ART – CCIM Phase II-A Project
Retrofit DWPF with Cold Crucible Induction Melter Technology

Project Kick-Off Meeting

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Project Manager

Savannah River Site

October 25, 2007

Agenda

- Overview of the ART CCIM Phase II-A Project
- The ART CCIM Phase II-A Project team
- Key features of the proposed CCIM vitrification technology
- Summary of the key results of the Phase I effort
- Plan for Phase II-A lab testing and pilot-scale demonstrations
- Available modeling, testing & demonstration capabilities
- Schedule for Phase II-A lab testing and demonstration activities
- Overview of the Phase II-A engineering activities
- Project deliverables

THE ART CCIM PHASE II-A PROJECT

- Overview
- The project team

The "ART – CCIM Phase II-A" Project

- **Contract DE-AC09-06SR22467 Modification M006 for Phase II-A work was awarded to AREVA NC Inc. on September 25, 2007**
- **It is the second phase of a DOE-funded project focused at validating the expected benefits of CCIM on the existing DWPF joule-heated melter vitrification technology identified during Phase I of the project, through**
  - **Lab testing activities at SRNL and at CEA Marcoule**
  - **Pilot-scale demonstrations under representative conditions on existing CCIM pilot platforms at Marcoule and at INL with analytical support from SRNL**
  - **Specific technical studies of key technical issues identified in Phase I and that will support assessing the feasibility of installing a CCIM into the DWPF Melter Cell**
  - **Development of a comprehensive plan (including cost and schedule) for lab-testing, pilot- and large-scale demonstrations, and engineering activities to be performed during Phase II-B**

The "ART – CCIM Phase II-A" Project

- Is managed by AREVA NC Inc Richland Office, teaming with
  - CEA, co-developer with AREVA, of the proposed CCIM technology
  - SRNL & WSRC, R&D and analytical lab support to DWPF operations, and DWPF engineering
  - INL, expertise in off-gas characterization, monitoring and control. Owns a CCIM test platform
  - SGN, engineering of commercial HLW vitrification facilities. Conduct a CCIM retrofit project into an operating HLW vitrification facility at La Hague

The team assembles years of experience in development, design, deployment, and operation of HLW vitrification processes, and has a unique knowledge of the DWPF configuration and operation

The team has worked together on the ART CCIM Phase I Project at preparing and submitting the Topical Report and the successful proposal for Phase II work

The ART CCIM Phase II-A Project Team

AREVA NC Inc.
Project Manager
Eric Tchemitcheff

Quality Assurance
Project Controls
Contracts Management
Records Management/Administration

Subcontracts

SGN

- Define CCIM characteristics
- Develop engineering design studies for retrofit of the CCIM technology into DWPF
- Support preparation of pilot-scale demonstration
- Support CCIM flowsheeting and sizing
- Develop detailed engineering plan, with cost & schedule for Phase II-B

Consultant

- Summarize data inputs from CEA, SRNL, & INL
- Summarize CCIM lab test & demonstration results
- Support development of the Phase II-A Technical Reports

CEA

- Conduct lab tests and pilot-scale demonstration on the 650-mm CCIM at Marcoule
- CCIM flowsheeting and sizing
- Develop detailed plan for Phase II-B lab tests and CCIM pilot-scale demonstrations at CEA Marcoule

WFO Agreements

INL

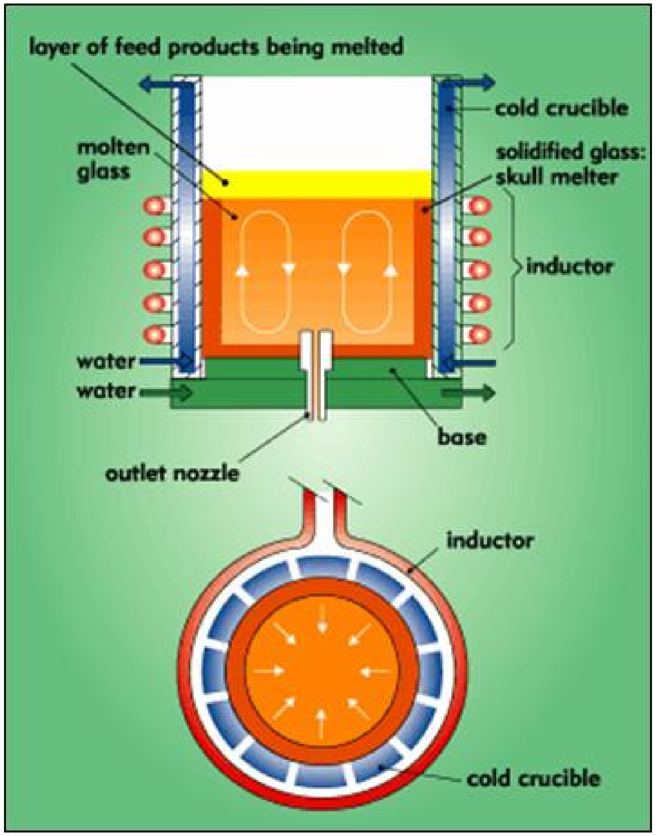
- Conduct off-gas characterization & testing on the INL CCIM platform
- CCIM flowsheeting
- Develop detailed plan for Phase II-B CCIM off-gas characterization & testing at INL

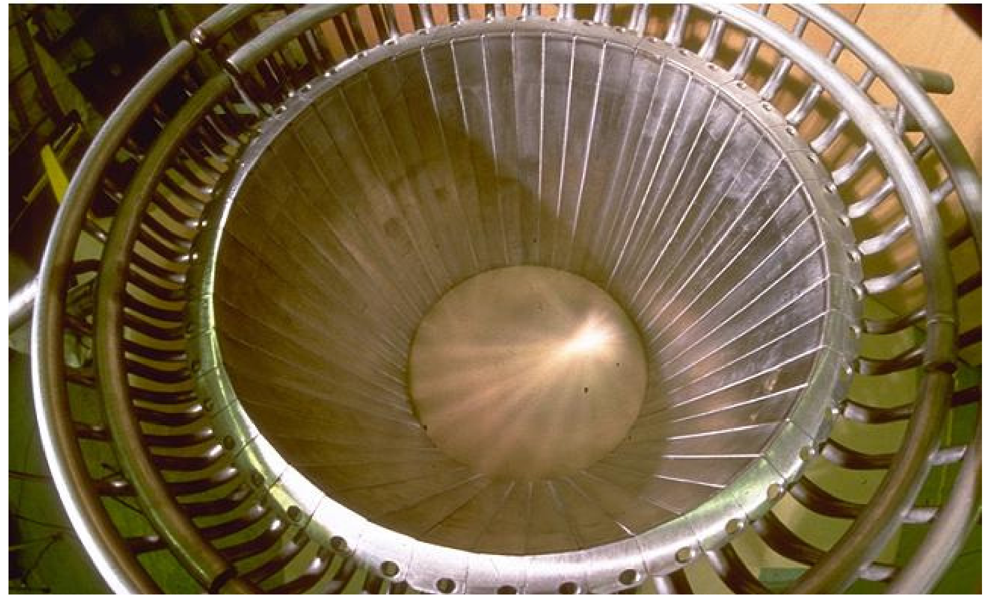
SRNL/WSRC

- Provide DWPF data
- Conduct lab tests at SRNL
- CCIM flowsheeting
- Support engineering design studies for retrofit of the CCIM technology into DWPF
- Develop detailed plan for Phase II-B lab testing activities at SRNL

THE PROPOSED CCIM VITRIFICATION TECHNOLOGY
KEY FEATURES

The Proposed CCIM Vitrification Technology





Water-cooled structure of a CCIM

- **The energy source is outside the melter: the molten glass is heated directly with no need for immerged electrodes**
- **The crucible itself is a water-cooled structure made of plain stainless steel segments: no need for refractory assemblies**
- **CCIM accommodates corrosive glass and refractory melts (up to more than 2,000 deg C)**

REMINDER – KEY FINDINGS OF THE ART CCIM PHASE I EFFORT

AREVA

From Phase I Topical Report Section 3.1 – Summary of Existing CCIM Test Results

- The project team drew on extensive lab and pilot-scale development work done by the CEA at Marcoule, on DWPF glass compositions studies and lab tests at SRNL, and on international cooperation programs launched by DOE with Russian Research Institutes and US National Labs
- Past and current tests indicate strongly that the proposed CCIM technology will provide very promising benefits for the DWPF and SRS
  - Higher waste loadings, and specific glass and waste throughputs achievable than with the current JHM technology
  - Stable operational process - Ability to process liquid waste and slurries steadily and produce a consistent glass
  - Feasible to feed a CCIM with liquid waste or slurries
  - Reliable technology demonstrated in a commercial application

From Phase I Topical Report Section 3.3 – Pre-conceptual Design Study for Retrofitting a CCIM into DWPF

- **The design study provides a detailed examination of the feasibility of installing the CCIM technology in DWPF**
- **Guiding principles were established by the project team**
  - **Reuse as much as possible of the successful design developed for the CCIM installation at La Hague**
  - **Implement a process that relies on the same feeding strategy as is used for current DWPF operations**
  - **Rely on proven concepts from the existing DWPF Melter Cell design for CCIM interfaces and interconnections, to the extent possible**
  - **Minimize modifications to existing DWPF in-cell equipment designs**
- **The design study shows there are no major technical impediments to retrofitting CCIM into DWPF**

From Phase I Topical Report Section 5.3 – Identified Potential Benefits of the CCIM Technology

- **The application of CCIM at DWPF will benefit from**
  - **The possibility to overcome the 1,150 deg C temperature limit and the related throughput, waste loading, and corrosive composition limits of the current JHM technology**
  - **The resistance of the melter to corrosive melts, since the cold skull prevents any contact between the melt and the structural material**
  - **The presence of effective homogenizing systems**
  - **The capability of gravity pouring from the bottom of the melter**
  - **The compactness of the melter and elimination of need for refractory materials**
  - **The capability to stop and start the melter as many times as required, and to drain the melter completely**
  - **An integrated configuration designed for operation in a high rad facility**

PHASE II-A MODELING, LAB TESTING, AND PILOT-SCALE DEMONSTRATIONS

- List of the tasks to be conducted
- Testing and demonstration systems to be used
- Schedule

Phase II-A Modeling, Lab Testing and Pilot-scale Demonstrations

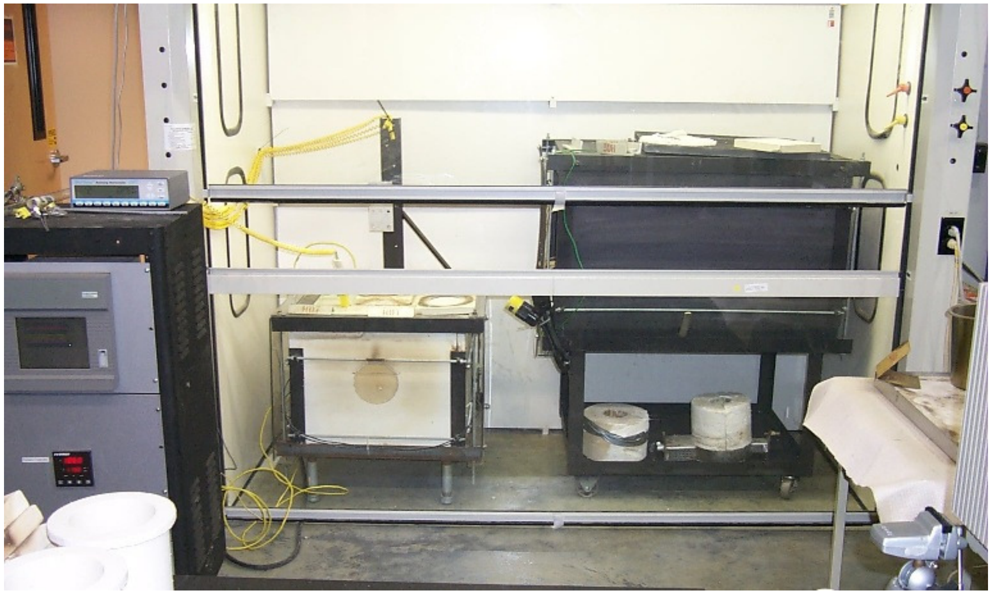
- **Phase II-A lab testing and pilot demonstration activities will be conducted on a non-radioactive HM-type waste surrogate and will include**
  - **Task II-A-1 - Lab-scale studies, modeling, and testing**
    - **Subtask II-A-1-1 includes determination of the composition of the waste surrogate to be tested in Phase II-A and of the fabrication protocol for the surrogate, definition of operational parameters, selection of glass frit, crucible glass composition studies and melt rate studies at SRNL with CEA support and review including complementary lab tests and analyses,**
    - **Subtask II-A-1-2 includes modeling, and testing (e.g., CCIM stirring, electromagnetic parameters) conducted at CEA Marcoule**
  - **Task II-A-2 - Pilot-scale demonstration on an existing CEA Marcoule platform including a 650 mm-diameter CCIM**
  - **Task II-A-3 - Off-gas system characterization and testing on the existing INL CCIM pilot platform**

Available Testing Capabilities for Phase II-A at CEA Marcoule

- **3D-Models**
  - **"OCTAVE" thermo-electromagnetic code to calculate the power dissipated in the glass and in the CCIM itself**
  - **Thermal, hydraulic, and electromagnetic phenomena occuring in the molten glass inside the stirred CCIM**
- **Hydraulic mock-ups for optimization of the mechanical stirrer and bubblers configuration**
- **Pilot-scale demonstration platform including a 650 mm-diameter CCIM (see photo below)**

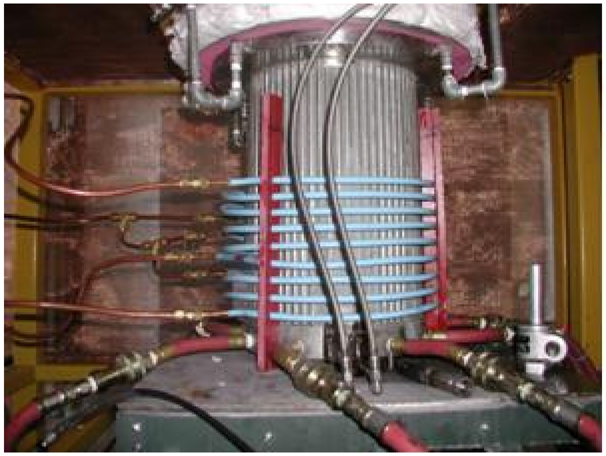
Available Testing Capabilities for Phase II-A at SRNL

- **Models**
  - **Glass property model**
  - **Melt rate model**
- **Bench-scale tools (see photo below)**
  - **Melt Rate Furnace (MRF)**
  - **Slurry-fed Melt Rate Furnace (SMRF)**

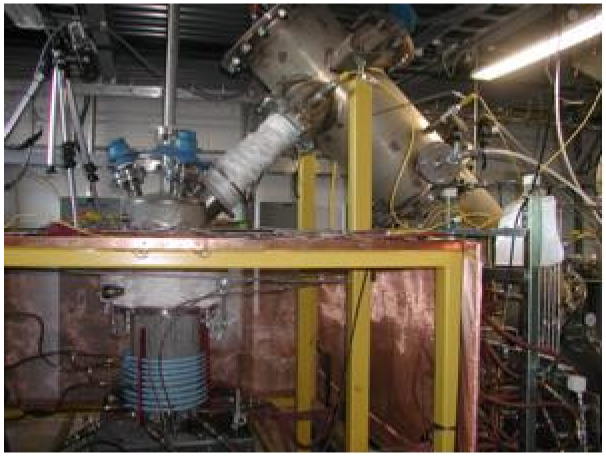


Available Testing Capabilities for Phase II-A at INL

- **Integrated CCIM test platform including**
  - **Solid and liquid/slurry feed systems**
  - **A 267 mm-diameter CCIM**
  - **A complete MACT-compliant off-gas treatment system instrumented with complete CEMS racks**



INL CCIM



INL CCIM, crucible lid, and first off-gas system components

Schedule for Phase II-A Lab Testing and Demonstration Activities

- **Duration of the ART CCIM Phase II-A project is 18 months (October 1, 2007 through March 31, 2009)**

OVERVIEW OF THE PHASE II-A ENGINEERING ACTIVITIES

Overview of the Phase II-A Engineering Activities

- **Phase II-A will address the highest priority “key technical issues’ identified during Phase I that are necessary to confirm the design of the CCIM system for implementation in DWPF**
  - **Define the preferred maintenance strategy for CCIM and the High-Frequency power line**
  - **Optimize the CCIM lay-out in the DWPF melter cell**
  - **Design the CCIM melter frame**
- **Engineering activities will also include**
  - **Updating the Basic Process and Implementation Data Report (Phase I Topical Report Section 3.2)**
  - **Establish a reference process flow sheet**
  - **CCIM system sizing**

See description of the corresponding tasks in the next slides

ART CCIM Phase II-A Engineering Activities (1/3)

WBS	Phase II-A engineering tasks Section A-1: Basic Data	SGN	WSRC	SRNL	INL	CEA
A1-1	Define data needed	P				R
A1-2	Update Basic Process and Implementation Data Report: - Feed stream compositions - Maintenance requirements - Lay out constraints - Other	R	P			R

P = Preparing

R = Reviewing

S = Supporting

ART CCIM Phase II-A Engineering Activities (2/3)

WBS	Phase II-A engineering tasks Section A-2: participation to Testing Activities	SGN	WSRC	SRNL	INL	CEA
A2-1	Establish a reference process flow sheet using results from tests on CCIM to establish o Off gas flow rate at the outlet of CCIM o Decontamination factor for the CCIM o Characterize the organic content in the off gas o Assess the dust flow rate at the outlet of the CCIM	S			P	P
A2-2	CCIM system sizing using results from tests on CCIM to assess o CCIM diameter to reach 200 l/h o Electrical needs / balances at 200 l/h o Design of the stirrer for a large-diameter CCIM	S				P

ART CCIM Phase II-A Engineering Activities (3/3)

WBS	Phase II-A engineering tasks: **Section A-3: Engineering Studies**	SGN	WSRC	SRNL	INL	CEA
A3-1	Define the preferred maintenance strategy for CCIM / HF line among the following strategies - Equip the in-cell crane with robotic arms mounted on a mast to support fine maintenance operations (La Hague type) and Ti ring introduction - Equip the melter cell with robotic arms located on the CCIM support frame to support fine maintenance operation (La Hague type) and Ti ring introduction - Implement a change in CCIM design that will enable the direct use of the "jumper concept" in order to perform maintenance operation with: o Existing MSMs / crane / tele-robotic arm o Implementation on the right side of the melter cell of a maintenance area based on MSM utilization: ▪ Glass removal prior to transferring components to hands-on maintenance cell (via the decontamination cell) ▪ Direct exchange of small components	P	S			
A3-2	Optimization of the CCIM lay-out - Consider the implementation of the CCIM over the draining trolley which will be moved to the current glass pouring position (or to an intermediate position) o Better use of the existing cell windows and existing MSM positions - Adjust position of melter frame / pouring table to ease the CCIM access with MSM	P	S			
A3-3	CCIM melter frame mechanical design - Develop the CCIM design adapted to the chosen maintenance strategy and DWPF environment - Integrate the CCIM into a melter frame	P	S			S

ART CCIM Phase II-A Project Deliverables

- Project Management Plan (PMP)
- Project schedule
- Monthly project status reports
- Updated Basic Process and Implementation Data Report (from Phase I)
- Lab-testing and modeling report (combining SRNL and CEA inputs)
- CCIM demonstration report (for demonstration run at Marcoule)
- CCIM off-gas system characterization and testing report (for demonstration run at INL)
- Engineering report for the 3 Phase II-A engineering studies
- Proposal for Phase II-B detailed work scope including cost estimate and schedule