



Calcine Disposition Project – Technology Demonstration

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IDAHO
ENVIRONMENTAL
COALITION



Vitrification Technology Validation

- Objective is to gather meaningful data to validate the different vitrification technologies with respect to treating mixed high-level radioactive waste (HLW) (i.e., calcine)
- A statement of work—developed and reviewed by experts within DOE and the industry—is being executed by multiple vendors

Glass melt demonstration at Catholic University, Washington D.C., October 2022

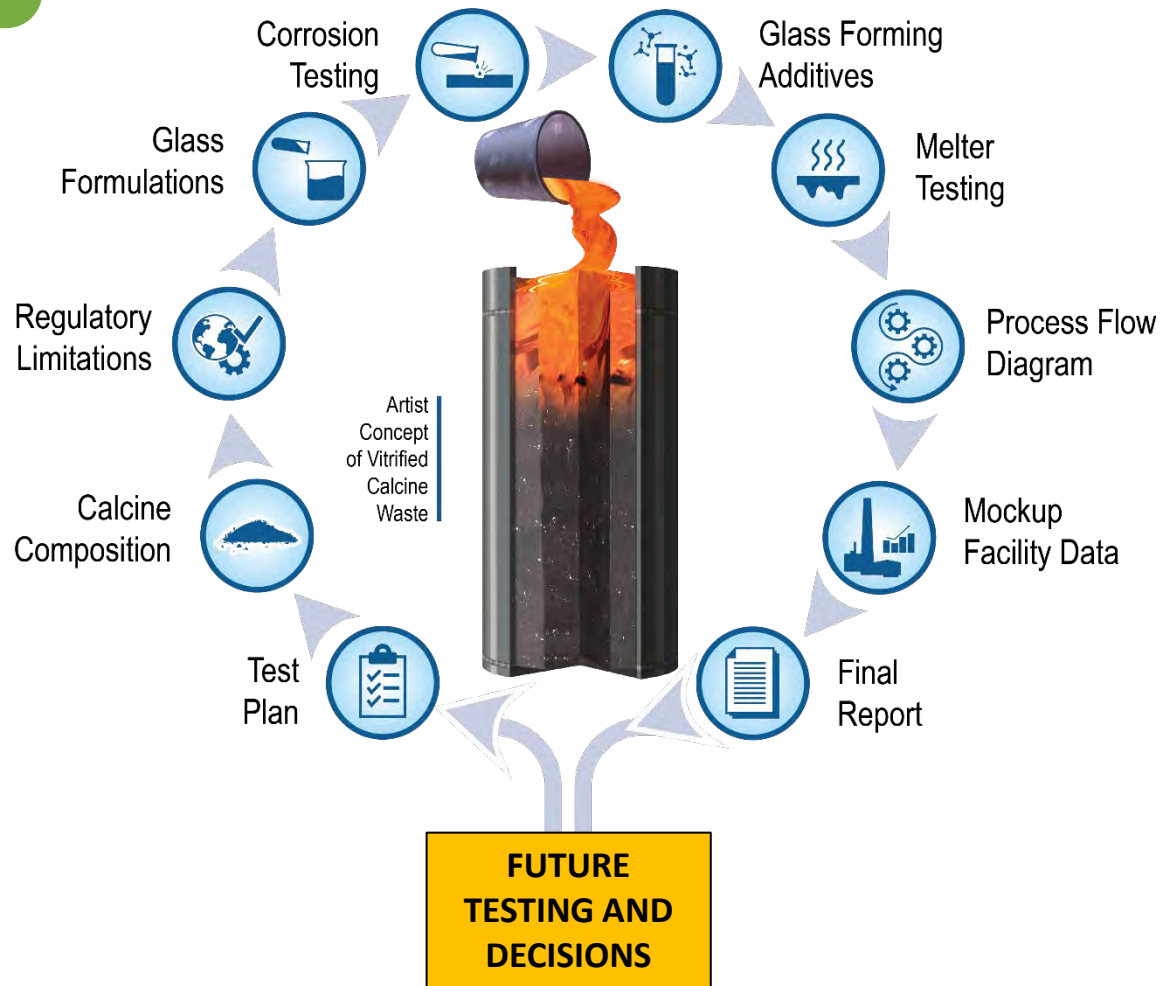


Illustration showing tasks that will be completed by each of the vendors

Calcine Vitrification Studies

- Execute several tasks that will validate the feasibility of the vendor technology to treat calcine
- Perform work at the required quality level to provide data that can be used for future decisions and design inputs

Vitrification

- Achieved by heating materials (waste and glass forming additives) until they liquidize, then cooling the liquid so that it forms a glassy solid
- Used in disposal and long-term storage of nuclear waste
- Treatment method for mixed HLW throughout the world
- Glass is a long-lasting, durable material that effectively immobilizes radioactive hazardous material



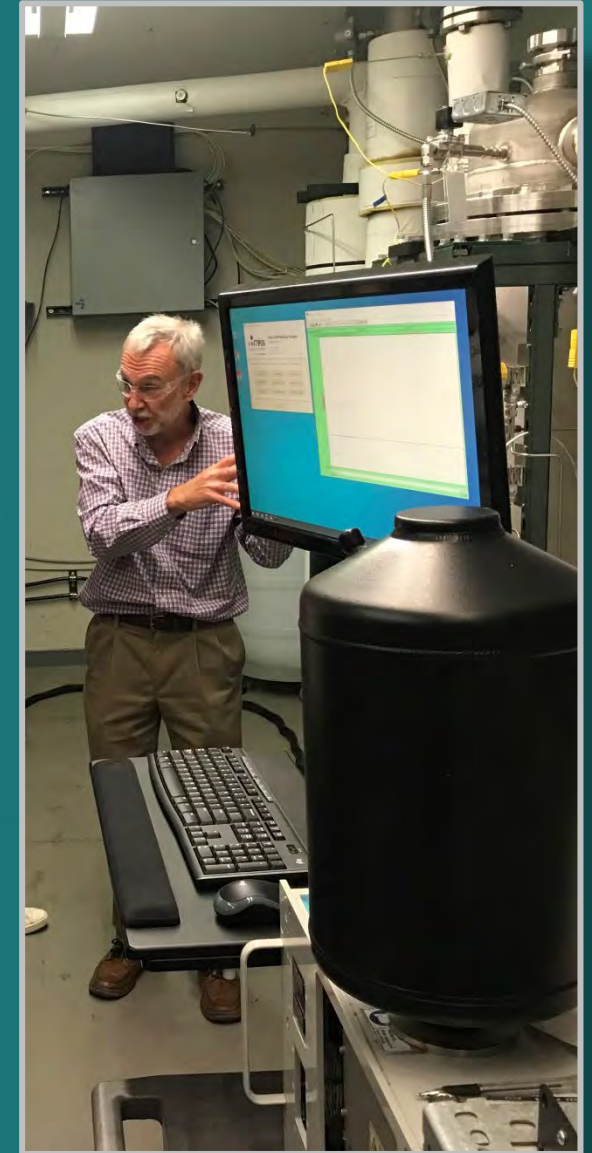
Photo from lab-scale testing using calcine simulant



Glass made with Zr-calcine at 35% waste loading

Vitrification Technologies

- Joule Heated Ceramic Melter (JHCM)
 - Used within the DOE complex, Europe, Japan
 - Used to treat LLW and HLW
- Cold Crucible Induction Melter (CCIM)
 - Used in France, Russia, and Korea
 - Used to treat HLW
- In-Container
 - Used in US, Europe, Japan, Australia
 - Used for LLW and different mixed media waste (e.g. soil, sludges, and debris)
 - Full-scale pilots in operation for HLW



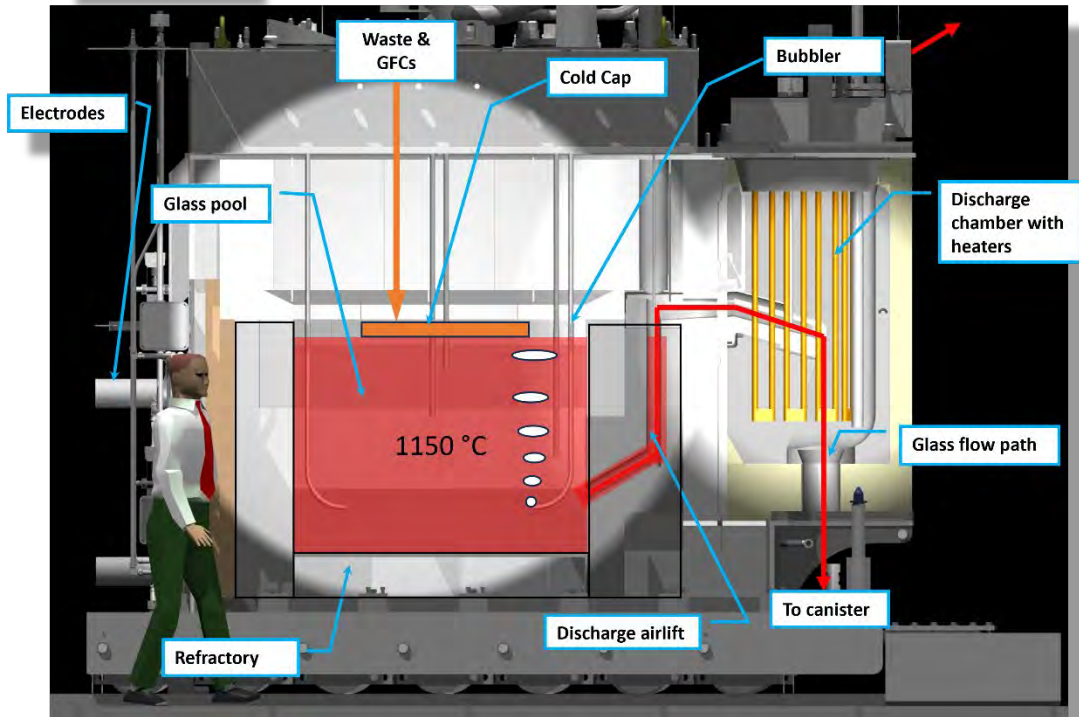
*Test facility tour at Catholic University,
Washington D.C., October 2022*

Technology Facts and Figures



JHCM	CCIM	In-Container
<ul style="list-style-type: none">• Continuous process• Unlimited scale• Low temperature (950 – 1200°C)• In-melt electrodes• Over 30 years operation in the DOE complex	<ul style="list-style-type: none">• Continuous process• Limited scale• High temperature (>1300°C)• Non-intrusive induction energy• Over 12 years industrial operation*	<ul style="list-style-type: none">• Batch process• Custom size• Wide temperature range (1100 – 1600°C)• In-melt electrodes/non-intrusive induction energy• Over 20 years industrial operation

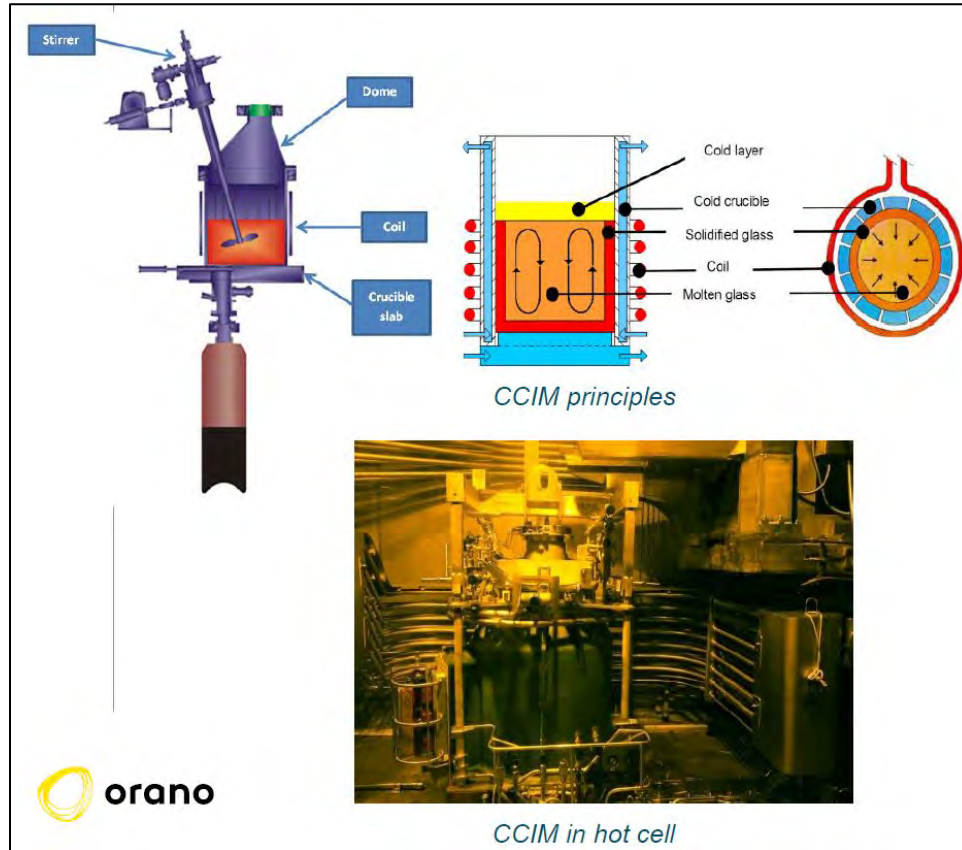
*France has also used IHMM (induction heated metallic melter) for over 40 years



*Illustration of the primary systems
of the Joule Heated Ceramic Melter*

JHCM Principles of Operation

- Refractory/ceramic lined vessel
- Sealed vessel
- Submerged, permanent electrodes
- A/C power
- Vertical melting process
- Continuously stirred



*Illustration of the primary systems and
photo of the Cold Crucible Induction Melter*

CCIM Principles of Operation

- Glass heated by a current that is passed through an induction coil surrounding the crucible
- Solidified layer of glass protects the melter from the corrosive melt
- Mixing ensured by bubbling and stirring



HLW canisters used at the Defense Waste Processing Facility at the Savannah River Site

In-Container Principles of Operation

- Canister used as the melter
- Canister is filled with waste and glass forming additives
- Mixing ensured by heat and convection
- Uses either in-melt electrodes or non-intrusive induction energy

Importance of Vendor Studies

- Each vendor provides valuable insight respective to their technology and the potential treatment of calcine
- Current demonstrations are scheduled to complete fall of 2024
- Results will be used to inform next steps of the validation process

