

Current Progress and Future Plans for the DOE Office of Environmental Management International Program

K.D. Gerdes, J. C. Marra*, D. K. Peeler*, J. R. Harbour*, K. M. Fox*, J. D. Vienna**,
A. S. Aloy⁺, S. V. Stefanovsky⁺⁺ and M. D. Bondarkov⁺⁺⁺

Office of Engineering and Technology
Office of Environmental Management
U.S. Department of Energy, EM-20/Germantown, 1000 Independence Ave., S.W.,
Washington, DC 20585-1290

*Savannah River National Laboratory, Savannah River Site, P.O. Box 616, Aiken, SC 29808

**Pacific Northwest National Laboratory, P. O. Box 999, Richland, WA, 99352

⁺Khlopin Radium Institute, St. Petersburg, Russia

⁺⁺SIA Radon, Moscow, Russia

⁺⁺⁺International Radioecology Laboratory, Slavutych, Ukraine

ABSTRACT

The U.S. Department of Energy's (DOE) Office of Environmental Management (EM) has collaborated with various international institutes for many years on radioactive waste management challenges of mutual concern. Currently, DOE-EM is performing collaborative work with researchers at the Khlopin Radium Institute and the SIA Radon Institute in Russia and the Ukraine's International Radioecology Laboratory to explore issues related to high-level waste and to investigate experience and technologies that could support DOE-EM site cleanup needs. Specific initiatives include:

- *Application of the Cold Crucible Induction Heated Melter to DOE Wastes* - SIA Radon and Savannah River National Laboratory;
- *Improved Solubility and Retention of Troublesome Components in SRS and Hanford Waste Glasses* - Khlopin Radium Institute, Pacific Northwest National Laboratory and Savannah River National Laboratory
- *Long-term Impacts from Radiation/Contamination within the Chernobyl Exclusion Zone*, International Radioecology Laboratory and Savannah River National Laboratory.

This paper provides an overview of the status of the current International Program task activities. The paper will also provide insight into the future direction for the program. Specific ties to the current DOE-EM technology development multi-year planning effort will be highlighted as well as opportunities for future international collaborations.

INTRODUCTION

The DOE-EM Office of Engineering and Technology is responsible for implementing EM's international cooperative program. The Office of Engineering and Technology's international efforts are aimed at supporting EM's mission of risk reduction and accelerated cleanup of the environmental legacy of the nation's nuclear weapons program and government-sponsored nuclear energy research. To do this, EM pursues collaborations with government organizations, educational institutions, and private industry to identify and develop technologies that can address the site cleanup needs of DOE. The Office of Engineering and Technology currently works with the Khlopin Radium Institute (KRI) and SIA Radon Institute in Russia and the International Radioecology Laboratory (IRL) in Ukraine through cooperative bilateral arrangements to support EM's accelerated cleanup and closure mission.

The Office of Engineering and Technology is also currently developing an "Engineering and Technology Program Management Plan" (i.e. technology roadmap) including a multi-year program plan to identify areas for focused research and development to support DOE-EM's environmental cleanup and waste management objectives. It is anticipated that the international cooperative program will be an important element of the technology development roadmap through the leveraging of world-wide expertise in the advancement and deployment of remediation and treatment technologies.

The following overview is an update to that presented at the 2007 Waste Management Conference [1]. The latest results from the current bilateral collaboration projects being implemented by EM in support of the EM accelerated cleanup and closure mission are presented. Discussion regarding efforts to integrate the international cooperative program with the current engineering and technology development program is also included.

APPLICATION OF THE COLD CRUCIBLE INDUCTION HEATED MELTER TO DOE WASTES

Background and Application

This effort continued the evaluation of the Cold Crucible Induction Melter (CCIM) technology as a means to increase waste loading and waste throughput for the Savannah River Site's Defense Waste Processing Facility (DWPF). Specific attention in FY07 was given to processing of high alumina content feeds. The DWPF Sludge Batch 4 (SB4) surrogate composition, representing the highest alumina content feed processed to date in the DWPF, was selected for testing. Compositions with high alumina concentrations have the potential to increase nepheline ($\text{NaAlSi}_3\text{O}_8$) crystal formation in the glass [2]. The formation of nepheline can have a detrimental impact on glass durability because it decreases the amount of the glass forming oxides Al_2O_3 and SiO_2 in the residual glass matrix. Additionally, the refractory nature of alumina may have a negative impact on melting rate for high alumina concentration feeds [3].

The reference Joule Heated Melter (JHM) technology has a process temperature of 1150°C . This temperature limitation combined with the refractory nature of the high alumina feeds has the

potential to hamper continued waste throughput improvements with the current JHM technology. The CCIM technology offers the potential for higher vitrification process temperatures which could lead to increased waste loading and melting rates for high alumina concentration feeds.

Scope of Work and Results

The FY07 test program focused on demonstrating high waste loading of the SB4 feed without detrimentally impacting glass properties or melter processing. To accomplish this objective, a two-phased testing approach was used: i) glass composition development to identify a frit composition to increase waste loading and maintain acceptable glass properties and ii) demonstrating CCIM processing in a series of varying scale melter tests.

A previously developed frit composition (Frit 503) was used by SRNL researchers as a starting point for frit composition development. Frit 503 was modified by lowering the sodium content and/or increasing the boron content. It was hypothesized that removing sodium from the glass would reduce the tendency for nepheline formation and the negative impacts on durability. Additionally, the decrease in alkali content would result in an increase in SiO₂ concentration, further reducing the tendency for nepheline formation. Increasing boron content was also postulated as a means to reduce the tendency for nepheline formation [4]. The compositional adjustments were also made with the processing conditions and requirements of the CCIM in mind. The identified candidate frit compositions are shown in Table I. Glasses were fabricated using all five candidate frit compositions with SB4 waste loadings of 40, 45, 50, and 55 wt %, each. The compositions were batched using oxide chemicals and melted at 1250° C in Pt/Rh crucibles. After nominally two hours at temperature, the glasses were quenched by pouring on a steel plate. A portion of the glass was heat treated to simulate cooling along the centerline of the DWPF canister (i.e. Canister Centerline Cooling [CCC] profile) [5]. The CCC cooling profile was adjusted to a higher starting temperature consistent with the 1250° C melt temperature. Both quenched and CCC glass samples were then evaluated for crystallization using X-ray diffraction (XRD) and response to the Product Consistency Test Method A Procedure (PCT-A) [6].

Table I. Candidate frit formulations for CCIM testing (oxide concentrations in wt %).

Frit ID	B ₂ O ₃	Li ₂ O	Na ₂ O	SiO ₂	Total
503-R1	14.0	8.0	2.0	76.0	100.0
503-R2	14.0	8.0	--	78.0	100.0
503-R3	16.0	8.0	2.0	74.0	100.0
503-R4	16.0	8.0	--	76.0	100.0
503-R5	18.0	8.0	--	74.0	100.0

Based on the results of the experimental testing composition 503-R4 was selected for follow-on CCIM testing with the SB4 composition. This composition exhibited more than adequate durability as determined by the PCT and, unlike the other frit formulations, no evidence of nepheline formation was found in 55 wt % waste loading glasses even after CCC heat treatment. However, it should be noted that the lack of nepheline in the 503-R4 glass may have been a result of sampling or an analytical detection limit issue for this glass.

A series of melter test campaigns was completed at the SIA Radon test facilities utilizing the Frit 503-R4 compositions with various levels of SB4 waste loading. Initial testing was conducted in a lab-scale 56 mm diameter CCIM unit. This test included the addition of uranium oxide in the waste surrogate to evaluate the partitioning of uranium within the vitrified product. Testing was conducted at 40 and 50% waste loading (on a calcined oxide wt % basis). The resulting glass products consisted of primarily an amorphous matrix with some spinel crystals (enriched in transition metal ions) present. Uranium was only found in the glassy matrix and, therefore, did not partition to the crystalline phase. This initial testing provided confidence in the ability of the CCIM to process the SB4 waste composition and led to larger-scale testing.

The second test campaign was performed in the pilot-scale, 216 mm diameter, CCIM located at the SIA Radon Sergiev Posad facility. The first test processed the SB4 composition at 40 wt % waste loading while the second test started with a 40 wt % waste loading glass and progressed to a 60 wt % waste loading feed. The latter test allowed a progressive evaluation of processing from 40-60 wt % waste loading. All these tests used the simulated SB4 waste slurry and the Frit 503-R4 composition that was simulated using oxide chemicals. The testing provided insight into melter operations (e.g. power levels, production rate, etc.) and again provided confidence to move to the next scale of testing. The glass products produced from the testing were primarily vitreous with a minor spinel phase present. The concentration of the spinel phase was a maximum (~10 vol %) in the 60 wt % waste loading glass.

The final test campaign was conducted in the production-scale, 418 mm diameter, CCIM. This unit is located at the SIA Radon Sergiev Posad facility and is shown schematically in Figure 1. A 50 wt % SB4 waste loading target was selected for the testing. The waste composition was spiked with CsNO₃ to evaluate Cs volatility. Frit 503-R4 was fabricated in the U.S. and shipped to Russia to support the testing. The frit was sized to be consistent with current DWPF frit specifications. The test was conducted for 66 hours and approximately 460 kg of glass was produced with an average specific glass production rate of about 100 kg/(m²-hr). Melter operation and off-gas data were obtained from the testing. The resulting glass product was primarily vitreous with about 12 vol % spinel phase dispersed in the glass matrix. The crystalline content was higher in this testing vs. 216 mm CCIM testing due to the slow cooling of the glass receipt containers in the annealing furnace in the production-scale system. The durability of the 50 wt % SB4 glass, as determined by B release from the glass in the PCT-A, was an order of magnitude better than the Environmental Assessment (EA) glass. The EA glass is the current benchmark glass used for repository qualification in the U.S. [7]. Cesium volatility from the glass was estimated to be greater than 50 wt %. Future testing will be conducted to better quantify this volatility and to evaluate means to reduce volatility.

Significant FY07 Accomplishments:

- Glass formulation efforts led to a frit formulation that allowed for high waste loadings of a high alumina content waste that was suitable for processing in the CCIM.
- The ability to vitrify an SRS defense waste SB4 surrogate at high waste loading in the CCIM was demonstrated via testing at several scales. An extended test campaign at 50 wt % SB4 waste loading was successfully completed in the SIA Radon 418 mm diameter production-

scale CCIM with an average specific glass production rate of about 100 kg/(m²-hr). The resulting glass product was of excellent quality.

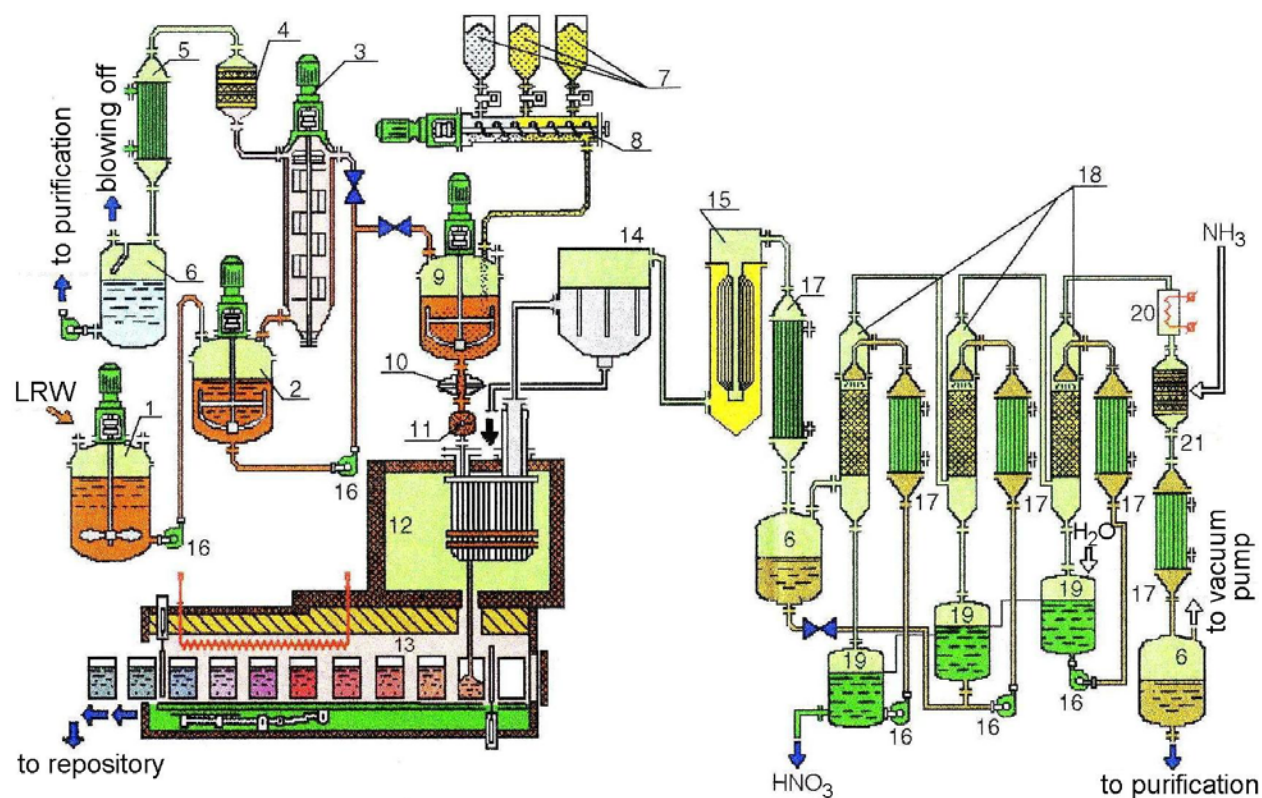


Figure 1. SIA Radon 418 mm CCIM unit. 1 – Interim storage tank, 2 – Concentrate collector, 3 – Rotary film evaporator, 4 & 15 – HEPA-filters, 5, 17 & 21 – Heat-exchangers, 6 & 19 – Reservoirs, 7 – Glass forming additives hoppers, 8 – Screw feeder, 9 – Batch mixer, 10 – Mechanical activator, 11 – Peristaltic pump, 12 – Cold crucible, 13 – Annealing furnace, 14 – Sleeve (coarse) filter, 16 – Pumps, 18 – Absorption columns, 20 – Heater.

Path Forward

Future testing is planned to evaluate processing of other troublesome high level waste feeds. Continued evaluation of volatility from the melt (especially cesium) is also planned. In addition to quantifying volatility, means to reduce volatility from the melt will be investigated.

IMPROVED SOLUBILITY AND RETENTION OF TROUBLESOME COMPONENTS IN SRS AND HANFORD HLW GLASSES

Background and Application

The U.S. DOE is currently processing high-level waste (HLW) through a JHM at the Savannah River Site (SRS) and plans to process HLW through a JHM at the Hanford Site. The process combines the HLW sludge with a prefritted additive (DWPF at SRS) or with mined mineral glass forming additives (Hanford). The combination is subsequently melted, and the molten glass is poured into stainless steel canisters to create the final waste form. In preparation for the qualification and receipt of each sludge batch, development and definition of various tank blending and/or washing strategies are often evaluated. The various strategies are contemplated in an effort to meet critical site objectives or constraints such as those associated with tank volume space, transfer options, and settling issues. Although these objectives or constraints are critical, one must not lose sight of both process and product performance issues associated with the final waste form. The product performance issue relates to the durability of the glass waste form (both fast and slow cooled). Process related issues (e.g., liquidus temperature, viscosity, electrical conductivity, and melting rate considerations) ultimately dictate the efficiency and effectiveness of the melter operation. The composition and loading of waste in the glass impact all of these issues.

Tank retrieval and blending strategies at both SRS and Hanford have identified high Al_2O_3 waste streams that are scheduled to be processed through their respective HLW vitrification facilities. These streams have Al_2O_3 concentrations above 25 wt % (on a calcined oxide basis). For example, the Liquid Waste Organization (LWO) at SRS has provided compositional projections for the next sludge batch (Sludge Batch 5) to be processed in the DWPF with Al_2O_3 concentrations up to 31 wt % (assuming aluminum dissolution is not implemented). In addition, physical limitations in the Tank Farms and/or settling issues associated with the sludge have prevented “advanced” washing which has resulted in relatively high Na_2O (23 to 27 wt %) and SO_3 (~ 0.8 – 1.6 wt %) concentrations. Current Hanford projections suggest the Al_2O_3 concentrations in sludge could be much greater than those currently projected for DWPF, with Al_2O_3 concentrations as high as 80 wt %.

Under this task, researchers from the Pacific Northwest National Laboratory (PNNL), Savannah River National Laboratory (SRNL), and Khlopin Radium Institute (KRI) are collaborating to conduct experiments that will develop glass formulations for specific DOE waste streams with high Al_2O_3 concentrations. The glasses should meet or exceed waste loading and/or waste throughput expectations as well as satisfying critical process and product performance related constraints. Secondary objectives of this task are to assess the melting rate for various glass frits for the DWPF composition and spinel settling for the Hanford composition.

Scope of Work and Results

The International Team developed and fabricated an integrated test matrix of 70 glasses that have provided valuable compositional – property relationship data from which optimization studies can be based. The 70 glasses were statistically designed to cover glass composition regions of

interest to both DWPF and Hanford. The team has completed characterization of specific properties of interest including durability, liquidus temperature, homogeneity and viscosity. Particular attention has been paid to crystallization within the glasses. An example of the identification and quantification of spinels in one of the test matrix glasses is shown in Figures 2 through 4. Further evaluation of these data is underway, and will be used to support development of glass composition – property models for high Al_2O_3 concentration glass systems.

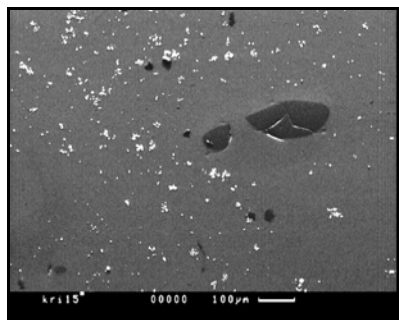


Fig. 2. Original image. White inclusions are spinel.

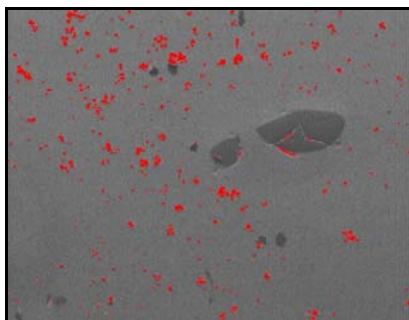


Fig. 3. Digitized image. Red dots are spinel.

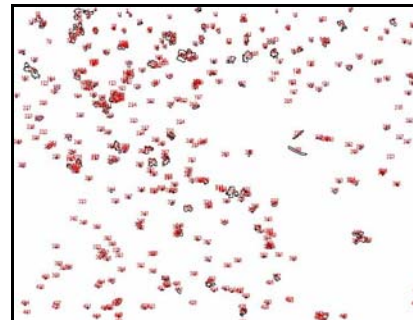


Fig. 4. Processed image with each spinel particle recorded and numbered.

Results from the glass test matrix were also used by the team to select glass compositions of interest for melter testing. For Hanford, a waste composition high in alumina was selected in consultation with DOE with a nominal 53 wt % Al_2O_3 content and a glass system containing approximately 26 wt % Al_2O_3 (HAL-17) was formulated. The goal of the Hanford test was to evaluate melt crystallization under various process conditions. SRNL selected Sludge Batch 5 (SB5) as the basis for its share of the melter testing, as this will be the next waste stream to be processed in the DWPF. With this composition, testing will be conducted on an SB5 composition with low Al_2O_3 and high Al_2O_3 concentrations to represent both flowsheet options (i.e. flowsheets with and without Al_2O_3 dissolution). Therefore, the primary objective of this test will be to evaluate the potential melt rate differences between the high and low Al_2O_3 based sludges as well as gain insight into the impact of frit composition on the melt rate of both sludge types. To support the testing, KRI refurbished two test melters as described below.

The SMK System

The SMK system is a small-scale melter system located at the Khlopin Radium Institute that can be used to evaluate crystallization within the melter and in the poured glass. The melter can also be used to study various frit compositions to evaluate melting behavior and determine relative melting rate prior to pilot-scale testing.

The SMK is a stainless steel can (alloy EI-0652) with the internal volume of about 1200 cm^3 . A pour spout made of the same alloy is welded into the melter bottom. A pour closure pipe is installed vertically inside the assembly on the centerline to open/close the pour spout. An arm installed on the melter lid lifts and lowers the pour closure pipe. The melter crucible is heated by eight resistively heated silicon carbide elements. Photos of the SMK system are provided in Figure 5.

The slurry is fed to the SMK melter from a feeder tank through the water-cooled tube using a peristaltic pump. The slurry is stirred continuously in the feeder tank. The final glass product is poured into removable, insulated steel collector cans placed on the scales with a lifting mechanism. When the collector can is lifted into the upper position, the melt area is sealed preventing cold air from contacting the pour spout in the lower ceramic plate. When the collector can is in the lowest position, it becomes readily accessible.

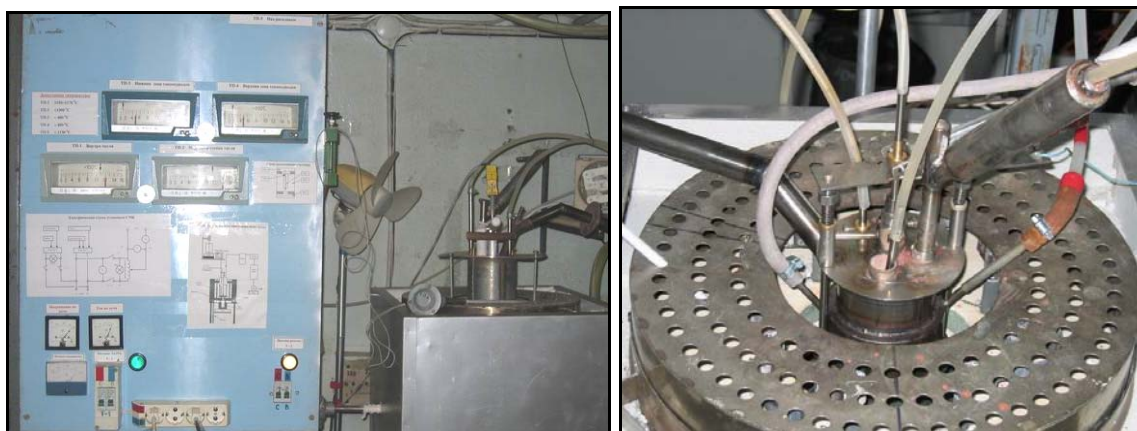


Fig. 5. Refurbished SMK System. Left: Overview of melter system. Right: Top head components.

Refurbishment of the SMK system included upgrading the electrical system for greater power availability, replacement of refractory materials, and a new water-cooled upper lid with five penetrations for the following applications:

- a pipe to connect with the off-gas chiller,
- a water-cooled feeder tube (for feeding sludge into the crucible),
- an opening to install a bubbler tube,
- an opening with a guard rail to provide for operation of the locking device, and
- a viewport to observe the melt.

The EP-5 System

The EP-5 pilot-scale melter is intended for joule-heated glass production. Figures 6 and 7 provide a schematic representation and general view of the melter system. The design of the EP-5 provides for feeding slurry onto the melt surface, air bubbling, periodic glass pouring, melting temperature monitoring and glass sampling. This configuration allows for extended melter operation.

The melter is a rectangular bath with refractory steel (Kh70/EI-652) main heaters installed along the walls. The area of one electrode inside the bath is 150 cm². The lower parts of the electrodes are water-cooled. The front wall of the melter bath has a 50 mm opening for pouring glass, with the lower edge of this opening on the bath bottom level. The pour spout of the bath is combined with the aperture of the locking device. The melter has a melt surface of 338 cm² and a total volume of approximately 7 L. The working volume is 5 L and the volume of the poured glass is 2.5 L.

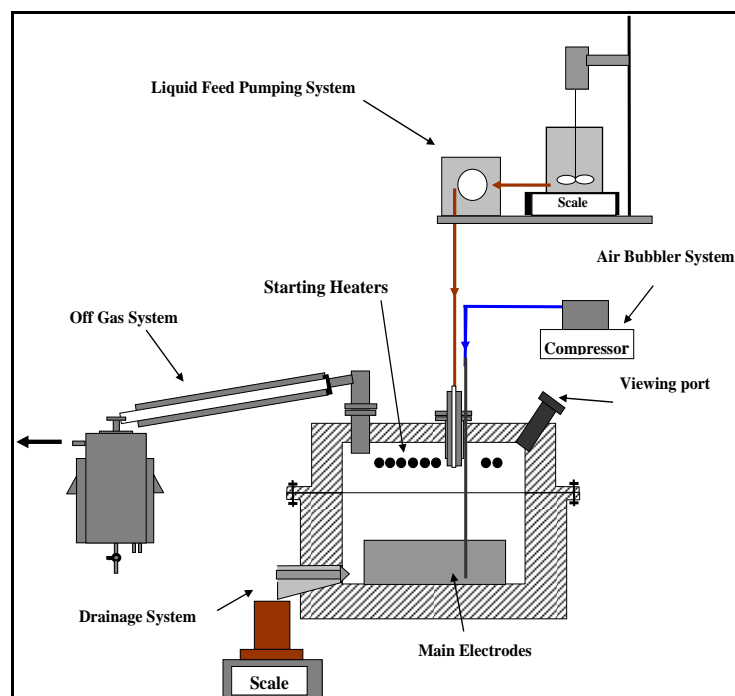


Fig. 6. Schematic of the EP-5 System.



Fig. 7. General View of the EP-5 System.

The melter and the pour spout assembly are installed in a steel enclosure with water-cooled walls and bottom and an insulating material between the external walls of the melter bath and the internal walls of the steel enclosure. The upper detachable part of the melter (lid) contains starting silicon carbide heaters required to produce the startup melt. In addition, the lid has openings for installation of the feeder tube, bubbler, integration with the off-gas system and a viewing port for observations of the melt and sampling.

To prepare for testing, KRI performed a number of refurbishment/renovation activities on the EP-5 system, specifically:

- fabricated and installed new main electrodes from EI-652 steel,
- installed the melter bath using ceramic refractory (Bacor-33) plates for the walls and bottom and sealed all areas with refractory cement,
- fabricated quartz tubes to protect the starting heaters from splashes and vapors, and
- installed new starting heaters in the quartz tubes and tested startup of the system.

Significant FY 2007 Accomplishments:

- The characterization of 70 surrogate glasses was completed.
- The results of the surrogate glass test matrix were used to select compositional regions of interest to Hanford and SRS for melter testing at KRI.
- A system of glass frits was developed for combination with the SRS feeds as part of the KRI melter testing to evaluate melting rates.

- The SMK and EP-5 melters at KRI were refurbished.
- Hanford and SRS sludge simulants were prepared and characterized to support melter testing.
- Testing of the Hanford compositions was completed for both the SMK and EP-5 melters.
- Melter testing with the SRS compositions was initiated.

Path Forward

Upon completion of melter testing at KRI, samples of both the poured glass and residual glass from the melters will be evaluated by the International Team for chemical composition, durability and degree/type of crystallization. Melting rate data from KRI for the SRS feeds will be evaluated in combination with data produced from test melters at SRNL to identify frits for potential application to high Al₂O₃ concentration feeds at the DWPF. The data from both the surrogate glass test matrix and the melter testing will be used by the International Team to further refine the glass composition/properties models that are used to support high-level waste vitrification in the DOE complex. Formulation and processing data from the Hanford High Al waste glass will be used to expand the composition region for Hanford waste treatment which will help assess the amount of HLW glass to be produced.

LONG-TERM IMPACTS FROM RADIATION/CONTAMINATION WITHIN THE CHERNOBYL EXCLUSION ZONE

Background & Application

The overall objectives of the project are:

- Assess the long-term impacts to the environment from radiation exposure within the Chernobyl Exclusion Zone (ChEZ).
- Provide information on remediation guidelines and ecological risk assessment within radioactively contaminated territories based on the results of long-term field monitoring, analytical measurements, and numerical modeling of soils and groundwater radioactive contamination.
- Recommend the development and testing of effective cleanup technologies to reduce environmental and health risks.

Scope of Work and Results

There are four subtasks that comprise the overall task:

Task 1 Characterization and Monitoring Methods

The nuclear accident at the Chernobyl nuclear power plant (ChNPP) in 1986 that resulted in destruction of the 4th power unit caused a catastrophic radioactive contamination of the environment. The highest contamination levels were observed in the areas adjacent to the ChNPP including the 30 km area known as the ChEZ. A report was issued that assessed the Environmental monitoring methods used during and after decommissioning of the ChNPP.

Comprehensive environmental radiation monitoring has been and is being performed at ChNPP and the adjacent areas where intense industrial activities are conducted. The environmental radiation monitoring pursues the following goals: (1) obtain information required to assure radiation, environmental and general safety of the personnel and the environment, (2) demonstrate that the actual radiation exposure and the radiation impact associated with the ongoing reactor units decommissioning activities and shelter stabilization activities is within the allowable regulatory limits established by the Ukrainian legislation, (3) perform forecast predictions and risk assessment of the ongoing activities. From this perspective, the ChNPP environmental radiation monitoring meets all safety and quality criteria established in the legislative and regulatory documents.

However, the performed analysis of methods and systems used in the environmental radiation monitoring at ChNPP and the ChEZ has shown that the environmental radiation monitoring does not fully meet the requirements for the environmental remediation management in this area. Specifically, the changes in biological speciation and quantities in the flora and fauna populations in the region are not effectively monitored. A number of parameters associated with chemical and biological degradation linked to the contamination are not sufficiently analyzed. This analysis is important for demonstration and assessment of the natural attenuation. Therefore, the current environmental radiation monitoring can be improved.

Task 2 Understanding of the Processes and Modeling of Fate and Transport of Radionuclides through Environmental Pathways (e.g., soils, groundwater, surface waters, microbiota, plants and animals, etc.)

A summary report has been issued which details the resuspension of radioactive aerosols through natural means such as wind and anthropogenic means such as agriculture and construction. After the initial airborne radioactive release from the ChNPP reactor stopped in 1986, secondary wind transport of radionuclides became the major source of near-surface atmospheric layer contamination. The most significant decrease of airborne radioactive concentrations was observed during the first two years after the accident. Currently, the situation has stabilized. Under natural, weather dependent, conditions the airborne radionuclide concentrations may vary by an order of magnitude during one year. However, during dust storms and wild fires, near-surface airborne radionuclide concentrations may increase by a factor of several hundred times.

Agricultural activities in contaminated areas affect the soil and increase the release of airborne radioactive dust. Therefore, agricultural machine operators and agricultural workers are considered to be one of the highest risk groups with regard to radionuclide inhalation.

Any construction activities in the Chernobyl areas may also cause resuspension of radioactive aerosols. For example, additional studies are required to evaluate wind radioactive transport and personnel dose exposure associated with construction of a new, safe confinement over the shelter structure, especially during the first phase of those construction activities related to laying the foundation. Another example is reclamation of the ChEZ, specifically, the ChNPP cooling pond, since the bottom deposits of that pond contain a large amount of radionuclides.

There have been many studies conducted to analyze the resuspension of radionuclides in aerosols by both international and Ukrainian groups. Currently, there is a reliable near-surface air monitoring system operating in the ChEZ.

A study of soil mycobiota (fungal flora) in the ChEZ also provides insight into the impact of contamination and radiation dose. A report was written that evaluated the effects of microbiological processes on the speciation and transport of radionuclides in soils using existing data plus results from additional studies on strains of micromycetes with positive radiotrophism. It turns out that fungal species can serve as bio-indicators for various degrees of radioactive contamination. The obtained results on the frequency of occurrence of the bio-indicating species make it possible to predict the natural remediation of the contaminated areas.

A report was written that reviews literature data on mathematical models for vertical migration of radionuclides in the soil upper layers (unsaturated zone). The modeling methods are assessed for a capability of providing a long-term prediction of radionuclide vertical transport in the soil profiles in the ChNPP fallout plume. The majority of approaches evaluate diffusion and convective transport of radionuclides with soil moisture flows. Methods for calculation of radionuclide distributions in soil profiles are described, parameters for radionuclide distribution in various soil layers are identified, exposure dose rates are calculated, and transport parameters calculated using the described models are evaluated. The modified convective-diffusion model for radionuclide transport in soils in the areas of ChNPP fallouts is described in detail for radionuclides in various physical and chemical forms. The model takes into account dynamics of major modes of radionuclide transport in soil.

Task 3 Evaluation of Risk Assessment Methods

The first part of this task consisted of documenting the methods used to assess radiation dose to humans and non-human species. In this report the dose assessments are based on physical measurement and mathematical calculations and do not include biological methods. The calculations for radiation dose include simplifications to deal with the extreme complexity of dose in the actual environment.

Task 4 Evaluation and Demonstration of Cleanup Technologies for Radioactively-Contaminated Sites

The first subtask in Task 4 was to document the analytical techniques used for detecting radionuclides (Sr-90, Pu-238, Pu-239, Pu-240, and Am-241) in soils and sediments.

Significant FY 2007 Accomplishments:

- Six reports were written summarizing the results described in the previous Section.

Path Forward

A series of deliverables has been developed and agreed upon that will summarize the research results from each of the four tasks for Fiscal Year 2008. These deliverables include reports on (1) evaluation of potential application of the project results to DOE sites, (2) summary of the evaluation of methods used for radioecological monitoring and data collection at abandoned sites within the ChEZ, (3) summary of the environmental monitoring methods during site restoration activities within the ChEZ, (4) assessment of groundwater contamination caused by the cooling pond at the ChNPP, and (5) evaluation of the results of observations and modeling on natural remediation in meadows and agricultural lands.

FUTURE INITIATIVES FOR INTERNATIONAL PROGRAM

The DOE-EM Office of Engineering and Technology is actively engaged in activities to reduce the technical risk in and accelerate DOE's cleanup efforts. To accomplish these goals, technologies are being evaluated and/or developed to provide technical solutions where none exist today, to identify solutions that enhance safety or effectiveness, and to find technologies that reduce overall risk. The effort is focused in three strategic areas: i) waste processing; ii) groundwater and soil remediation; and iii) deactivation and decommissioning (D&D). Currently, there is a DOE complex-wide effort underway to identify technical needs in each of the strategic areas. To address the technical needs, targeted research and development efforts will be initiated under the auspices of the Office of Engineering and Technology. Additionally, technology reviews and workshops will be conducted to promote sharing of knowledge and lessons learned.

An initiative of the international collaboration program will be to link international experience and expertise to these technical needs to foster further collaboration with international partners. The current international partnerships will be leveraged for this effort. Additionally, other international experts will be identified. As an example, dialog has already been initiated with representatives from the U.K. A Statement of Intent was recently signed between DOE-EM and the U.K. Nuclear Decommissioning Authority (NDA) to work cooperatively on areas of mutual interest. Under this umbrella, discussions were held with NDA representatives to identify potential areas for collaboration. Information and technical exchanges were identified as near-term actions to help meet the objectives of the Statement of Intent. Collaborative research opportunities will be identified in the future when the DOE-EM Engineering and Technology road map and multi-year program planning efforts are finalized. Comparisons of the DOE-EM technology planning documents and the NDA technology development business plan will be used to identify target areas for future collaborative work.

CONCLUSION

The DOE-EM Office of Engineering and Technology international collaboration program continues to support DOE-EM in identifying solutions to accelerate cleanup and reduce technological risk. The three tasks discussed in this paper provide data to support DOE-EM's environmental cleanup objectives. It is expected that follow-on test activities with the current

international partners will be initiated to support the current Office of Engineering and Technology multi-year planning program. Moreover, collaborative partnerships will be identified with other international experts to support efforts to address technology needs identified in the current Office of Engineering and Technology program planning.

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