

The US DOE-EM International Program – 13004

Rosa R. Elmetti*, Ana M. Han*, Alice C. Williams*

* Department of Energy
Office of Environmental Management
1000 Independence Ave. SW
Washington, DC 20585
Rosa.Elmetti@em.doe.gov
Ana.Han@em.doe.gov
Alice.Williams@em.doe.gov

ABSTRACT

The U.S. Department of Energy (DOE) Office of Environmental Management (EM) conducts international collaboration activities in support of U.S. policies and objectives regarding the accelerated risk reduction and remediation of environmental legacy of the nations' nuclear weapons program and government sponsored nuclear energy research. The EM International Program supported out of the EM Office of the Associate Principal Deputy Assistant Secretary pursues collaborations with foreign government organizations, educational institutions and private industry to assist in identifying technologies and promote international collaborations that leverage resources and link international experience and expertise.

In fiscal year (FY) 2012, the International Program awarded eight international collaborative projects for work scope spanning waste processing, groundwater and soil remediation, deactivation and decommissioning (D&D) and nuclear materials disposition initiatives to seven foreign organizations. Additionally, the International Program's scope and collaboration opportunities were expanded to include technical as well as non-technical areas. This paper will present an overview of the on-going tasks awarded in FY 2012 and an update of upcoming international activities and opportunities for expansion into FY 2013 and beyond.

INTRODUCTION

The EM International Program, through sponsorship by the DOE-EM, supports the EM mission by identifying opportunities to collaborate with international partners in evaluating technologies and strategies that potentially provide mutual benefits to the participants in areas of radioactive waste processing, groundwater and soil remediation, D&D, and nuclear materials disposition. As part of the Office of the Associate Principal Deputy Assistant Secretary (EM-2.1), the International Program leverages opportunities to leverage advances in science and engineering occurring on a global basis into practical solutions for the EM clean-up mission. Collaboration with governmental, academic, and industrial organizations in other countries expands the technical depth of the EM program. The EM International Program seeks to collaborate with multilateral international organizations as well as organizations within individual nations to improve opportunities to identify, evaluate and implement transformational technologies and strategies in support of the EM mission.

International Program Mission

The mission of the EM International Program is to foster international cooperation in addressing environmental and waste management issues leading to the reduction of technical, financial, and programmatic risks for the EM Program.

International Program Vision

The vision of the EM International Program is to be effective at an international level in connecting government, university, and industry technology development efforts resulting in transformational solutions to EM's technical and strategic challenges.

International Program Core Values

The core values guiding the conduct of international exchanges reflect the priorities of EM-2.1:

- ***Integration***
By integrating our technology development activities with those of international partners, we can leverage technological breakthroughs to expeditiously solve complex technical problems.
- ***Collaboration***
Working with the international community offers the opportunity to develop consensus on approaches to science, technology and policy for environmental and nuclear material management. Dialogue addressing common technical issues helps develop an internationally recognized foundation of sound science to support our environmental clean-up mission.
- ***Communication***
Successful international cooperation depends on open, responsible, and timely communication. The International Program promotes effective communication by active participation in international conferences, committees, site visits, and other activities here and abroad.

International Program Objectives

The EM International Program has two primary objectives. The first objective is to directly contribute to the advancement and deployment of technologies that are supportive of and integrated with the EM mission, complementing the technology development and testing activities such that the program assists in addressing identified environmental remediation and waste management needs through continued communication, collaboration, and integration with international entities. The second objective is to support EM in assisting countries in developing effective international waste management strategies, including identifying appropriate technologies that protect the environment.

STRATEGIC APPROACH

The EM international Program seeks to leverage the following existing mechanisms to increase EM engagement in international technology development activities:

- Multinational forums and agencies
- Collaborative international agreements
- International visitors at EM and foreign sites
- International conferences
- Other US agencies and programs
- Other DOE program offices

EM will seek to expand its role with multilateral international organizations in order to tap into best science being used in the field. The EM International Program will use existing international agreements in order not to duplicate efforts and, where none exist, establish new agreements, that assist in developing effective international waste management strategies and formalize undertakings with international partner countries.

EM will also strive to work with other U.S. agencies involved in energy, waste management, and other nuclear-related programs. By working closely with other government agencies, the International Program can be up to date on the latest policy and technological developments that have the potential to be leveraged to address the time and high-cost of the clean-up mission. To avoid duplication of effort and enhance return on investment, EM will strive to increase coordination with Departmental offices engaged in missions that interface with EM's remediation activities in order to leverage existing international programs and avoid duplication of efforts, and enhance return on investment.

Engage with Multinational Forums/Agencies

The EM International Program will benefit EM's environmental remediation mission by contributing its significant expertise and promoting U.S. leadership world-wide through participation in international organization forums, such as the International Atomic Energy Agency (IAEA) and the Nuclear Energy Agency (NEA).

The IAEA, established in 1957 within the United Nations, is the world's center of cooperation in the nuclear field. Headquartered in Vienna, Austria, the IAEA works with its 151 Member States, including the United States, to promote safe, secure, and peaceful nuclear technologies.

The United States along with 41 other nations are signatories pledged to support the objectives of the IAEA's Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (Joint Convention). Opened for signature in September 1997 and entered into force in June 2001, the Joint Convention is the first legal instrument to directly address those issues on a global scale.

In May 2006, the second Review Meeting of Contracting Parties to the Joint Convention identified a number of issues that EM may both aid in addressing and benefit from solving: (1) processing of legacy waste, (2) safety implications of longer storage of radioactive waste at the site of origin before disposition in a final repository, (3) the need for improved characterization and quality assurance of waste, and (4) assessment and demonstration of the safety of waste management activities and facilities. In addition, the need to establish a coherent policy for the disposal of all types of radioactive waste was identified.

An avenue for EM influence and benefit is participation in the IAEA "Network of Networks" established in September 2007 by the General Conference, the highest policymaking body of the IAEA composed of representatives of all Member States. Two established networks of interest to EM are the International Decommissioning Network (IDN) and the ENVIRONET for remediation of radiologically contaminated sites and remediation of soil and groundwater.

Among the activities of the IAEA networks, several offer clear opportunities for participation by EM as a "Member" organization (providing expertise and training capabilities) and for discovery by EM of innovative approaches to solving challenging remediation problems. These include, but are not limited to:

- Hosting training courses, fellowships or scientific visits by Members
- Providing suitably qualified and experienced individuals to support Participants (receive support from Members)
- Providing qualified peers for the Agency's peer reviews and technical assistance
- Providing expertise in the Agency's program areas; and
- Supporting fellowships, exchanges, coaching and mentoring.

The NEA is a specialized agency within the Organization for Economic Co-operation and Development (OECD), an intergovernmental organization of industrialized countries based in Paris, France. The mission of the NEA is to assist its member countries in maintaining and developing, through international cooperation, the scientific, technological, and legal bases required for the safe, environmentally friendly, and economical use of nuclear energy for peaceful purposes, through the entire fuel cycle, including D&D.

NEA consists of 28 countries, in Europe, North America, and the Asia-Pacific regions, including the United States. Together those countries account for approximately 85 percent of the world's installed nuclear capacity. The NEA works closely with the IAEA and with the European Commission, the European Union's executive body in Brussels, Belgium. Within the OECD, the NEA coordinates with other directorates, such as the Environment Directorate.

While EM's mission is to remediate the legacy waste from nuclear weapons production rather than to develop nuclear energy for peaceful purposes, the interests of EM and of the NEA intersect in several areas, such as D&D, radiological protection and public health, nuclear science, and radioactive waste management. The NEA seeks to assist its member countries in developing safe, sustainable, and societally acceptable strategies for the management of radioactive materials, with particular emphasis on the management of long-lived waste and spent fuel and on decommissioning of retired nuclear facilities.

The NEA's Radioactive Waste Management Committee and the Working Party on Decommissioning and Dismantling (WPDD) can benefit the EM mission through

- fostering a shared and broad-based understanding of the state of the art and emerging issues;
- facilitating the elaboration of waste management and D&D strategies that respect societal requirements;
- helping to provide common bases to the national regulatory frameworks;
- enabling the management of radioactive waste, materials and D&D to benefit from advances in scientific and technical knowledge, e.g., through joint projects and specialist meetings;
- contributing to knowledge consolidation and transfer, e.g., through the publication of technical reports, consensus statements and short flyers; and
- helping to advance best practice, e.g., by supporting international peer reviews.

Establish Collaborative International Agreements

The EM International Program will expand existing partnerships and establish new ones with countries that embrace a mission-completion philosophy based on remediation and reducing risk. For example, the United Kingdom (UK) is already one of EM's primary international partners. Current collaboration takes place under the DOE-EM and UK Nuclear Decommissioning Authority (NDA) Statement of Intent for Exchange of Information Concerning Management of Radioactive Waste. With the formation of the UK Department of Energy and Climate Change, EM has the opportunity to solidify this bilateral relationship at a government level and establish a mechanism in which to establish future work and an ability to grow the areas of cooperation under one overarching agreement. Additionally, EM signed an agreement with the Public Agency for Radioactive Waste Management (PURAM) of the Republic of Hungary for Information Exchange Relating to Operation of Modular Vault Systems for Storage of Spent Nuclear Fuel. The first meeting under this agreement was held May 18, 2010, at Fort St. Vrain, Colorado. Plans are to conduct the next meeting between PURAM and EM at the Paks Modular Vault Dry Store (MVDS) facility in Hungary in 2013. Recently, DOE signed an agreement with France's Commission for Atomic and Alternative Energies (CEA) for Cooperation in Low Carbon Energy Technologies. This agreement

will allow EM to explore potential collaboration with CEA to further EM's mission. On September 27, 2012, The Secretary of Energy signed a Statement of Intent with Rosatom concerning collaboration in innovative technologies for environmental restoration and radioactive waste management. This agreement further enhances our relationship with Russian organizations and promotes joint future collaboration. In addition, a Memorandum of Understanding was also signed in FY2012 between DOE and France's National Radioactive Waste Management Agency (Andra) which will allow cooperation and sharing of information on geological repository issues. Future agreements will enhance international cooperation in order to strategically promote research and development in EM.

Engage with International Visitors at EM and Foreign Sites

Visits by our international colleagues to DOE sites and facilities offer a unique opportunity to facilitate information exchange and collaboration. These visits can be formal (e.g., in conjunction with workshops or meetings) involving numerous participants or relatively informal visits by one or two individuals. Irrespective of potential language barriers, concepts and issues can be readily communicated through visual observations of sites, facilities and systems.

In the EM arena, the DOE sites that may have significant interest to international colleagues include-- the Waste Isolation Pilot Plant (WIPP), Idaho National Laboratory (INL), West Valley Demonstration Project (WVDP), Savannah River Site (SRS), and the Hanford Site.

Recent international visits to EM sites include a delegation comprised of the China Atomic Energy Authority (CAEA), China National Nuclear Corporation (CNNC), and China Institute of Atomic Energy (CIAE). This Chinese delegation visited SRS, and LLNL to discuss the management of projects. Additionally the UK NNL visited DOE Headquarters to discuss potential cooperation with EM in the areas of waste management, nuclear materials disposition, soil and groundwater remediation, and D&D.

Alternatively, visits by U.S. personnel to foreign facilities are equally important in providing insight into waste management practices employed outside the United States. For example, U.K. colleagues hosted personnel from DOE-EM and SRNL. During this visit, a tour of the U.K. Sellafield Site was provided including the Waste Vitrification Plant (WVP). The tour also included a tour of the Vitrification Test Rig (VTR) which is a scaled pilot-plant for the WVP. These tours provided the U.S. personnel perspectives on plant operations, technology development, and trouble-shooting philosophies employed in the U.K. EM has also participated in tours at AREVA facilities in Paris and Marcoule, France, that helped to promote transformational technologies in international melter programs.

Finally, during this past year, EM representatives, along with NNSA, met with Argentina representatives to discuss potential areas of mutual need and collaboration. In the EM arena, common interests were identified relative to Soils and Groundwater Remediation. Further discussions are ongoing to identify possible opportunities for collaboration.

Participate in International Conferences

International conferences provide the opportunity for EM to promote the EM program to an international audience, including at a programmatic and technology level. Most importantly it allows for the EM office to stay abreast of science and technology developments of other countries that may be leveraged to meet the overall EM mission. International conferences allow the opportunity to obtain current technical information related to treatment of radioactive waste in other countries, and to facilitate contact with potential subject matter experts that could assist DOE-EM in future technical reviews of environmental treatment technologies. EM has been a supporter of various conferences at which EM management has

been able to engage with international counterparts that have allowed the pursuit of research and development (R&D) collaboration. Important conferences that EM supports are the Waste Management Conference held annually in Phoenix, Arizona, the International Conference on Environmental Management and Radioactive Waste Management in Reims, France; and various topical meetings organized by the American Nuclear Society. The EM International Program will continue to identify key conferences focused on environmental remediation and radioactive waste management that allow EM to leverage the technical skills and knowledge of foreign governments, industries, and universities to help identify transformational solutions.

Coordinate with Other U.S. Agencies and Programs

In recent years, the U.S. State Department (Department of State [DOS]) has increased its activities in technical cooperation under the Joint Standing Committee on Nuclear Energy Cooperation (JSCNEC) and Joint Coordinating Meetings (JCM) on Science and Technology. The JSCNEC meeting includes a review of several joint projects between the United States and foreign nuclear research institutions. The JCM's focus is more on basic and applied scientific research. At these annual meetings the Department of Energy has been responsible for coordination among the DOS, U.S. national laboratories, program offices, and other DOE participants and private entities, collecting updates on ongoing projects and identifying any new areas of collaboration. DOE's Offices of Nuclear Energy and Defense Nuclear Non-Proliferation also participate in DOS's JSCNEC and JCM meetings held annually.

Both the JSCNEC and JCM provide an important opportunity for the EM International Program to continue to broaden its understanding of environmental remediation and energy efforts in the international context. The meetings also enable senior EM personnel to share information and to gain lessons learned from environmental programs that are highly developed and assist in expanding the EM International Program. A number of countries with developed energy and environmental programs use the JSCNEC and JCM as the formal bilateral cooperation channel between them and the United States through which nuclear and science policy consultations, exchange of technical information, joint R&D activities, etc., transpire.

The EM International Program may also engage and coordinate with other U.S. agencies through U.S. Department of Commerce (DOC) trade delegations and the Nuclear Regulatory Commission (NRC) Committee Sessions on Environmental Management. Both of these agencies can help to meet EM and the Department of Energy's goals in advancing scientific and technological innovation, energy security, and environmental remediation of the national nuclear weapons complex.

Recently, the President and Japanese Prime Minister Noda announced the establishment of a new Bilateral Commission on Civil Nuclear Cooperation. This Commission builds on the close U.S.-Japan cooperation following Japan's March 2011 nuclear accident in Fukushima to further strengthen joint work in this field, and foster comprehensive strategic dialogue and joint activities related to the safe and secure implementation of civil nuclear energy. Jointly with the Environmental Protection Agency (EPA), EM leads the Bilateral Commission's Environmental Management and Decommissioning Working Group. This Working Group focuses on bilateral cooperation to address long-term the consequences of the Fukushima accident, including lessons learned, facility decommissioning, site remediation and clean-up, and possibly managing the longer term consequences of an incident, such as monitoring contaminated areas.

Engage with Other DOE Program Offices

The EM International Program will engage with the DOE Office of Science (SC), National Nuclear Security Administration (NNSA), Office of Policy and International Affairs (PI), and the Office of Nuclear Energy (NE) on international programs that support and enhance the EM International Program goals and objectives

The Office of Science is the single largest supporter of basic research in the physical sciences in the United States, providing more than 40 percent of total funding for this vital area of national importance. It oversees – and is the principal federal funding agency of – the Nation’s research programs in high-energy physics, nuclear physics, and fusion energy sciences. It also manages 10 world-class laboratories, which often are called the “crown jewels” of our national research infrastructure. The national laboratory system, created over a half-century ago, is the most comprehensive research system of its kind in the world.

DOE-SC oversees the construction and operation of some of the Nation’s most advanced R&D user facilities, located at national laboratories and universities. These include particle and nuclear physics accelerators, synchrotron light sources, neutron scattering facilities, supercomputers and high-speed computer networks.

By tapping into these resources EM can leverage the ongoing work and the results to its technology innovation program. A good example for leveraging is working with SC to develop EM’s Advanced Simulation Capability for Environmental Management (ASCEM). ASCEM is an integrated, modular, open-source toolset for advanced modeling and simulation that reduces uncertainties and risks associated with environmental remediation and closure programs. Another example would be the coordination with SC on studies supporting transformational waste processing technologies.

The Office of Policy and International Affairs has primary responsibility for the DOE's international energy activities including international emergency management, national security, and international cooperation in science and technology. PI's role is to deliver unbiased advice to the Department of Energy's leadership on existing and prospective energy-related policies, based on integrated and well-founded data and analysis.

Through its Energy Policy Dialogue discussions, DOE-PI works closely with DOE program Assistant Secretaries and other DOE Secretarial officers to maintain a knowledge of the activities, issues, and policies of the Department, other Federal departments and agencies (including the National Security Council, Office of Management and Budget, and other White House offices), members of Congress and Congressional Committees, and energy producers and consumers. By engaging in the Energy Policy Dialogue discussions and being an active participant, EM can contribute to the optimization of the national environmental management system. Additionally, in its leadership role the U.S. will continue to assist other countries to adopt high-level waste management and disposal practices that enhance international security, safety, and environmental management.

The EM International Program will work closely with PI as it establishes international agreements to ensure that a mechanism is in place to pursue international collaborative undertakings in environmental management. In addition, the International Program will keep abreast of the latest policy issues affecting bilateral consultations in environmental management and radioactive waste management.

The Office of Nuclear Energy mission is to promote nuclear power as a resource capable of meeting the Nation's energy, environmental and national security needs. There are two programs relevant to EM’s

mission, currently the International Framework for Nuclear Energy Cooperation (IFNEC)¹ and the Generation IV International Forum (GIF). IFNEC was established to promote cooperation among States that share the common vision of the need to expand nuclear energy production worldwide in a safe and secure manner. It aims to accelerate development and deployment of advanced fuel cycle technologies to encourage clean development and prosperity worldwide, improve the environment, and reduce the risk of nuclear proliferation. To date the partnership consists of 31 partners, three permanent international nongovernmental observers and a number of observer countries. The partners are: Armenia, Australia, Bulgaria, Canada, China, Estonia, France, Ghana, Hungary, Italy, Japan, Jordan, Kazakhstan, Republic of Korea, Lithuania, Morocco, Oman, Poland, Romania, Russia, Senegal, Slovenia, Ukraine, United Kingdom, Argentina, Germany, Kenya, Kuwait, Netherlands, UAE, and the United States. The three permanent international nongovernmental observers are: the International Atomic Energy Agency, the Generation IV International Forum and EURATOM.

IFNEC has two working groups—the Infrastructure Development Working Group (IDWG) and the Reliable Nuclear Fuel Services Working Group (RNFSWG). Of special interest to EM is the IDWG. One of the subgroups of the IDWG is the Waste Management Group whose goal is to address radioactive waste management issues. EM has the unique opportunity to identify specific activities in the area of radioactive waste management. Some proposed activities are human capital development, exchanging information on calculations and costing methodology, identifying and addressing research and development gaps and providing lessons learned. The partners have suggested that each country identify an expert to participate in the subgroup. Through the International Program, EM can have an important role in the establishment of an IFNEC sub-Working Group to explore possible strategies for the long term management of radioactive wastes arising at nuclear power stations and from associated fuel cycle activities.

The mission of GIF is to develop the next generation nuclear energy systems to meet the world's future energy needs. This unique international effort allows unprecedented coordination among the national research organizations of the various partners in the GIF, which include Canada, China, Euratom, France, Japan, Republic of Korea, Republic of South Africa, Russia, Switzerland, the United Kingdom, and the United States [Argentina and Brazil are inactive]. Senior representatives from GIF member countries participate in committees that coordinate the research activities required to develop up to six next generation nuclear energy systems. The U.S. is actively participating in joint R&D with various GIF members; EM can leverage these research and development activities to assist in identifying environmental technologies.

EM is working with NE in a joint international Study of Glass Behavior over Geologic Time Scales. Recently, 22 representatives from five nations (Belgium, France, Japan, United Kingdom, and the United States, including three DOE offices and four national labs) simultaneously connected to a webinar/teleconference meeting to discuss progress and opportunities for collaboration in the field of Long-term Glass Corrosion. This webinar was a follow-up to a three-day workshop in Seattle in October 2009 at which a similar group of scientists and administrators met to establish the current state of understanding, to discuss and develop a comprehensive research plan, and to come to a consensus on required future research.

Glass is the waste form of choice for immobilizing HLW in the U.S. and internationally; however, there is uncertainty due to different repository environments and a lack of consensus on glass corrosion behavior

¹ The IFNEC was formerly known as the Global Nuclear Energy Partnership.

between nations vitrifying HLW. This activity aims to develop the data and understanding necessary for an international consensus on the behavior of glass waste form corrosion over geologic time scales in a variety of disposal environments. This long-term research program was initiated in 2009 with participation from the U.S. (Joint EM-NE-RW), France (CEA, Nantes, AREVA), Belgium (SCK-CEN), UK (NNL, Sheffield), and Japan (Kyushu and JAEA) [Note: additional members will be added on an as needed basis]. This international collaboration will not only help these scientific advances be realized more quickly, but an international consensus on corrosion rate will lessen the complications inherent in the qualification of waste forms and will open the possibility of disposing of HLW glasses in a variety of potential environments.

The National Nuclear Security Administration holds high-level meetings and discussions on non-proliferation issues that have the potential to influence the overall EM mission. NNSA holds meetings with countries with whom EM may be interested in working or expanding collaborations. Just recently, NNSA held discussions with Russia, India, and China in support of the Peaceful Uses of Nuclear Technology Agreement (PUNT). Even if some of these countries are not actively engaged with EM, there are collaborative opportunities that can be attained with research centers and institutions. As part of the NNSA Global Threat Reduction Initiative, EM can develop close relations with foreign countries possessing U.S.-origin foreign research reactor (FRR) spent fuel (i.e., Japan, Turkey, Israel, and Chile) that can lead to technology development and increased scientific interactions.

TECHNICAL FOCUS AND INTERNATIONAL PARTNERS

The International Program is structured within the EM-2.1 office, which also includes the primary Mission Units that the International Program currently supports. Specifically, the Office of Site Restoration (EM-10) includes the Soil and Groundwater and D&D technology areas. Similarly, the Office of Tank Waste and Nuclear Material (EM-20) includes Tank Waste Management, and Spent Nuclear Fuel (SNF) and Nuclear Materials Disposition technology areas. Within each of these areas, several technical topics have been identified that represent identified needs that are potential areas of international collaboration. These are as follows:

Waste Processing

- Next generation melter development
- Advanced waste form development
- Waste form chemistry and behavior (crystallization, melting rate)
- Long-term performance of waste forms
- Tank retrieval
- Waste pretreatment
- Waste tank integrity
- Repository issues

Soil & Groundwater Remediation

- Radionuclide distribution and migration
- Biogeochemical gradients and permeable reactive barriers
- Site characterization
- Performance assessments and modeling
- Predicting, contaminant fate and transport in the vadose zone
- Monitoring, access, control and delivery of remedial action in the deep vadose zone
- Transformational remediation technologies

- Natural attenuation and enhanced remediation technology development
- Green and sustainable remediation
- Long-term monitoring and data management
- Advanced modeling and simulation

SNF and Nuclear Materials Disposition

- Spent nuclear fuel receipts, storage transportation, and disposition
- Plutonium storage and disposition
- Corrosion and materials integrity (storage containers, spent fuel, etc.)
- Materials characterization

Deactivation & Decommissioning

- Decontamination technologies
- Remote inspection
- Characterization technologies
- In-situ immobilization and closure.

International Partners

Based on these areas of identified needs, and through the existing agreements, technical exchanges, and collaborative relationships, the following technology areas of mutual interest and potential partnering have been identified with various International participants.

Argentina

- Groundwater and Soil Remediation deep vadose zone treatment technologies

Australia

- Waste processing technologies (i.e., Hot Isostatic Pressing (HIP))
- Long-term performance of waste forms
- Nuclear material management
- D&D

Canada

- Monitoring and retrieval of Spent Nuclear Fuel
Deactivation & decommissioning technologies

China

- Repository programs-- Developing a detailed knowledge of long-term corrosion behavior in a deep repository
- Spent fuel and fissile-materials management
- Peaceful Uses of Nuclear Technology (PUNT) --to share interest, experiences and potential topics for cooperation in the areas of environment and radioactive waste management

France

- Waste processing technologies-- melter technology, waste form chemistry
- Long-term performance of waste forms
- Deactivation & decommissioning technologies

Germany

- Safety case of a salt-based repository-- this cooperation may include exchange of experiences and results of theoretical, experimental and development projects

Hungary

- Operation of modular vault systems for storage of spent nuclear fuel

India

- Performance Assessment
- Waste form development and qualification
- Vitrification and glass technologies

Japan

- Waste processing technologies-- melter technology, waste form chemistry
- Waste retrieval technologies
- Long-term performance of waste forms
- Groundwater and Soil Remediation
- Deactivation & decommissioning technologies

Korea

- Waste processing technologies-- melter technology, waste form chemistry
- Molten salt extraction (electrochemical) processing of used nuclear fuel
- Long-term performance of waste forms

Russia

- Fundamental studies of contaminant transport processes to support modeling and simulation;
- Advanced Simulation Capability for Environmental Management (ASCEM)
- Waste processing technologies-- melter technology, waste form chemistry
- Mercury remediation technology

Sweden

- Fuel packaging technologies
- Long-term storage of Spent Nuclear Fuel

United Kingdom

- Plutonium storage
- Spent fuel storage
- Nuclear facility life management and materials degradation
- Waste form chemistry—crystallization, melting rate
- Tank retrieval technologies – Cryograb technology
- Deactivation & decommissioning technologies
- Advanced fogging technologies
- Glass chemistry – sulfur solubility model
- Safety, Security, and Quality Programs

Ukraine (Chernobyl)

- Performance Assessment

- Radionuclide distribution and migration in soils and groundwater
- Migration and fate of radionuclides in urban ecosystems.

In addition to the benefits from the technical knowledge of these international partners, EM has also realized significant benefit through use of existing infrastructure at various research institutions, national laboratories, and universities located in these countries. These capabilities will provide cost-effective methods to conduct key experimental work and testing.

RECENT AND ONGOING COLLABORATIONS

In FY 2012, the International Program awarded eight international collaborative projects for work scope spanning waste processing, groundwater and soil remediation, deactivation and decommissioning (D&D) and nuclear materials disposition initiatives to various foreign organizations. Additionally, the International Program’s scope and collaboration opportunities were expanded to include technical as well as non-technical areas. The following table provides a brief description of the awarded projects.

International Partner	Title	Scope/Status
OPAB	Overseas Presence Advisory Board	The EM International Program sits in the DOE’s OPAB, to support the Department’s mission, strategic plan objectives and requirements in DOE overseas assignments.
Russia	Collaboration on Investigation of Next Generation Melter Technologies with Emphasis on Cold Crucible Induction Melters (CCIM) – Automated Control, Modeling, and Innovative Draining Techniques	ETU, Radon, and NuVision are collaborating on testing and development of CCIM systems for immobilization of challenging Hanford tank wastes, such as AZ-101, 244-TX, and C-102 (i.e., high alumina and high iron).
United Kingdom	Development of Cryograb technology for application to sludge removal challenges in tanks with significant obstructions	UK NNL, NuVision and SRNL are collaborating on development of a cryogenic technology for freezing and retrieving sludge from tanks that have obstructions or have sludge that is difficult to mobilize.
Russia	Mercury Remediation Technology Development for DOE by the Khlopin Radium Institute (KRI)	KRI and ORNL are collaborating to evaluate the effects of soil amendments for control of mercury species and related flux through surface and groundwater, as well as in situ immobilization techniques.
Canada	Collaboration on Development of Improved Techniques for Monitoring and Retrieval of Spent Nuclear Fuel SNF in Extended Storage	Canada’s AECL and INL are collaborating on innovative techniques to monitor, retrieve, dry, and package degraded SNF packages from underground vertical storage shafts.

International Partner	Title	Scope/Status
United Kingdom	Advanced Fogging Technologies Demonstration – Misting	UK NNL and INL are collaborating on an advanced fogging technique for more effective coverage (i.e., larger area in less time, using less product) for fixing airborne and loose surface contamination in inaccessible areas, such as HVAC ducts and piping.
United Kingdom	Glass Chemistry and Processing Issues – Sulfur Solubility, Materials and Engineering Research Institute (MERI) Sheffield University	MERI, SRNL, PNNL, and ORNL are collaborating on development of a more comprehensive sulfur solubility model for glass chemistry related to HLW immobilization.
Russia	Fundamental research of contaminant transport processes in geological media to support the development of the Advanced Simulation Capabilities for Environmental Management (ASCEM), Phase II	IBRAE and ORNL are collaborating on development of advanced numerical methods for modeling transport in the subsurface.
Sweden	Fuel packaging technologies and methods for long-term storage of SNF spent nuclear fuel	EM is collaborating with SKB to gain subject matter expertise on their KBS-3 SNF package and repository design, including package closure and emplacement.

CONCLUSION

EM's International Program will continue to focus on identifying and leveraging international expertise, infrastructure, and collaboration opportunities that can assist in reducing the cost and schedule of the environmental remediation mission; enhancing understanding of the processes related to environmental management; accelerating and increasing innovative technology applications; and helping to ensure that science-based approaches and solutions are implemented on an international level that provide safe, effective, and responsible environmental management approaches. This will be accomplished by enlisting international support and cooperation through participation in international organizations and developing and maintaining appropriate frameworks for bilateral and multilateral cooperation. Most importantly, EM's International Program will direct the implementation of international agreements which involve all of EM. The International Program will also be able to monitor and support international advances in technology that reduce cost and optimize the efficiency of site remediation and will be responsible for obtaining and exchanging information on the global status of technical progress and relevant policies in waste management. Additionally, in its leadership role, the EM program will seize the opportunity to assist other countries to adopt safe waste management and disposal practices that enhance international security, safety, and environmental integrity.