



U.S. DEPARTMENT OF  
**ENERGY**

OFFICE OF  
**ENVIRONMENTAL  
MANAGEMENT**

# Idaho High-Level Waste

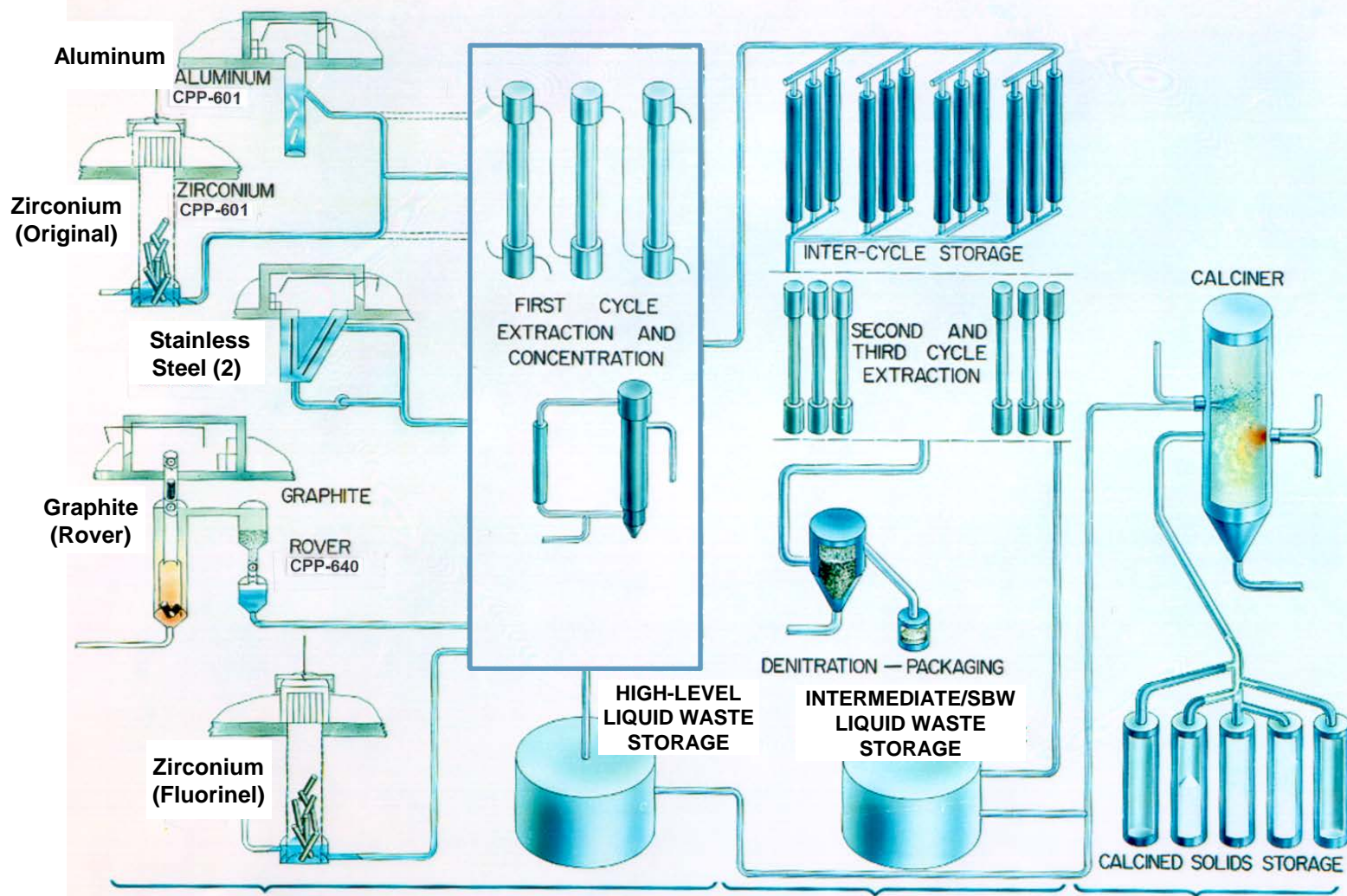
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**Mark Shaw**

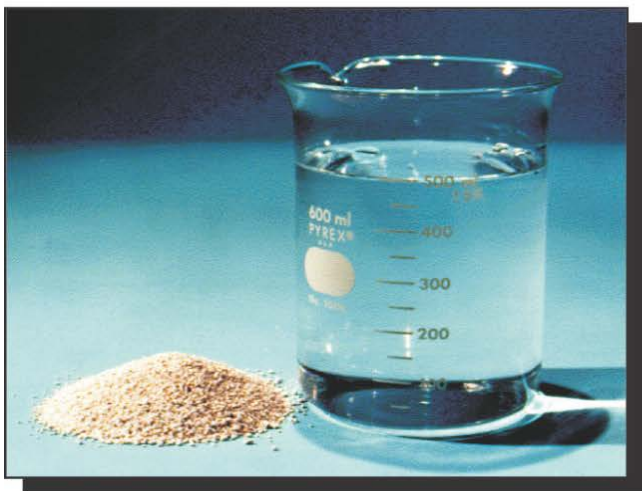
*DOE-Idaho*

**Feb. 21, 2018**

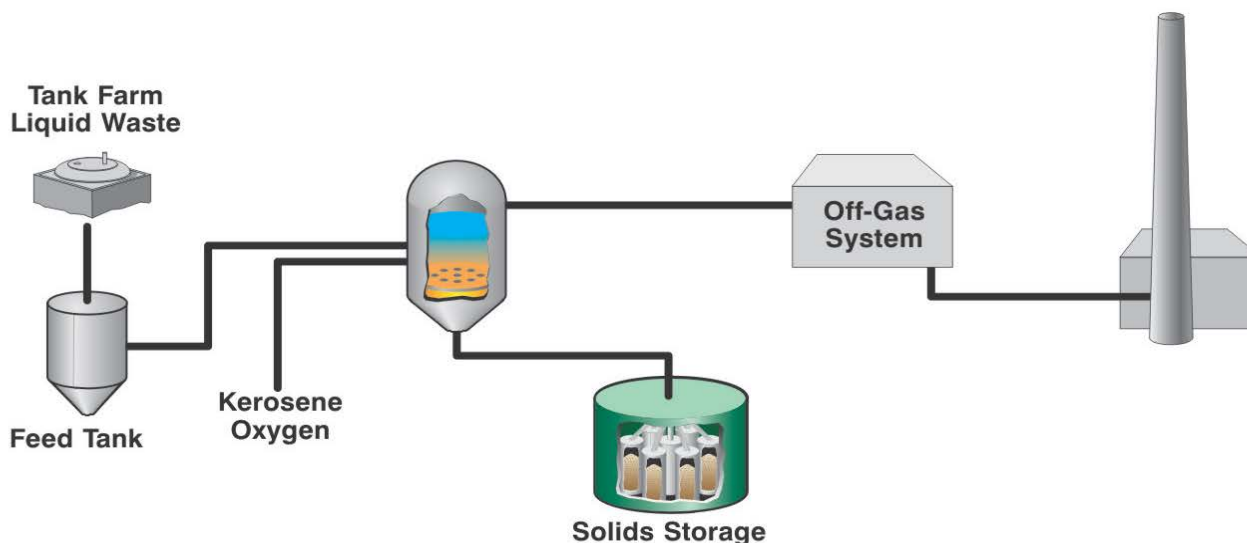
# INTEC Fuel Reprocessing and Waste Treatment



# INTEC Calcination Process



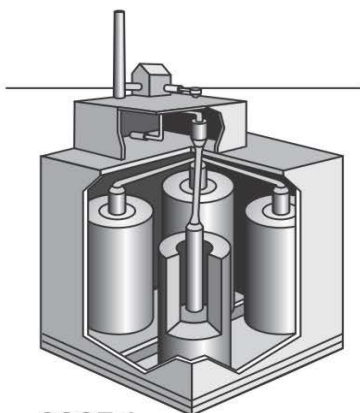
- Conversion of liquid, high-level radioactive waste to solid by calcination (high temperature drying) process
- Fluidized bed produces solidified granular high-level radioactive waste
- Pneumatic transfer of solid waste to bin set storage
- Extensive off-gas system



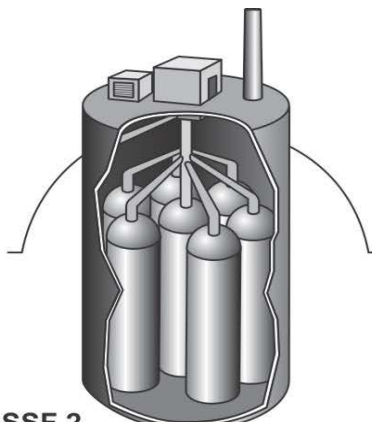
# Aerial View of Calcining and Calcined Solids Storage Facilities (CSSFs)



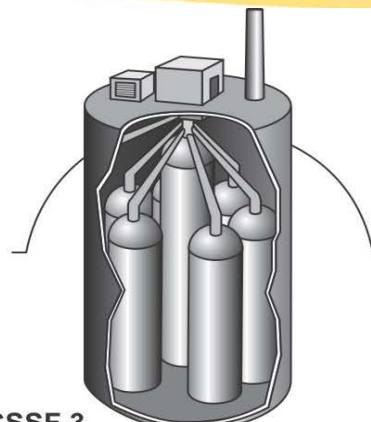
# INTEC Calcine Storage Volume



**CSSF 1**  
Calcine Volume: 220 m<sup>3</sup>  
Usable Capacity: 227 m<sup>3</sup>



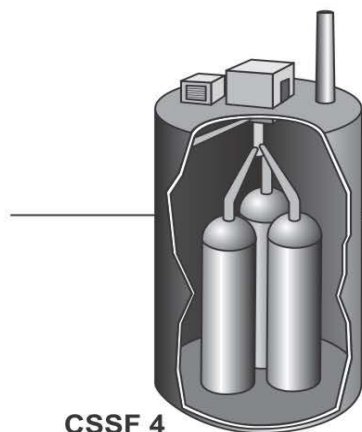
**CSSF 2**  
850 m<sup>3</sup>  
850 m<sup>3</sup>



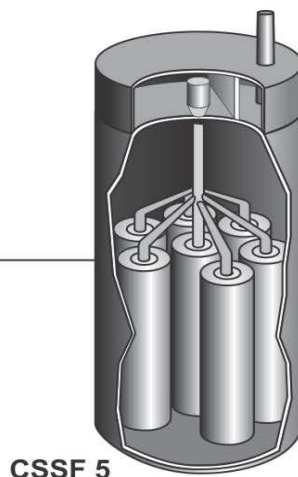
**CSSF 3**  
1,120 m<sup>3</sup>  
1,130 m<sup>3</sup>

**Total: 4,400 m<sup>3</sup>  
of calcine waste**

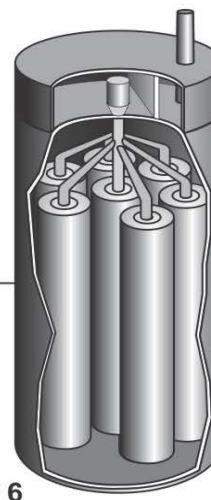
INEEL/EXT-98-00455, Rev. 4  
Staiger and Swenson 2011



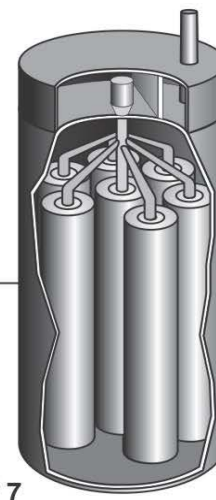
**CSSF 4**  
Calcine Volume: 486 m<sup>3</sup>  
Usable Capacity: 486 m<sup>3</sup>



**CSSF 5**  
1,010 m<sup>3</sup>  
1,010 m<sup>3</sup>

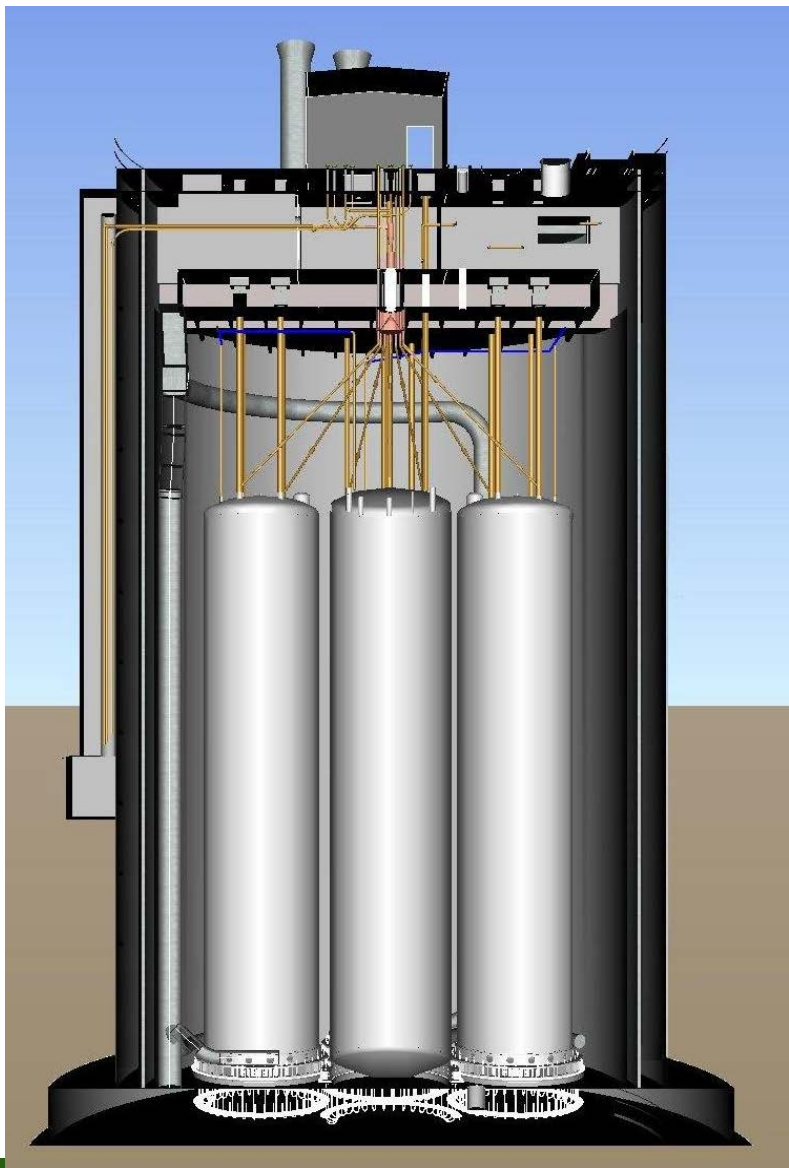


**CSSF 6**  
713 m<sup>3</sup>  
1,506 m<sup>3</sup>



**CSSF 7**  
0 m<sup>3</sup>  
1,784 m<sup>3</sup>

# Calcined Solids Storage Facilities (CSSF) Common Design Features



- Stainless steel bins—primary containment
- Concrete vault—shielding/secondary containment
- HEPA-filtered bin ventilation system
- Bin/calcline cooling air system
- Calcline leak detection (radiation monitor) also sump liquid monitor
- Calcline temperature/level monitoring (thermocouples)
- Calcline retrieval lines (except CSSF 1)
- Bin corrosion coupons (except CSSF 1)
- Bins 20 to 68 ft tall; 3 to 13.5 ft dia.
- Periodic inspections

# Calcine Solids Storage Facility (CSSF) Bins



# Calcine Disposition Project

- **Calcine Disposition Project (CDP) formed during FY 2002.**
- **Design and construct processing facility using the Integrated Waste Treatment Unit (IWTU) to the maximum extent practical.**
- **Retrieve, transport, and process 4,400 m<sup>3</sup> (12.2M pounds) of calcine.**
- **Treat calcine using hot isostatic pressing (HIP) technology**
  - Utilize Waste Acceptance System Requirements Document (WASRD) for Yucca Mountain.
- **Package treated waste form in canisters.**
- **Ship off-site to repository.**
- **Perform RCRA closure on existing and new retrieval/treatment/storage facilities.**

# Analysis of Alternatives (AoA)

The Analysis of Alternatives (AoA) was chartered for two primary reasons:

- 1) New requirement was issued by the Secretary of Energy for all projects exceeding \$10M in total cost to conduct an AoA, independent of the contractor, prior to approval of Critical Decision 1.
- 2) The current baseline to immobilize the calcine via HIPing (hot isostatic pressing) is technically immature, with significant challenges to overcome, which may represent unacceptable project risk.

# Analysis of Alternatives (AoA)

## Conclusions from AoA:

- Selection of the most appropriate processing technology is highly dependent on the disposal path, and the associated waste form performance requirements. A fully informed final decision regarding processing of the calcine cannot be made until the disposal path is known along with the associated regulatory framework.
- The current baseline of HIPing appears to represent the least preferable processing technology for all disposal options based on the assumptions and supporting criteria. HIPing represents the highest operational safety risk (e.g., high pressures and temperatures) of all the processing options.

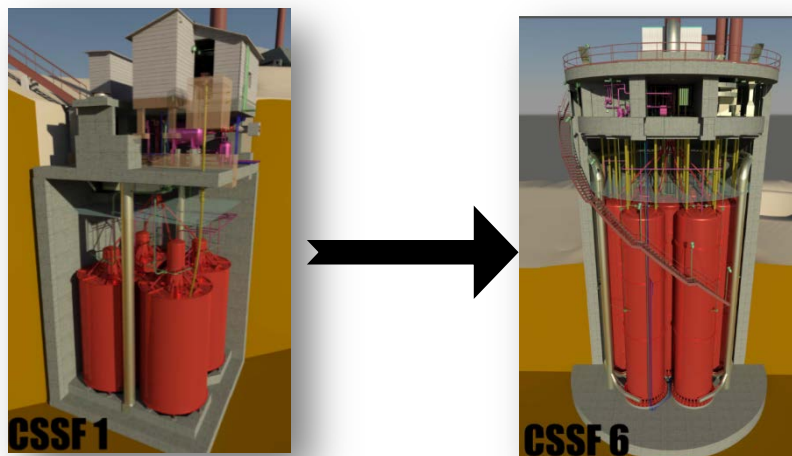
# Analysis of Alternatives (AoA)

Based on the conclusions of the AoA, the following recommendations were made:

- The Calcine Disposition Project should be divided into two subprojects: a) Calcine Retrieval; and b) Calcine Processing. The project near-term priorities should focus on calcine retrieval activities, and limited technology maturation to better inform future processing decisions.
- A final decision regarding the processing technology should be deferred until the disposal path is better defined, as well as its expected regulatory framework, and resulting waste form performance requirements.
- Efforts should be accelerated on development and testing of the most effective retrieval technologies and systems. Significant progress can be made in advance of processing and disposal to address key retrieval risks and uncertainties.
- The Calcine Retrieval Subproject should consider the concept of a full-scale radioactive demonstration of the retrieval and transport system, to include retrieval from CSSF #1 to CSSF #6.

# Calcine Retrieval Project (CRP) Overview

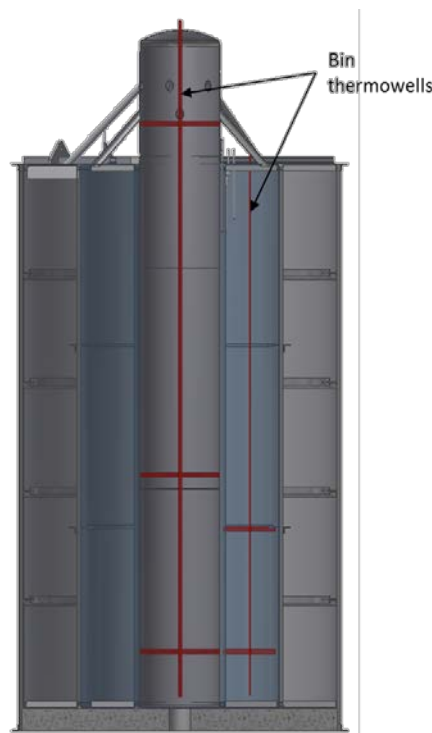
- Sub-project of Calcine Disposition Project (CDP):
- Demonstrate safe retrieval and transfer of calcine:
  - Remove calcine from CSSF 1 and transfer to CSSF 6.
- Demonstrate ability to achieve Calcined Solids Storage Facility (CSSF) closure:
  - National Defense Authorization Act (NDAA) Section 3116.
  - Resource Conservation and Recovery Act (RCRA).
  - Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).



# Backup Slides

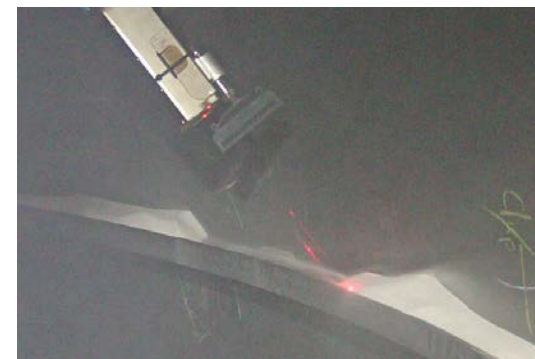
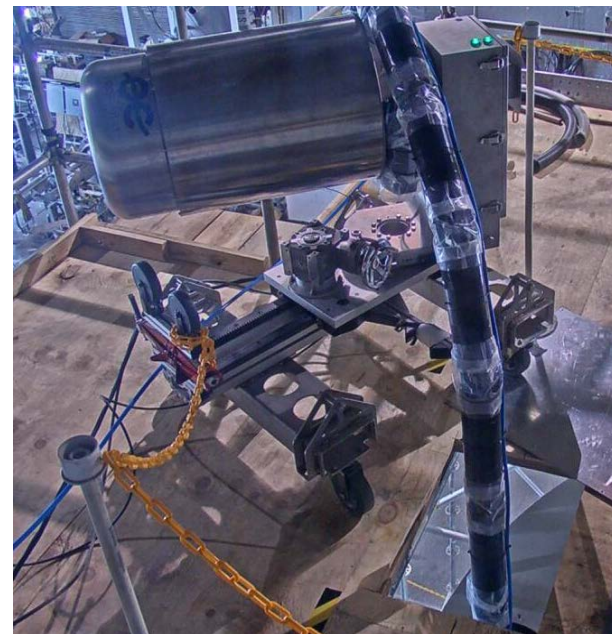
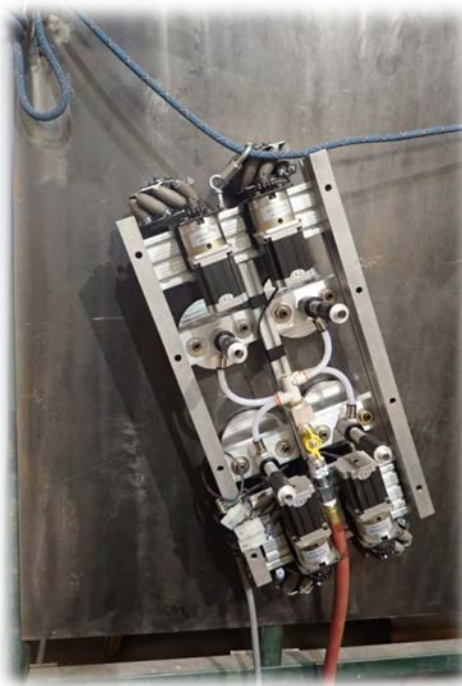
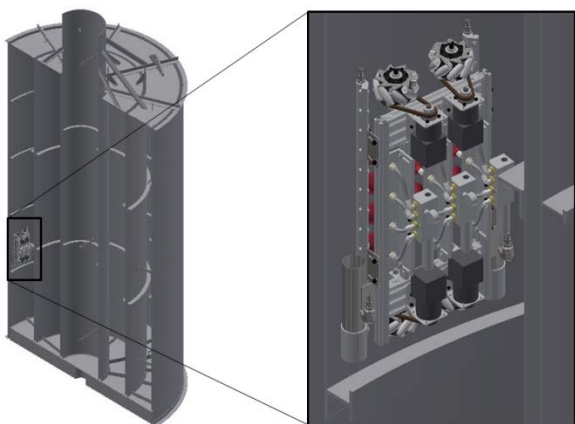
# CRP 2017 Testing and Development

- Access riser placement
- Full scale mockup of bin group
- Bulk retrieval system design and testing
- Residual clean out system Design and testing

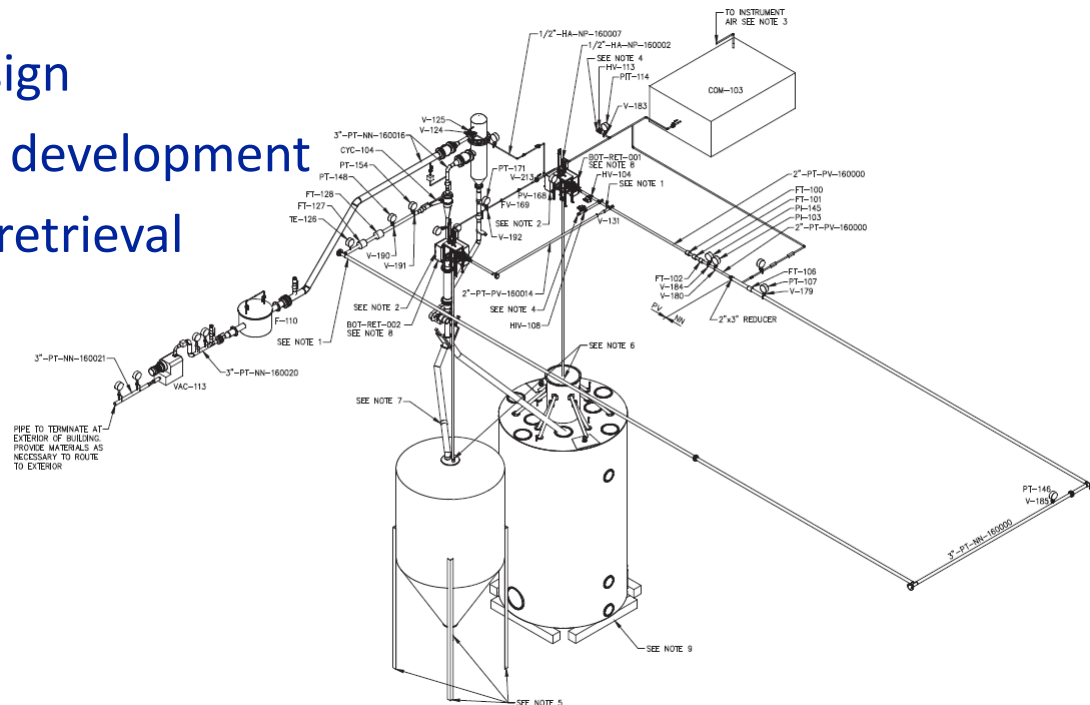


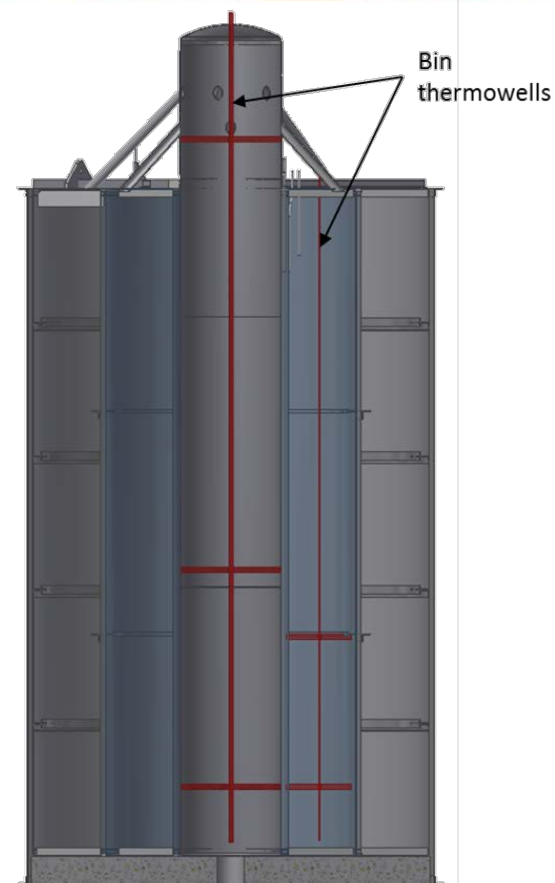
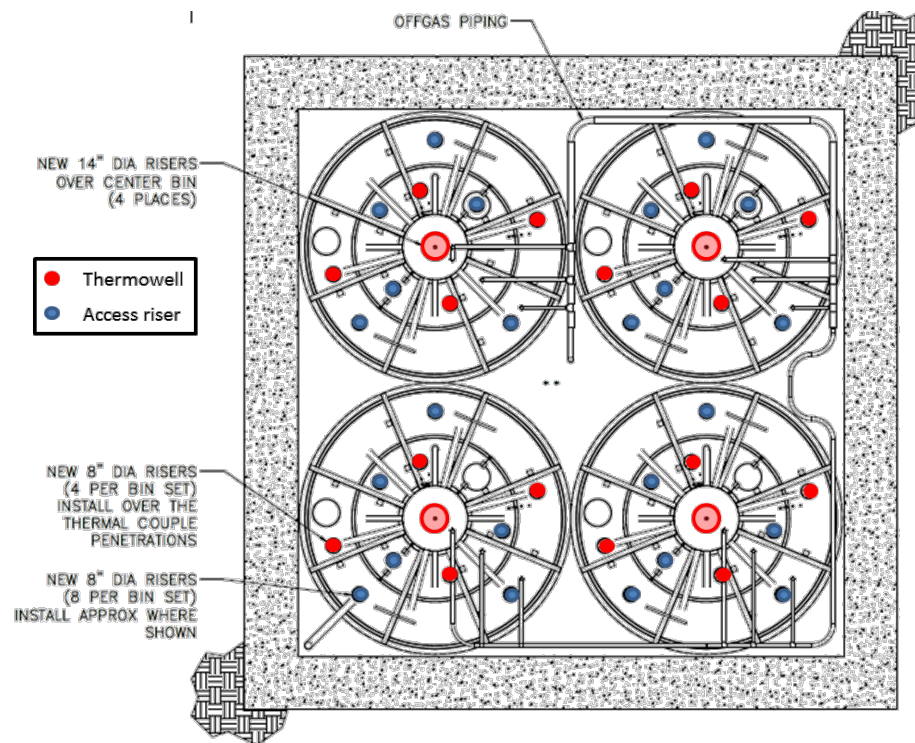
# CRP Residual Clean Out

- OC Robotics Snake Arm
  - Successfully deployed and cleaned stiffening rings
- Vacuum Crawler
  - Uses vacuum to attach to bin wall
  - Traverses the bin
  - Cleans surfaces



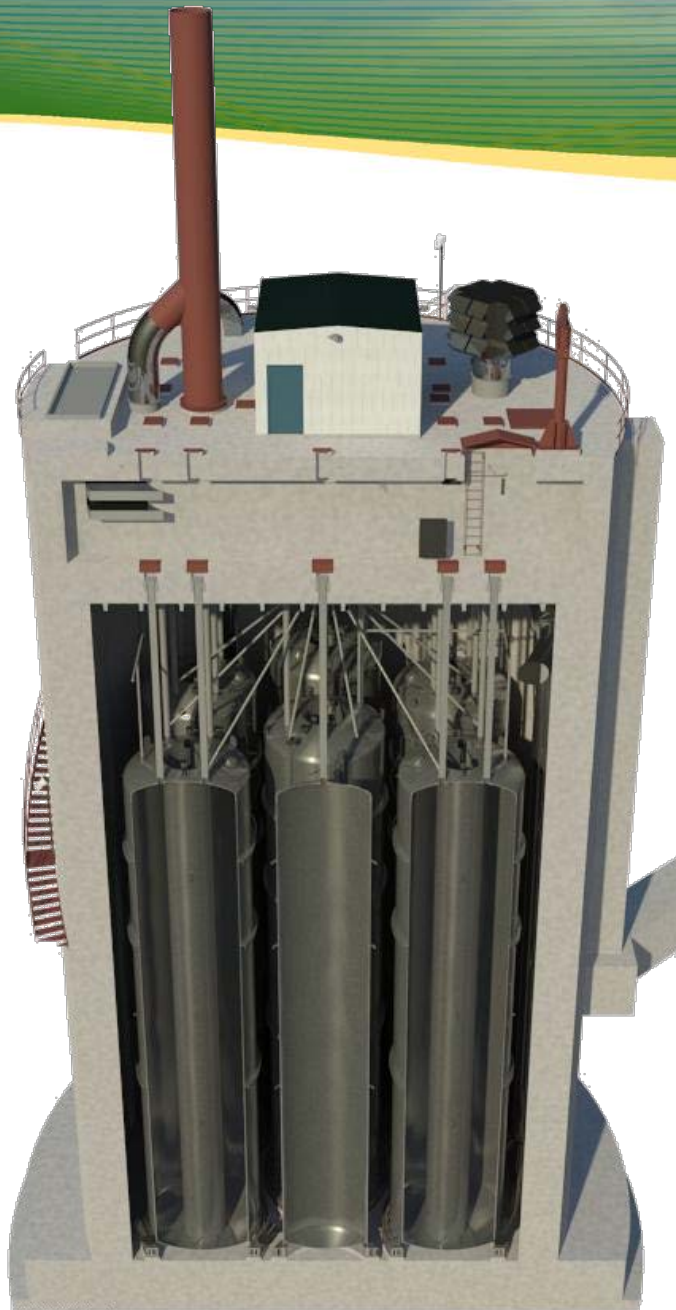
- Build full scale mockup system in CPP-691 Fuel Processing Restoration Building
- Perform full scale transfer and retrieval tests
- Continue development of access riser placement system
- Optimize bulk retrieval design
- Continue residual retrieval development
- Prepare CSSF 1 for calcine retrieval installation





# Solids Storage Bin VES-WCS-115-2 in CSSF I





# Calcine Trivia

- Spent Fuel Reprocessing operated from 1953 to 1992.
- The Waste Calcining Facility (WCF) operated from November 1963 to March 1981, and converted 4,091,000 gal of liquid HLW into 77,300 ft<sup>3</sup> of calcined solids.
- The New Waste Calcining Facility (NWCF) operated from August 1982 through May 2000, and converted 3,642,000 gal of liquid HLW into 78,000 ft<sup>3</sup> of calcined solids.
- The total volume of calcine stored in the CSSFs is about 155,300 ft<sup>3</sup> (4,400 m<sup>3</sup>). The equates to about 12.2 million lbs.
- CSSF-1 was filled between Nov 1963 and Oct 1964.