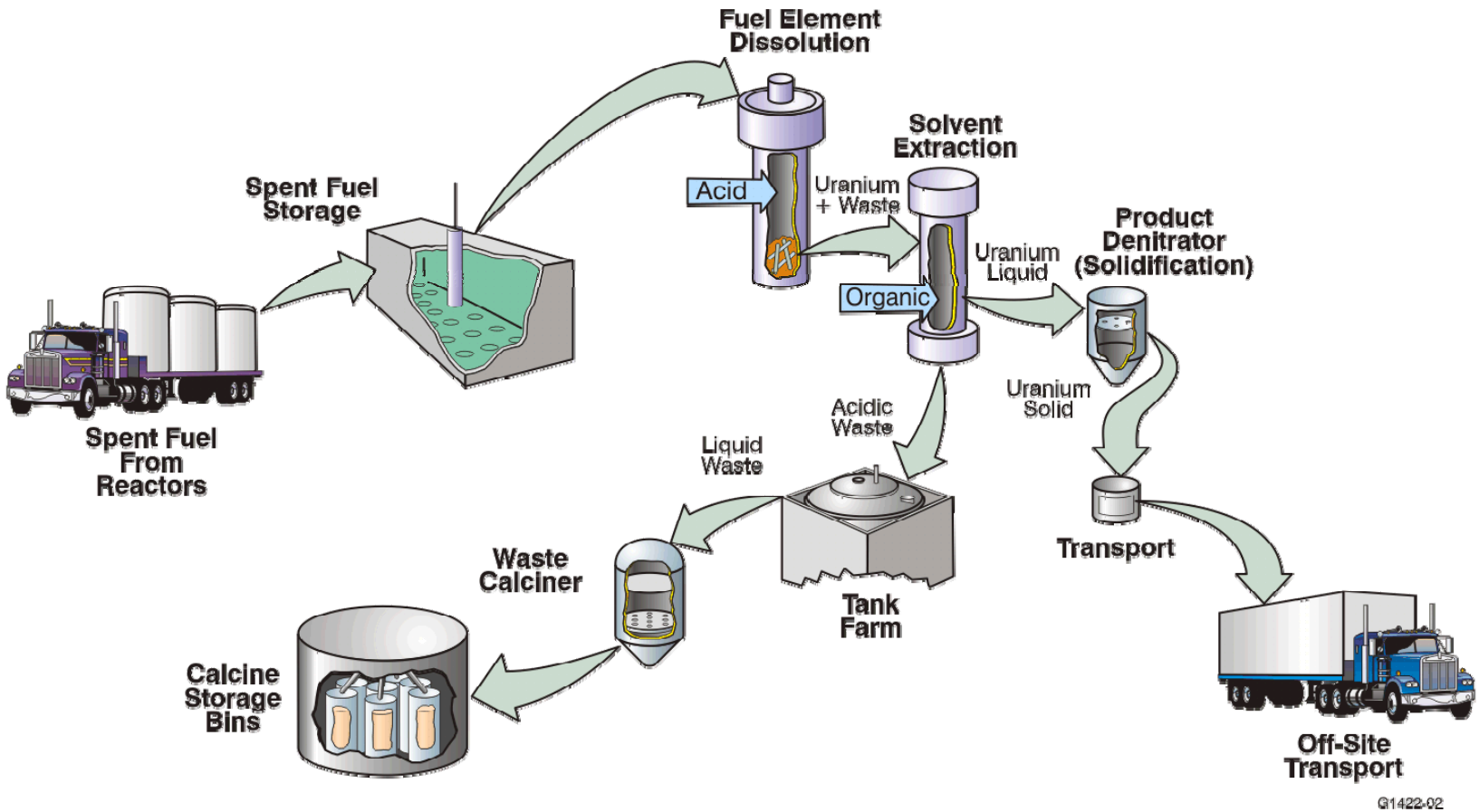
DOE-ID Project Manager

July 2006

Calcine is First Cycle Raffinate from the Reprocessing of Spent Nuclear Fuel

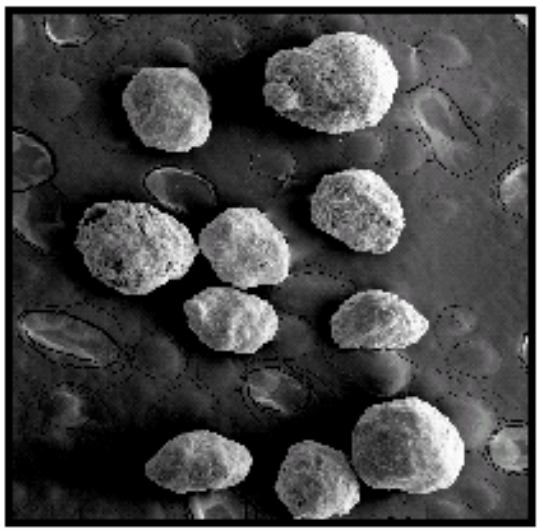


Calcine Characteristics

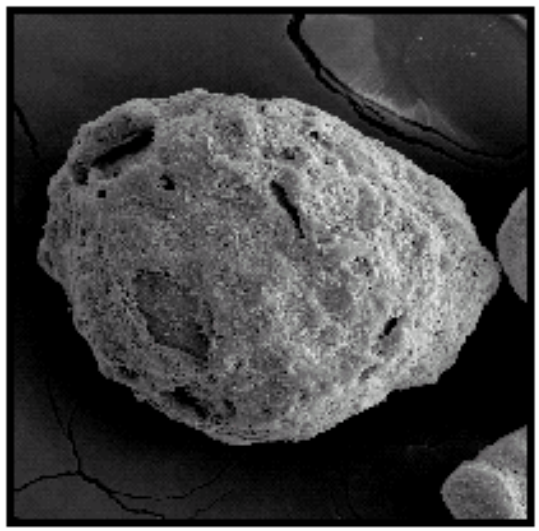
RCRA hazardous (listed and characteristic) High Level Waste resulting from dissolution of multiple reactor fuel types for uranium recovery

Abrasive, hydroscopic, granular oxides ranging from 0.2 to 0.6 mm, (~15% "fines")

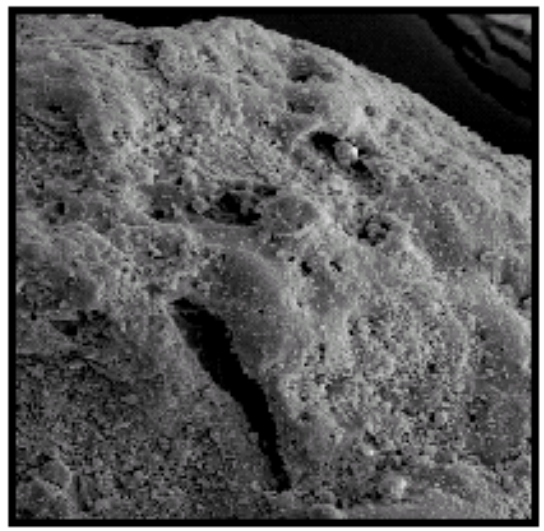
Calcine Bed Material 40x



Calcine Bed Material 150x

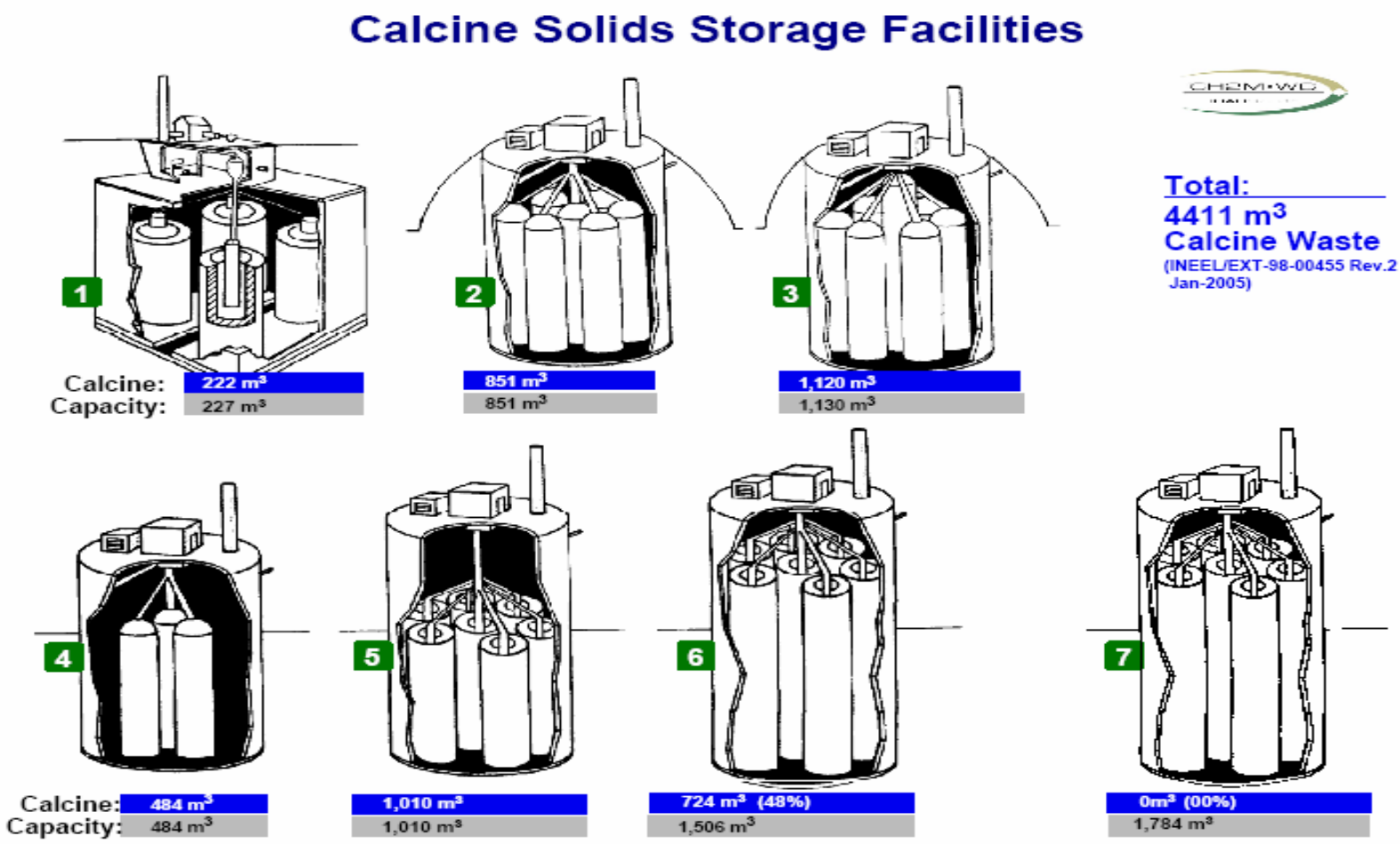


Calcine Bed Material 500x



Calcine is Currently in Compliant Storage

Calcine Solids Storage Facilities – “Bin Sets”

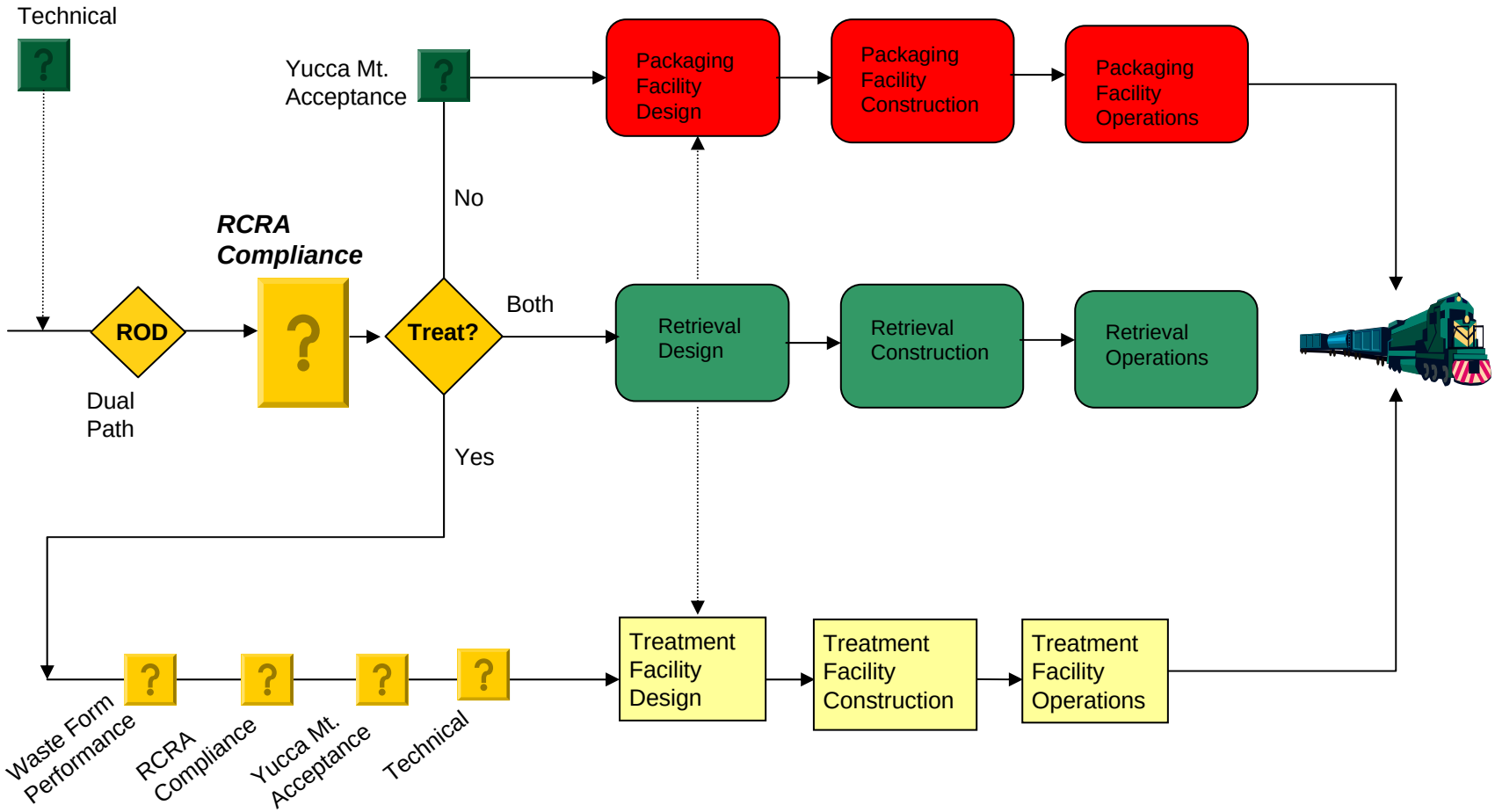


Calcine Disposition Project Drivers

- ***Settlement Agreement Milestones***
  - Issue a **Record of Decision by December 31, 2009** to identify method to direct dispose of calcine (if possible) and treat calcine (if necessary) – Dual path approach
  - 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 December 31, 2035** (so-called "road ready")

- ***Site Treatment Plan Milestones***
  - Approval of **CD-0 by December 31, 2006**; approval of **CD-1 by March 31, 2008**

Calcine Disposition Project Dual Path Approach



VE Session on Technologies Selection Held March 2006

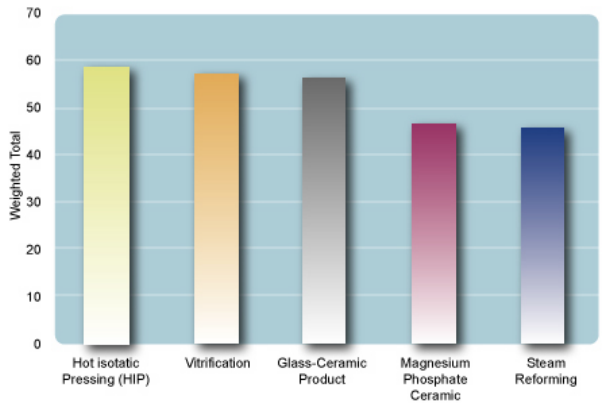
Purpose:

*To **down-select** previously identified Calcine **disposition options** and technologies to a short list **for** consideration in the Calcine Disposition Strategy and **2009 Record of Decision**.*

Previous HLW and FD EIS Options

- *Glass-Ceramic*
- *Grouting (Cement)*
- *Transuranic Separations*
- *Hot Isostatic Pressed (HIP)*
- *Steam Reforming*
- *Magnesium Phosphate Ceramic*
- *Vitrification*
- *Full Separations*
- *No-Action*
- *Untreated (Direct) Disposal*

VE Session Results

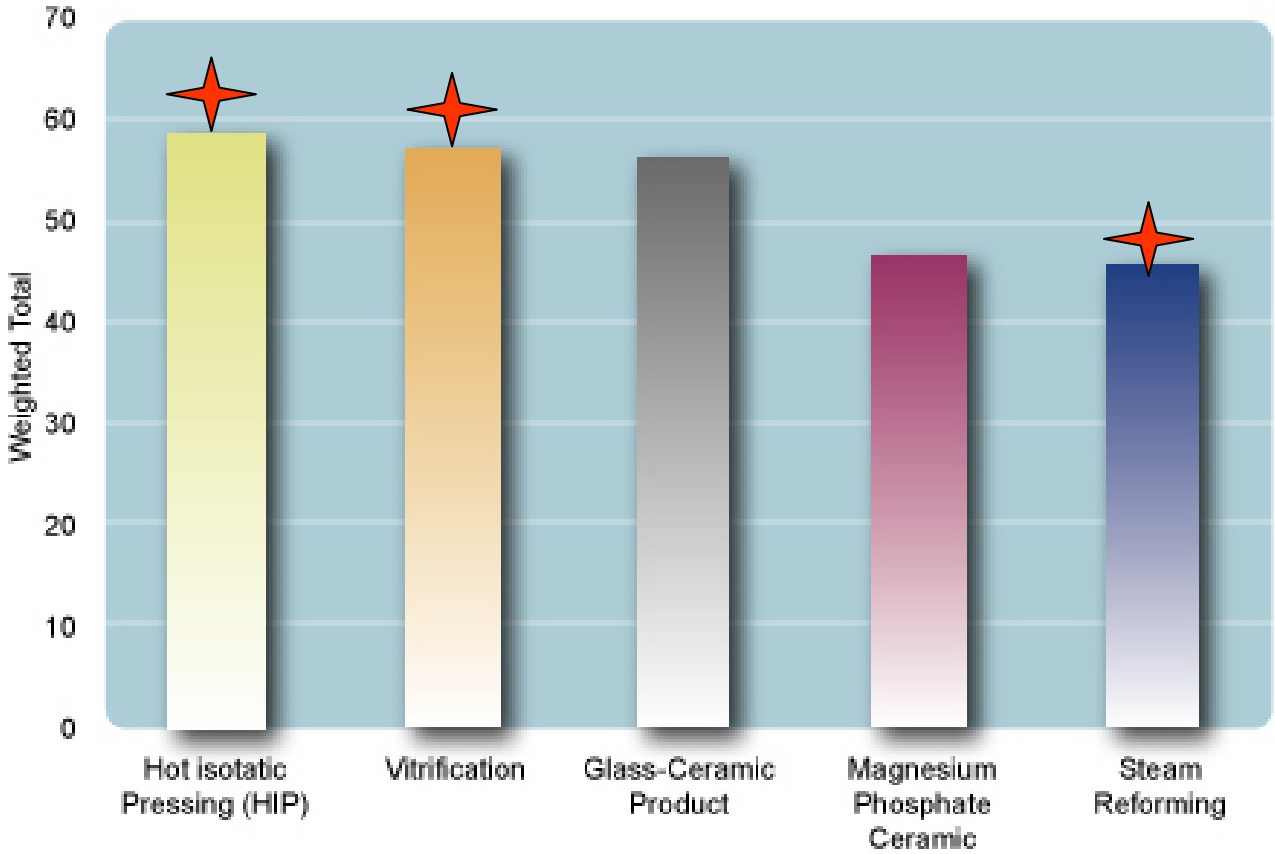


Technology Weighting Criteria
Development Status
Leachability
Long-Term Stability
Complexity
Quality Assurance
Product(s) Volume Produced
Secondary Waste Volume Produced
Difficulty of achieving worker Rad safety
Difficulty of achieving worker industrial safety
Waste Type
Regulatory Risk

Technology "Go, No-Go" Criteria

- Disposition path for product waste form
- Disposition path for secondary waste streams
- Settlement Agreement compliance

VE Session Results (cont)



Selected Candidate Treatment Technologies

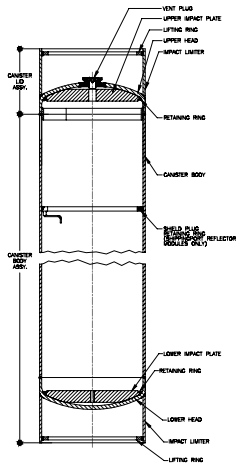
Direct Disposal (Retained for Dual Path ROD)

Top View of CSSF 6 Bins

Plus: *Low product and waste volume, least expensive, packaging size flexibility*

Minus: *High regulatory risk*

ASME Spent Fuel Canister



- **ASME B&PV Code, Section III, Division 1, Subsection NB (with Code Case N 595-2)**
- **Constructed of 316L stainless steel**
- **Full penetration closure weld, ultrasonic & liquid penetrant NDE**
- **Sizes**
  - 18 inch diameter, 10 or 15 ft long
  - 24 inch diameter, 10 or 15 ft long
- **Designed for Transport and Storage at a National Repository**

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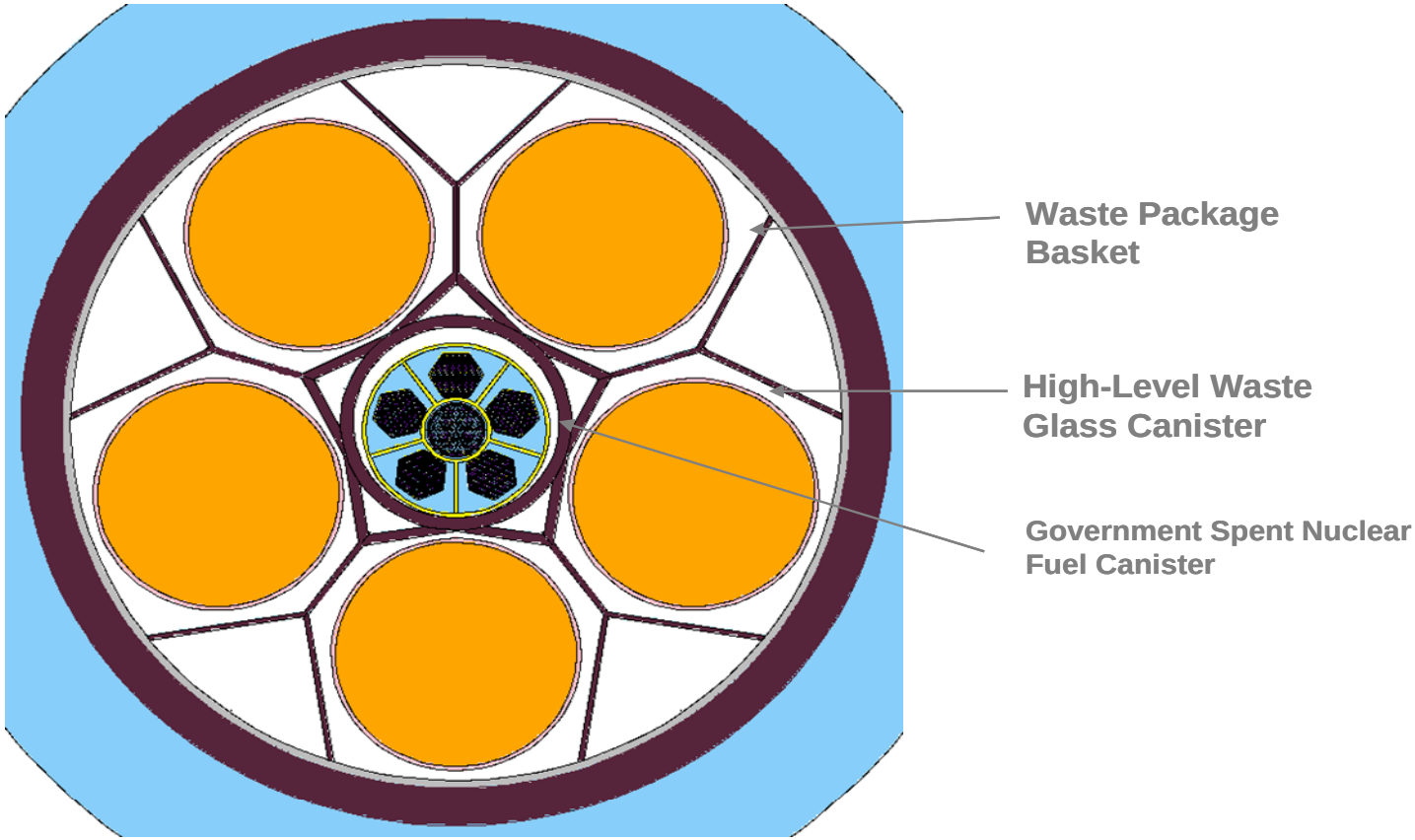
Foster Wheeler Environmental Corporation

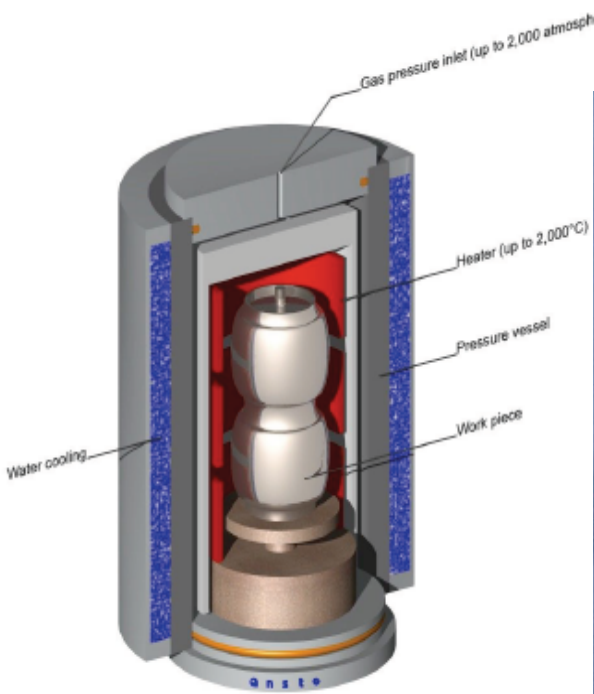
Flexibility in Canister Size Would Assist in Co-Disposal



Hot Isostatic Pressing

Plus: *Excellent monolythic waste form, several regulatory options, low product and waste volume*

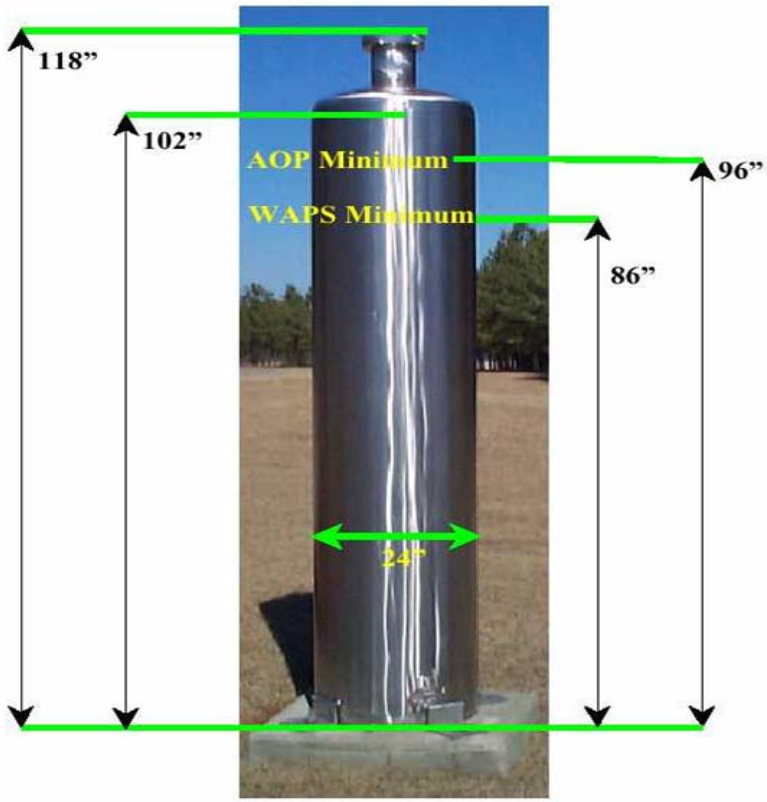
Minus: *Industrial safety concerns; moderate to high cost*



Vitrification

***Plus**: Clearest regulatory path, state of Idaho's preference*

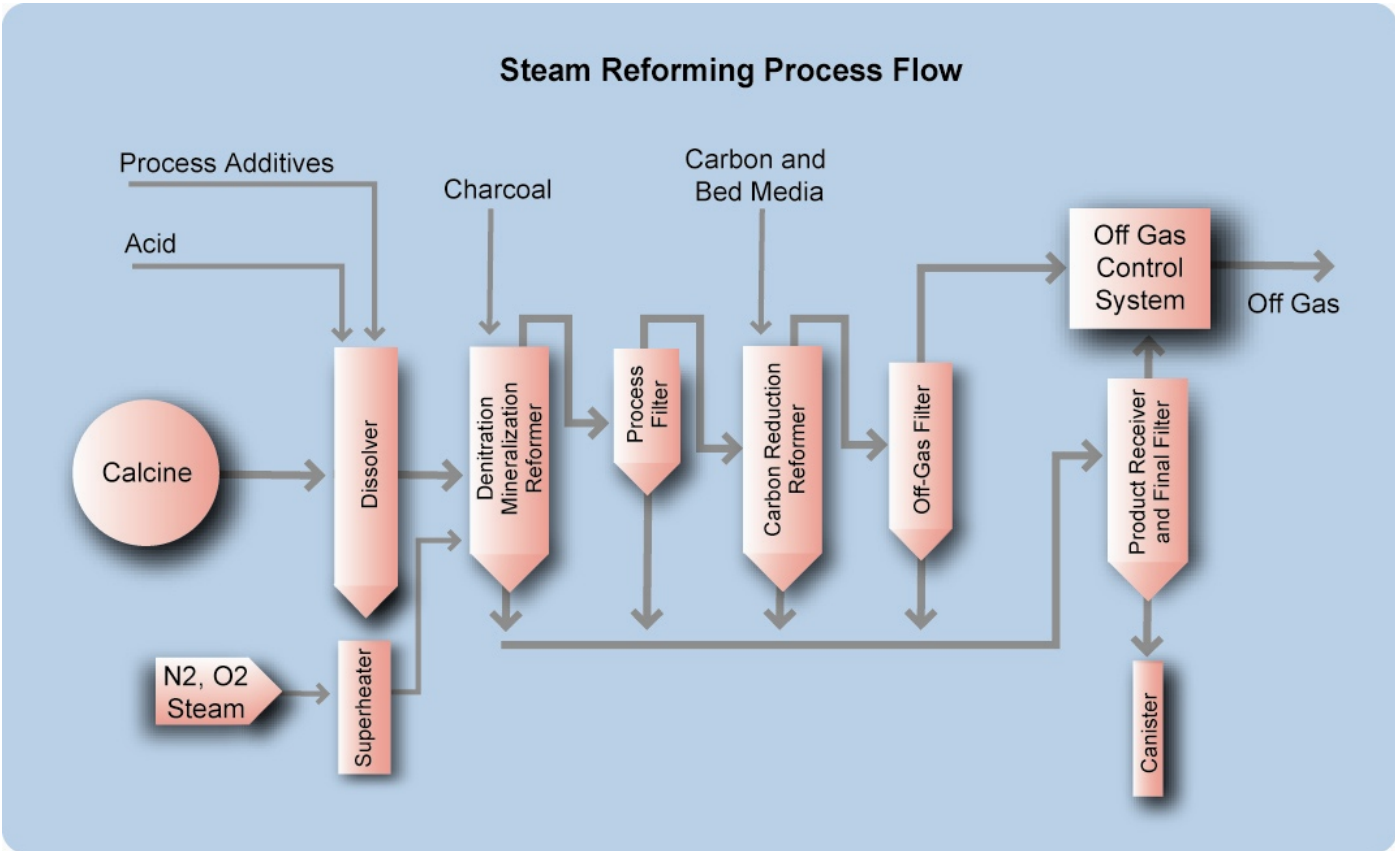
***Minus:** High product and waste volume, most expensive*



Steam Reforming

Plus: *Maximum reuse of the IWTU facility, moderate product and waste volume, moderate cost*

Minus: *Technically immature, uncertain regulatory path (granular wasteform)*



Independent Cost Estimate

- ***Issued May 2006***
  - Based on a conservative 85 percent confidence level
- ***Scope of work was to estimate Life Cycle Costs of 4 alternatives***
  - Included "cradle to grave" costs beyond achieving "road-ready" status in 2035
    - *Cost of shipping packages, transportation, and repository disposal fees*
  - Technology alternatives included:
    - *Direct Disposal*
    - *Vitrification*
    - *Steam Reforming*
    - *A technology selected by the independent cost team*
      - Selected technology was Hot Isostatic Pressing developed by ANSTO
- ***Estimated degree of risk was factored in including:***
  - Regulatory uncertainty
  - Funding uncertainty
  - Technology development and deployment

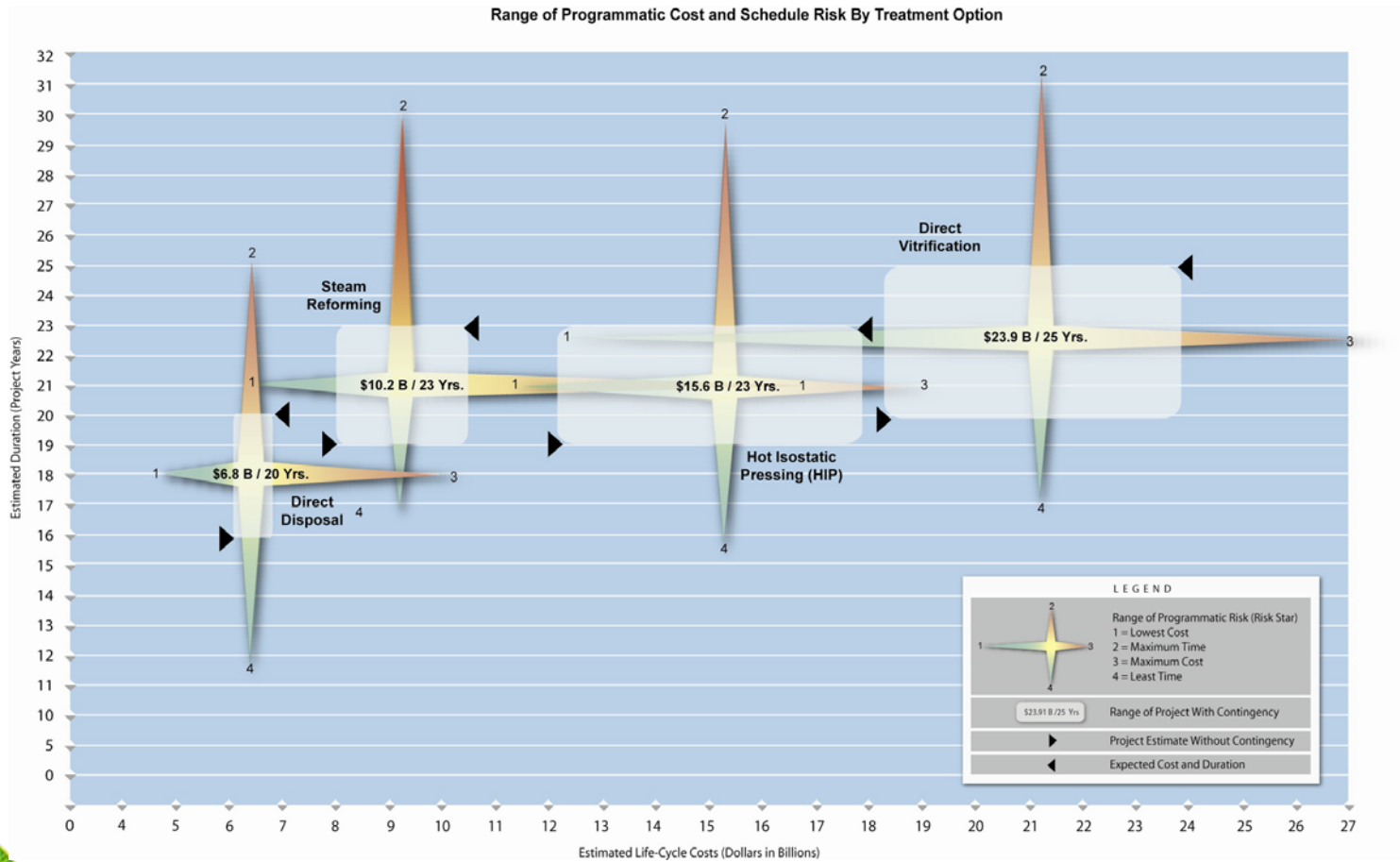
Independent Cost Estimate Assumptions

- ***Common assumptions included:***
  - Calcine has not agglomerated in storage
  - Retrieval, treatment (if required) , packaging, and shipping will occur in an 8-year period (2015-2022)
  - The Sodium Bearing Waste mission of the Integrated Waste Treatment Unit (IWTU) will be complete prior to 2015 to allow facility availability (if advantageous)
    - *IWTU Project will integrate Calcine mission in design and constuction*
  - A nominal 10 foot by 2 foot diameter canister is assumed for packaging all options
  - Packaged HLW will be shipped to the repository by rail
    - *Rail spur will lead to the Canister Loading facility*
    - *Direct rail access to the repository is established*
  - The MP-187 shipping package has been certified for use in shipping HLW canisters to the repository (capacity is 5 canisters)
  - Post-operation closure of all calcine storage facilities at INTEC is assumed to be performance-based; processing facilities (including IWTU) clean-closed
  - Repository disposal fee is $620,000 per canister

Independent Cost Estimate Results

Treatment Technology	*Retrieve, Process, Load, Ship, D&D*	*Estimated Number of 10 Foot Canisters*	*Yucca Mountain Disposal Charge*	*Total Estimated Life-Cycle Cost*
Direct Disposal	*$2.712B*	*6,660*	*$4.129B*	*$6.841B*
Direct Vitrification	*$16.968B*	*11,200*	*$6.944B*	*$23.912B*
Steam Reforming	*$6.072B*	*6,660*	*$4.129B*	*$10.201B*
Hot Isostatic Pressing	*$13.519B*	*3,300*	*$2.046B*	*$15.565B*

Approaches under Consideration Vary in Cost and Schedule Risk Profiles



Summary of Calcine Disposition Project Options Currently Under Consideration

- ***Direct Disposal option (retrieve and package without treatment)***
  - Retained as one of the dual-path options
  - Greatest regulatory risk – 6600 canisters – granular waste form – lowest cost
- ***Steam Reforming treatment option***
  - Attractive to re-use major portions of Integrated Waste Treatment Unit
  - Moderate to high regulatory risk – 6600 canisters – granular waste form
- ***Hot Isostatic Pressing treatment option***
  - Attractive due to volume reduction, but operates at high pressure and temperature
  - Moderate regulatory risk – 3300 canisters – monolithic waste form
- ***Vitrification treatment option***
  - Results in borosilicate glass, which is the EPA preferred wasteform
  - Lowest regulatory risk – 11,200 canisters – monolithic waste form – highest cost

Near Term Priorities for the Calcine Disposition Project

- ***Resolve comments on RCRA permit for storage in existing calcine bins***
- ***Resolve comments on the Mission Need Statement***
  - Need approval of CD-0 by the end of the CY 2006
- ***Develop Dual Path Record of Decision for calcine path forward:***
  - Regulatory approach for each option
  - Feasibility studies with more detailed cost estimates
  - Wasteform testing and comparison
- ***Retrieval design***
- ***Prepare RCRA Part B permit application for retrieval, treatment (if required), packaging and shipping***
  - Issue supplemental ROD to select path forward
  - Facility design adequate for permit application
  - Satisfy repository waste acceptance criteria

Issues and Challenges

- ***Regulatory complexity***
  - Dual NRC/EPA regulation
  - DOT requirements
  - Settlement Agreement & Site treatment Plan (FFCA)
  - Repository litigation, new radiation standard, waste acceptance criteria
- ***Repository availability and integrated shipment schedule***
- ***Sodium Bearing Waste Project interface***
  - Design integration with IWTU (storage as a minimum)
  - WIR status
- ***Opportunities for cost reductions and optimizing repository use***
  - Product and waste stream volume reductions
  - Co-disposal considerations (canister size flexibility)