EM INTERNATIONAL PROGRAM

Moving Forward

STRATEGIC PLAN

2015 - 2020

Building Upon Strong International Partnerships

U.S. DEPARTMENT OF ENERGY

FOREWORD

Message From
Monica Regalbuto

ASSISTANT SECRETARY,
OFFICE OF ENVIRONMENTAL
MANAGEMENT (EM-1)

The U.S. Department of Energy (DOE) Office of Environmental Management (EM) mission is to complete the safe clean-up of the environmental legacy resulting from six decades of weapons production and energy research. This effort is recognized as one of the largest and most diverse and technically complex environmental clean-up operations in the world.

In the DOE Strategic Plan, released April 2014, the Secretary of Energy stated the following:

"We will address the legal and moral imperative of cleaning up legacy nuclear waste to protect human health and the environment. Great progress has been made, but significant technical challenges remain. We will continue to utilize an integrated, systematic, and comprehensive process to address these issues."

This integrated process includes several components, one of which involves leveraging the expertise within the International community, when applicable. EM has been supporting the clean-up mission of the Department through international collaborations for almost 20 years. As a result, innovative solutions and benefits to EM clean-up challenges have been or are planned to be implemented in the U.S. through these international collaborative efforts. A few examples include:

- United Kingdom-based Xago HydroLance for mobilization and retrieval of sludge from the Engineered Containers to be used for Hanford K-Basin decommissioning;
- United Kingdom Nuclear National Laboratory sulfate solubility model for improving high level tank waste processing through increased waste loading; and
- Multiple International Partners collaboratively working to develop a consensus protocol for predicting long term performance of glass waste forms.

Continued international collaborations are important for EM such that potential solutions and strategies to our clean-up challenges can continue to be identified and implemented. These interactions are also mutually beneficial to our international partners as DOE lessons-learned are shared through technical exchanges, while showcasing U.S. leadership in areas of interest.

In coordination with the International Program, EM will also continue to leverage opportunities with other Program Offices and Agencies within the Federal Government involved in international collaborative activities in support of U.S. Policy, while focusing and prioritizing resources to maximize benefit. A prime example of such collaboration is the EM involvement with the DOE Office of Nuclear Energy (NE) Used Fuel Disposition International Program, which is addressing spent nuclear fuel (SNF) and high-level radioactive waste (HLW) glass disposition, on a global basis.

The opportunities related to international collaborations are an important component of the overall DOE strategy for the clean-up mission, providing excellent forums for EM to stay beneficially engaged with the international community and our global partners.

Introduction

The mission of the EM Program, which is captured in Goal 3, Strategic Objective 8 of the DOE Strategic Plan, is to complete the safe clean-up of radioactive and chemical waste resulting from the Manhattan Project and Cold War activities. As described in the DOE Strategic Plan, to accomplish this mission, the Department will leverage past experience, applying best practices and lessons learned; identify, develop, and deploy practical technological solutions derived from scientific research at the national laboratories; and look for innovative and sustainable practices that make clean-up more efficient.

An important strategy that EM deploys to seek such innovative solutions is through a domestic and international network with other federal agencies, national laboratories, academia, foreign government agencies and institutions, and industry to collaboratively develop and deploy scientific and technological solutions in support of mission needs.

The EM International Program provides an important and complementary function within the overall EM program. In conjunction with EM senior management and Program Offices, we develop and implement strategies for effective interactions with the international community that are focused on areas related to the EM mission. Through these interactions, the EM International Program contributes to successfully completing the challenging clean-up mission, while ensuring compliance with U.S. policy.

EM INTERNATIONAL PROGRAM

Mission

The mission of the EM International Program is to provide benefit to the Department in successful completion of the EM clean-up mission, through establishing strategic approaches for specific international collaboration initiatives that are focused on applicable strategic program goals, and aligned with U.S. foreign policy.

Vision

The vision of the EM International Program is to be an integral component of the overall DOE and EM strategies for mission success through leveraging international capabilities and expertise that offer benefit and assistance in addressing the challenges of the EM clean-up program.

Table of Contents

Strategic Overview

Challenges

The primary purpose of the EM International Program is to support EM mission success, as described in Goal 3, Objective 8 of the DOE Strategic Plan. While key challenges remain to complete the EM clean-up mission, the EM International Program actions, in coordination with the EM Program Offices, are focused on identifying opportunities to address some of these challenges through engagement with the international community.

These challenges and opportunities provide the basis for the specific strategic objectives established for the EM International Program.

The challenges related to environmental clean-up resulting from nuclear energy and weapons production activities are not unique to the U.S. Common issues and challenges have been identified by many countries.

For example, safe and more cost effective methods for processing and immobilization of radioactive waste continue to be areas of primary investment throughout the world. Whether dealing with HLW or SNF, processing and packaging of these materials for long term storage and eventual disposal represent significant technical challenges. Although processing systems are in operation, or under construction, in the U.S, France, Russia, and several other countries, improvements to existing processes and/or new approaches are continually being sought with the intent of providing more cost-effective strategies. Additionally, better understanding of the long term performance of the waste forms and packages produced by these processes are pursued to ensure that the systems implemented result in safe environmental conditions for future generations.

Similarly, many countries are actively investigating and/or developing geologic repositories for final disposition of the HLW and SNF inventories. As the global understanding of the environmental risk associated with these materials has grown, the international community has recognized that this issue is not specific to a given country or region, but rather a world challenge. As a result, there is an increasing interest and global influence in establishing and implementing international standards related to waste form/package, configuration, and overall system performance for disposition of these more challenging inventories. Due to the fact that nuclear power generation is growing throughout the world, ensuring safe, cost-effective, and reliable disposition of the resulting HLW and/or SNF is becoming increasingly important. The U.S. also faces significant challenges in developing and deploying cost-effective technologies and strategies for conducting large scale environmental remediation (e.g., natural and modified natural attenuation techniques), for both surface and subsurface applications. A major area of emphasis is to develop a better understanding of the fate (i.e., complexation, biogeochemistry effects, etc.) and transport (i.e., rates, mechanisms, etc.) of key contaminants, such as technetium-99, and iodine-129. Developing a more comprehensive understanding of these characteristics will provide the technical bases for developing validated predictive modeling capabilities to support establishing more risk-informed alternatives to site closure and long term monitoring. Many others within the International community are addressing similar issues for their large environmental remediation projects.

Addressing the DOE clean-up challenges in a timely and cost-effective manner will require innovative and transformational technologies. Engagement with the international community is effective in providing exposure to global technological advances in areas related to the EM mission. Accordingly, EM must be positioned to leverage existing agreements and other vehicles, or establish new ones where they do not exist, to enable effective international collaborative activities that support the EM mission. Additionally, these agreements must be structured such that they provide mutually beneficial exchanges, while compliant with U.S. foreign policy, and supportive of DOE energy and environmental policies.

Opportunities

As previously stated, much of the International community is facing similar challenges as the U.S. related to their environmental clean-up programs. With the recognized environmental impacts of global climate change, coupled with a struggling global economy, ongoing communication and technical exchange by the U.S. with the international community is potentially beneficial in addressing some of the EM clean-up challenges. The EM International Program provides an effective framework for organizing and conducting this important dialogue through the strategic objectives and performance goals, described later in this plan.

Opportunities to leverage key capabilities and expertise related to environmental clean-up have been continually and successfully exercised. Throughout the past two decades, EM has collaborated with numerous International partners in a variety of areas, including:

- Radioactive waste treatment, immobilization, and long term waste form performance;
- Management and disposition of plutonium, as well as other excess nuclear materials and challenging radioactive materials;
- Geologic Disposal requirements, configurations, and geochemistry effects;
- Environmental remediation, fate and transport modeling and predictions, natural attenuation, and other environmental technologies and techniques;
- Deactivation and Decommissioning (D&D) technologies, including innovative decontamination characterization/assay techniques; and
- Other areas of similar challenges and interest related to management of complex clean-up-related projects.

These interactions have helped to establish a strong international network, in which EM is a recognized leader, and that will be essential in supporting current and future collaborations. While significant collaboration has been ongoing, we also recognize that technology development and deployment efforts within the international community have proceeded independently, and often there are innovative technologies, new approaches, and key lessons-learned that are applicable to U.S. challenges. Through our international exchanges and participation, the EM program continually learns of potential solutions that are deployed or being investigated by other countries that may offer benefit to the EM clean-up mission.

Recent examples from our United Kingdom partners include an innovative non-thermal destruction technology for treating radioactive organic waste streams and a 3-D sonar based technology that can map heel materials and obstructions in underground storage tanks. The EM International Program provides the opportunity to develop and/or maintain effective working relationships with the International community. Effective coordination and communication with the appropriate EM Program Offices will position EM to leverage the global capabilities and expertise that are applicable to the EM clean-up challenges.

The EM International Program is positioned to recognize the appropriate international agreements and other alliances (i.e., Memorandums of Understanding, Statements of Intent, etc.) that have been established, or when new agreements are appropriate, while ensuring compliance with the DOE strategy and U.S. foreign policy.

In this role, the EM International Program is a recognized element in an integrated EM strategy for completing the clean-up mission, providing the expertise in U.S. policy and knowledge-base to leverage or establish appropriate vehicles for international collaborations, as appropriate.

Strategic Objectives and Performance Goals

The underlying principle of the EM International Program strategy is that all actions and engagements are aligned with U.S. policy and the DOE mission in supporting the successful completion of the EM clean-up program. Thus, all strategies and activities in which the EM International Program is engaged must establish and maintain an efficient framework for leveraging international opportunities to address the identified clean-up challenges, while providing clear organizational communications related to ongoing and planned strategic actions.

The following strategic objectives are founded on the principle outlined at left and are focused to address the identified challenges and opportunities, as appropriate.

Strategic Objective 1:

Ensure that collaborative projects and activities conducted under the auspices of the EM International Program are aligned with the priority need areas identified by the mission-specific program offices within EM, and appropriately augment technology projects conducted within the respective base programs.

Performance Goals

- Issue an annual call for international collaborative proposals to the EM program offices to identify high priority, potential high-impact opportunities.
- Select and fund collaborative international projects that support the EM clean-up mission, and are endorsed by the cognizant EM program offices.
- Engage national laboratories, academia, and industry, as appropriate, to collaborate with international partners.

Strategic Objective 2:

Ensure that the EM organization is engaged with and well-represented to other DOE Program Offices, as appropriate, to support U.S. policy and the overall DOE strategy related to the EM mission.

Performance Goals

- Maintain EM involvement with the National Nuclear Security Agency (NNSA) on the U.S. – China Peaceful Uses of Nuclear Technology (PUNT) Joint Coordinating Committee, Working Group III Environment and Waste Management.
- Represent EM on the Overseas Presence Advisory Board and its Working Capital Fund Working Group.
- Maintain EM involvement with DOE Office of Nuclear Energy (NE) through the International Framework for Nuclear Energy Cooperation (IFNEC).
- Maintain EM leadership, collaboration with NE and DOE Office of Science (SC) and international partners supporting investigation of long term performance of glass waste forms.
- Maintain EM collaboration with the DOE Office of International Affairs (IA) through the Science and Technology Committee.

Strategic Objective 3:

Ensure that the EM organization is engaged with and well-represented to key federal agencies, through effective communications, to support U.S. policy and the overall DOE strategy related to the EM mission.

Performance Goals

- Maintain EM involvement with the Department of State (DOS) through the Joint Standing Committee on Nuclear Energy Cooperation (JSCNEC) and related Joint Coordinating Meetings (JCM) on Science and Technology, and other appropriate JCM meetings.
- Maintain EM leadership with the White House Office of Science and Technology Policy (OSTP) Fukushima Sharing Forum.
- Maintain EM involvement with the Department of Commerce (DOC) through participating on the Civil Nuclear Trade Working Group: Civil Nuclear Trade Policy Missions, and other appropriate committees.

Strategic Objective 4:

Ensure that the EM organization, to include the mission-specific program offices within EM, is engaged with and well-represented on appropriate International organizations, committees, conferences, and partnering countries that can provide benefit to the EM mission.

Performance Goals

- Maintain EM engagement and leadership with the International Atomic Energy Agency (IAEA) through the IAEA Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, Network of Networks, and other priority activities.
- Maintain EM engagement with the Nuclear Energy Agency (NEA) Radioactive Waste Management Committee Working Party on Decommissioning and Dismantling (WPDD), as well as other priority activities.
- In conjunction with the EM program offices identify and support key international conferences focused on environmental remediation and radioactive waste management (e.g., Waste Management Symposium (WM) and International Conference on Environmental Remediation and Radioactive Waste Management [ICEM]).

Strategic Objective 5:

Ensure that appropriate agreements, statements of intent, memorandums of understanding, and other alliances are maintained and/or established, as appropriate, and in accordance with U.S. policies, to maintain an effective network for international collaboration.

Performance Goals

- Maintain existing agreements (see Appendix A) that are important to and supportive of the EM clean-up mission, and in compliance with U.S. policies.
- Identify and establish new alliances that are beneficial to the EM mission, while in compliance with U.S. policies.

In May 2014, DOE signed a notice of intent to prepare an environmental assessment to analyze the potential environmental impacts from a proposed project to accept SNF from the Federal Republic of Germany at the DOE Savannah River Site (SRS) for acceptance and disposition. In this collaborative effort, between EM and NNSA the Department proposes to accept, process, store, and disposition SNF from Germany. The SNF is composed of kernels containing thorium and approximately 900 kg of U.S.-origin Highly Enriched Uranium (HEU) embedded in thousands of small graphite spheres. The fuel was used in pebble bed research reactors.

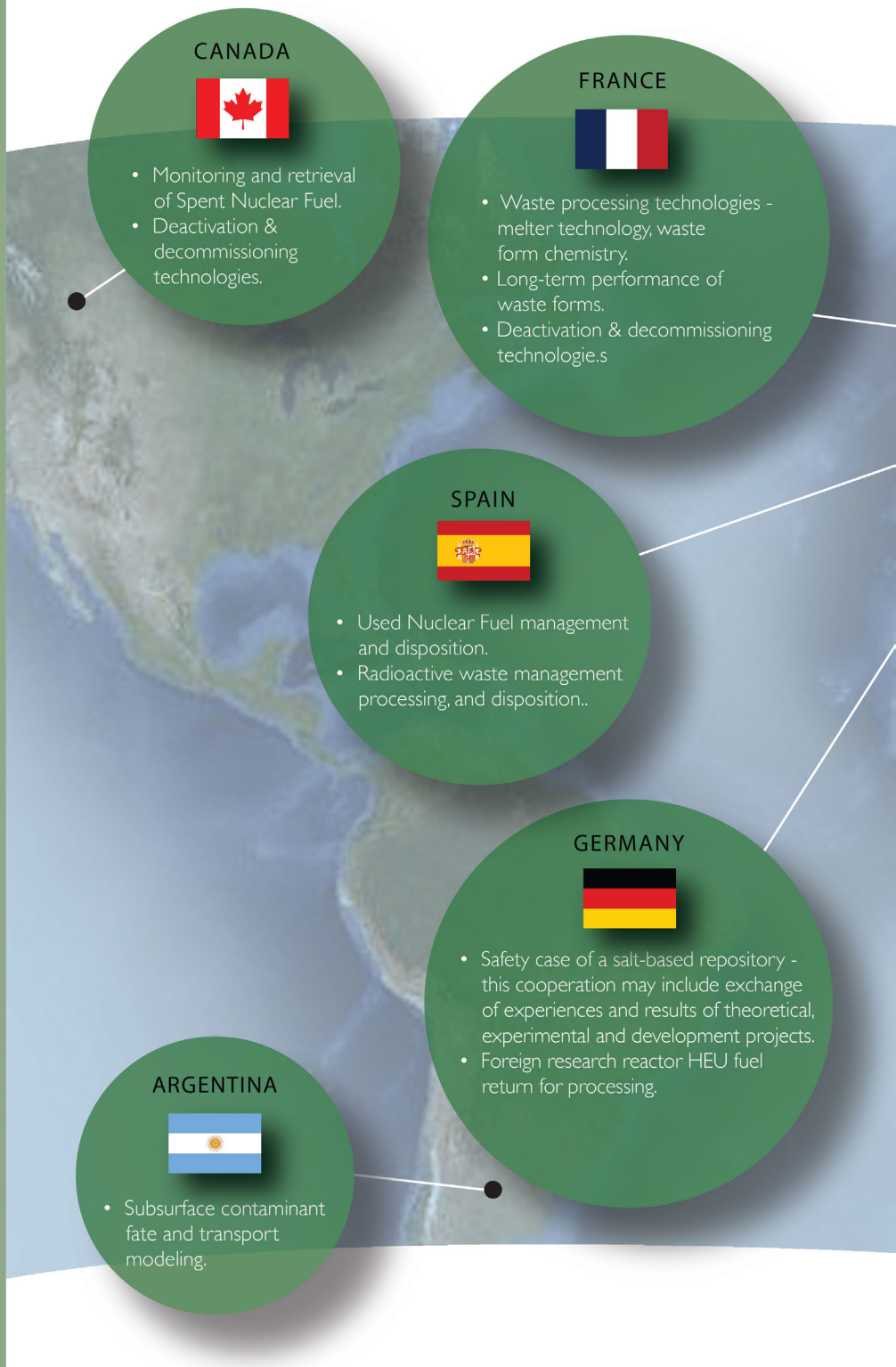
The Department would install a capability in H-Canyon at SR to chemically remove graphite from the fuel kernels via a digestion technique being developed by Em's Savannah River National Laboratory. While no decision has been made to accept this fuel, the planned cooperation would support efforts by the U.S. to reduce and eventually eliminate HEU from civil commerce. By removing U.S.-origin HEU from Germany and returning it to the U.S. for safe disposition, DOE could render it unusable in a nuclear weapon or an improvised nuclear material dispersal device.

The EM International Program performs several key strategic actions aimed at achieving the Strategic Objectives, which also support DOE policies on energy and the environment, as described in the DOE Strategic Plan, as well as U.S. foreign policy. We employ a multi-faceted approach to ensure that EM is actively engaged with and well represented throughout the International community for matters .related to environmental clean-up. Key components include having visible and effective representation through the following activities:

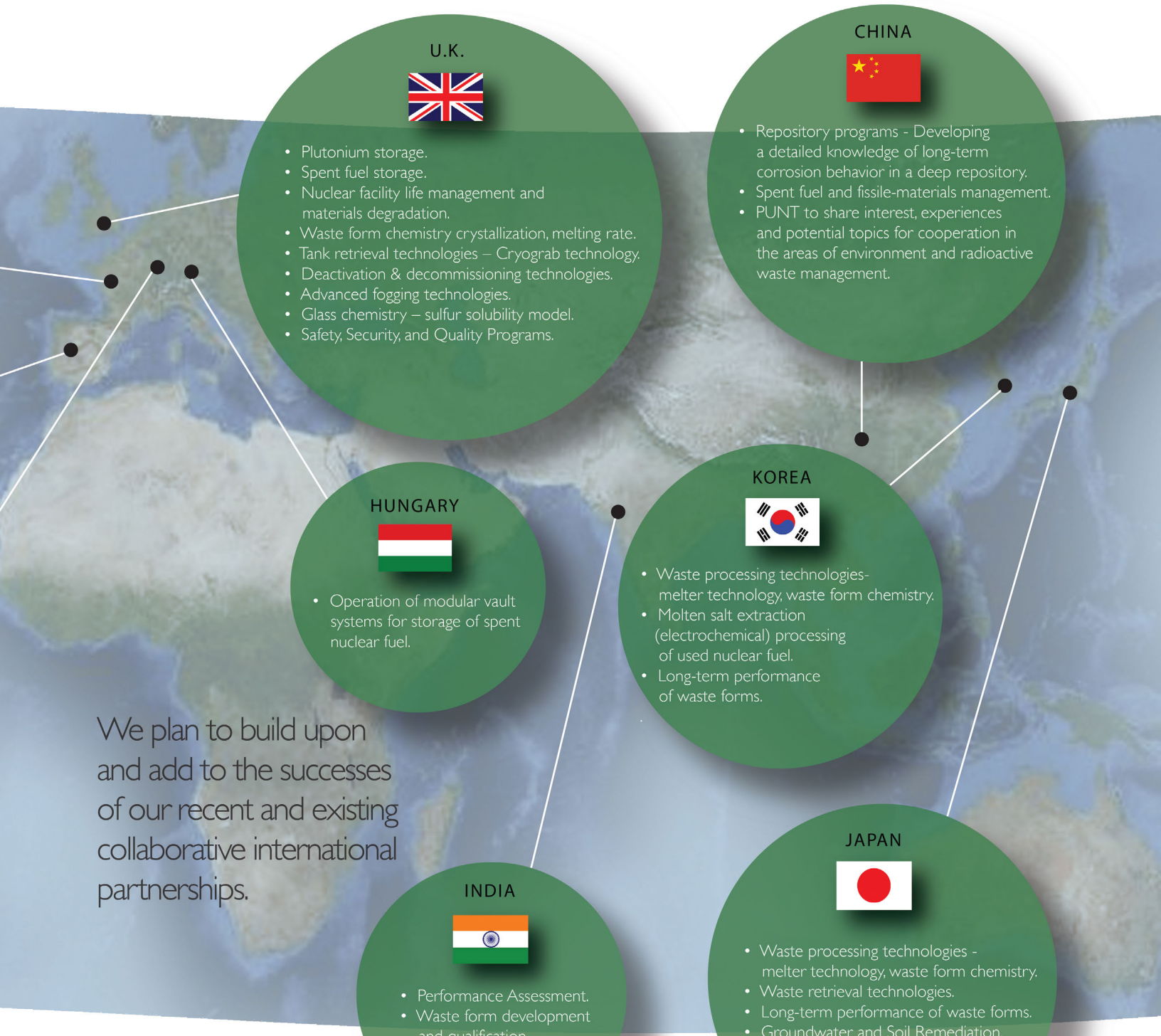
- Establishing collaborative technology projects with international partners;
- Engaging with DOE program offices
- Engaging with other U.S. agencies and programs;
- Participating in multinational forums and agencies;
- Exercising and/or establishing collaborative international agreements; and
- Participating in key International conferences.

These efforts which are described in more detail later, position the EM International Program to identify and leverage opportunities to engage with international partners in specific areas that can potentially benefit the EM clean-up mission.

EM collaborates with AREVA in multiple technical areas.



Moving Forward: Strategic Actions



U.K.

- 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.

CHINA

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

HUNGARY

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

KOREA

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

We plan to build upon and add to the successes of our recent and existing collaborative international partnerships.

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.

Technology Framework

In May 2014, the Secretary of Energy chartered the Secretary of Energy Advisory Board (SEAB) Task Force on Technology Development for EM. In the Report of the Task Force on Technology Development for Environmental-Management (December 2014), the SEAB Task Force identified a framework for identifying and prioritizing technology development for the EM program.

Three strategic elements were recommended:

- An incremental technology development program focused on improving the efficiency and effectiveness of existing cleanup processes;
- A high-impact technology development program that pursues technologies that are outside the day-to-day program, that target big challenges, and that hold the promise of breakthrough improvements; and
- A fundamental research program focused on developing new knowedge and capabilities that bear on the EM challenges, and are tailored to the EM mission.

Establishing Collaborative Technical Projects

The EM International Program works closely with the mission-specific program offices within the EM organization to identify and select technical collaboration projects that are aligned with the SEAB recommended framework, and address the high priority technical challenges facing the EM mission and/or areas that offer potential significant improvement to baseline approaches. In this role, the EM International Program works directly with the EM program offices to leverage existing opportunities that are aligned with U.S. policy and the DOE mission to work with counterparts from foreign governments, agencies, and organizations to:

- Identify areas of applicable technical expertise/technologies that are aligned with EM mission needs;
- Identify areas of mutual interest and benefit related to best management practices;
- Identify areas of mutual interest/opportunities within other DOE Program Offices for international collaborations;
- Identify beneficial technical exchanges, workshops, conferences, committees, etc. in which to engage/support/participate.

Through the EM International Program, resources are provided, within the constraints of available funding, to support high priority collaborative projects and activities that have potential for significant benefit to the EM mission. Key technical program areas include:

- Tank waste management and disposition;
- Soils and Groundwater remediation;
- Nuclear Materials management and disposition;
- Decontamination and Decommissioning (D&D) technologies.

New opportunities continue to be identified for collaboration that represent important and effective international engagements.

Collaborative International Partners

EM has been working collaboratively with foreign governments, institutions, and universities throughout the past 20 years in a wide range of areas related to the EM mission. The technical focus and priorities continue to evolve as challenges are resolved and new challenges related to the EM mission, as well as global needs, are identified. Around mid-fiscal year (FY), the International Program awards multiple collaborative projects for work scope spanning waste management, tank waste management, groundwater and soil remediation, D&D, disposal operations, and nuclear materials disposition initiatives to nine foreign organizations. These projects, which include both technical and non-technical activities, have opportunities for continuation into the next FY and beyond. See page 11 for recent examples. Highlights of recent and ongoing collaborations in key technical areas (shown in the figure next page).

Key Areas of Focus Over the Next Five Years for Potential Collaborative Technical Projects

The EM International Program will work closely with the program offices within the EM organization to identify and select technical collaboration projects that are aligned with the high priority technical challenges (i.e., initiatives) facing the EM mission and/or areas that offer potential significant improvement to baseline approaches. Current areas of technical focus identified by the respective EM program offices are summarized below. These provide the basis for establishing the priorities for International collaborative projects for any given fiscal year throughout the next five years. Priorities will likely change from year to year depending on the current state of the various technical programs. The following listing of technology challenges represents a comprehensive summary level description of the issues facing the total EM program. It is not anticipated that an international solution exists for all of these need areas, rather this provides the basis for identifying the appropriateness of a given technology proposal. The continued engagement by the EM program with our existing and potential international partners, as enabled by the effective network established by the EM International Program, will ensure that the most promising and beneficial opportunities are identified.

Key Areas of Future Focus

1. Tank Waste Management and Disposition

- Innovative Immobilization Technologies.
- Novel Glass and Ceramic Waste Forms.
- Glass Product Qualification.
- Sludge Mapping in Tanks for Retrieval.

AUSTRALIA FRANCE INDIA JAPAN KOREA RUSSIA UK

2. Soils and Groundwater Remediation

- Containment Fate and Transport Mechanisms.
- Mercury Remediation.
- Performance Assessment (PA) Modeling.

ARGENTINA JAPAN RUSSIA UK UKRAINE

3. Decontamination and Decommissioning

- In Situ Decommissioning Techniques.
- Advanced Surface Decontamination Techniques.
- Graphite Reactor Decommissioning.

AUSTRALIA CANADA JAPAN UK

4. Nuclear Materials Management and Disposition

- Plutonium and SNF Management.
- SNF Retrieval.
- SNF and HLW Disposal Systems.
- SNF Processing and Packaging.

AUSTRALIA CANADA CHINA GERMANY HUNGARY JAPAN UK

International Collaboration Projects

FY2015 EM International Collaborative Projects

OFFICE	TITLE	COUNTRY	FOREIGN ORG.	
EM-12	Predictive Modeling of Groundwater Flow and Transport	Argentina	CNEA	PNNL, LBNL
M-13	Advanced Fogging Technologies Demonstration	U.K.	NNL	INL
EM-13	SRNL/CNL Nuclear Facility Decommissioning/In-Situ Decommissioning Collaboration	Canada	CNL	SRNL
EM-13	Demonstration of UK Snake Arm Robot Technology for both Calcine and Tank Wastes Retrieval	U.K.	OC Robotics	NVE
EM-13	Leveraging International Experience in the Implementation of Characterization Technologies to D&D in the DOE Complex	U.K.	NDA	NVE
EM-22	Technical Support and Collaboration on Fukushima Cleanup	Japan		
EM-23	Correlating the Aging and Durability of Ancient Hillfort Glasses to the Predicted Long-Term Performance of Vitrified Waste	Sweden	Luleå University of Technology	PNNL
EM-21	Active Demonstration of Novel UK 3D SONAR Technology for Surveying and Mapping of Tank Sludges at Savannah River and Hanford	U.K.	FORTIS Technology	NVE
EM-23	Novel Glass Formulation Computer Model	Germany	The Rhenish-Westphalian Technical University	PNNL, INL
EM-23	Zirconium-Metal Organic Frameworks for Pertechnetate Removal	Australia	The University of Adelaide	PNNL
EM-23	In-Situ Three-Dimensional Mapping of Cold Cap Utilizing X-Ray Computed Tomography	Japan	Tokyo Institute of Technology	PNNL, INL, BNL
EM-23	In-Situ Monitoring of Cold Cap and Melts Utilizing X-Ray Computed Tomography and Ultrasound for Research and Development and Vitrification Facility Process Control	Japan	Tokyo Institute of Technology	PNNL
EM-31	Destruction of Problematic/Orphan Wastes Using a Novel Technology from the UK	U.K.	Tokyo Institute of Technology	NVE
EM-30	Assessment of Np(IV) and U(IV) as Improved Analogues for Pu(IV) in High Ionic-Strength Brine Systems	Germany	Karlsruhe Institute of Technology (KIT) - Institute for Nuclear Waste Disposal (INE)	CFBO, LANL

FY2014 EM International Collaborative Projects

OFFICE	TITLE	COUNTRY	FOREIGN ORG.	
EM-13	SRNL/AECL Nuclear Facility Decommissioning/In-Situ Decommissioning Collaboration	Canada	Atomic Energy of Canada Limited (AECL)	SRNL
M-13	Advanced Fogging Technologies Demonstration (Phase II)	U.K.	UK National Nuclear Laboratory (NNL)	INL
EM-13	SRNL/CNL Nuclear Facility Decommissioning/In-Situ Decommissioning Collaboration	U.K.	Sellafield Ltd/NDA	FIU
EM-21	Secured (non-classified) Global Collaboration for Environmental Management	Japan	Ministry of Economy Trade and Industry (METI)/ Ministry of the Environment (MOE)	
EM-21	Support for U.S.-Japan Bilateral Commission Working Group on Decommissioning and Environmental Management for National Laboratories	U.K.	FORTIS Technology	NuVision
EM-21	Novel Glass Compositions for High Sulfur Concentration Wastes	China	China Institute of Atomic Energy (CIAE)	SRNL
EM-21	Nuclear Waste Glass Product Quality Validation	U.K.	U.K. National Nuclear Laboratory (NNL)	SRNL
EM-22	Salt Defense Disposal Investigation (SDDI) Technical Consultation	Germany	DBE Technologies GMBH	CBFO
EM-31	Demonstration of a Reliable, Safe and Cost Effective Treatment Technology for Radioactive Organic Wastes (Phase II)	U.K.	Arvia Technology	NuVision
EM-30	Management of Waste from the Decontamination and Decommissioning (D&D) of a Graphite-Moderated Reactor	China	China Institute of Atomic Energy (CIAE)	SRNL

Current Technology Challenges

The challenges related to environmental clean-up resulting from nuclear energy and weapons production activities are not unique to the U.S. Common issues and challenges have been identified by many countries.

Tank Waste

Technology Improvements to Current Approaches

- In-tank, in-process characterization techniques for improved chemical and physical property data.
- Slurry transport, mixing, and flammability control (vessel/piping erosion, mixing adequacy, gas generation prediction/mitigation).
- Refined separations processes (increased sodium concentration, use of Next Generation Solvent, filter fouling control/mitigation, problematic radionuclides – Technetium-99).
- Optimized processing facilities and waste forms (techniques to improve waste loading and throughput in waste form processing, reduce need for supplemental tank waste processing, reduce/improve pretreatment).

Alternative Processing Options

- Alternative separations methods and deployment strategies sorbents with improved Strontium and Plutonium uptake, mitigation of process-limiting constituents effectively – phosphates, aluminum, sulfates; effective near-tank/source treatment, effective Technetium management).
- Alternative waste forms and processes (more robust glass formulations that provide durable waste forms, alternative more cost-effective waste forms for non-HLW tank waste).

Tank Management and Closure

- Improved tank leak and intrusion detection and mitigation (improved techniques to verify integrity of tanks and associated systems).
- Improved in-situ sampling, analysis, characterization, and monitoring techniques (in situ, remote, faster analytical techniques, improved sampling methods to refine computation models for tank residual predictions).
- Improved/alternative retrieval methods (chemical and mechanical).
- Improved technical basis for closure and Performance Assessments (PA) (Identification, quantification, and an increased understanding of environmental and human health hazards posed by residual contaminants and stabilized tanks/infrastructure).

Soil and Groundwater

Deep Vadose Zone Characterization and Remediation

- Technical basis to quantify, predict, and monitor natural and post-remediation contaminant discharge (end point definition framework) (e.g., Plutonium, Americium, and Technetium-99).
- In situ solutions to limit discharge (e.g., Iodine-129 biogeochemistry for endpoint framework and remediation).

Attenuation-based Remedies

- Approaches/tools to monitor/remediate difficult sits contaminated with combinations of metals, radionuclides, and recalcitrant organic compounds.
- Strategies/tools to transition from active/aggressive technologies to natural attenuation processes (i.e., monitored natural attenuation).

Remediation of Mercury and Industrial Contaminants

- Remediation of point source contamination (soil, water, and biota).
- Source zone identification, characterization, and pathway analysis.
- Conceptual and numerical models of contaminant fate and transport processes (i.e., complexation, speciation, water chemistry effects, etc.).

Simulation Capabilities Focused on Contaminant Remediation, Advanced Simulation Capability for EM (ASCEM)

- Develop science underpinning for near field and far field predictive fate and transport modeling.
- Benchmark modeling results with field data.
- Improve PA modeling capabilities and reduce overly conservative assumptions and requirements.

Decontamination and Decommissioning

D&D Basic Science Research

- Identify and evaluate emerging or developing technologies and technical approaches that can provide transformational advancements.
- Develop innovative technical solutions that 1) address scientific and engineering problems germane to the mission of the organization; and 2) develop novel scientific approaches and instrumentation that create fundamentally new capabilities applicable to D&D issues.

Basic Research for Worker Safety

- Characterization –ultra-sensitive devices for rapid characterization, development of real-time and minimally invasive methods for closed systems, development of methods for remotely mapping radionuclides and EPA-listed substances.
- Robotics and Remote Intelligent Systems –intelligent remote systems that can adapt to a variety of tasks and be readily assembled from standardized modules, with special emphasis on actuators, universal operational software, and virtual presence.
- Decontamination and Dismantlement –chemical, biological and nano technologies as a means to remove, stabilize, and passivate contaminants on surfaces and equipment, advanced technologies and approaches for size reducing and removing large pieces of highly contaminated equipment from high hazards areas.

Basic Research for End States/Closure

- Materials Science –chemical, biological, and physical interactions of contaminants with primary materials of interest in D&D projects; fate and behavior of treated and untreated contaminated materials.
- Sensors and Data Systems –develop innovative, non-intrusive sensors that can withstand unique and harsh environments, effectively synthesize and visualize large amounts of data.
- Performance Modeling - develop performance models that provide a comprehensive understanding of the fate and transport characteristics related to end state (i.e. removal or retention of the slab, entombment, etc.)., understanding the behavior of radioactive and hazardous airborne contaminants.

Nuclear Materials

Improve standard containers to reduce personnel exposure, decrease the number of packages, and reduce the cost of disposal or extended long term storage

- Develop and demonstrate system for remote weld, inspection and repair of used fuel canister.
- Develop advanced neutron absorber materials for use in canister baskets/internals to ensure criticality safety under a broad range of disposal scenarios.
- Develop understanding of degradation and corrosion of container systems used in nuclear materials management.

Develop robust, non-intrusive methods to monitor spent nuclear fuel, containers, and storage systems

- Fuel Integrity – develop remote corrosion characterization and inspection techniques; repairing aging concrete; and the effects of water chemistries on concrete and fuel corrosion.
- Storage System Integrity - develop new technologies to extend the life of existing storage systems; develop inspection techniques to assess condition of fuel storage facility structural and other safety-related components; develop and demonstrate methodology for repairing aging concrete.

Identify and develop disposal pathways for plutonium, excess nuclear materials, foreign reactor fuel (i.e., HEU and other challenging materials).

- Improved approaches and techniques for plutonium management.
- Develop new methods to disposition challenging materials and reuse/recover isotopes for programmatic purposes.
- Develop models, evaluate and test impact of placing heat-generating material in salt repositories.

.

In addition to technologies and technical collaboration and exchanges, opportunities have also been identified for sharing of lessons-learned related to management best practices.

Acquisition Strategies

- Contracting strategies.
- Performer selection criteria/approach.

Project Management Principles

- Earned Value Management System.
- Cost estimating principles.
- Scheduling estimating principles.
- Independent/external review processes.

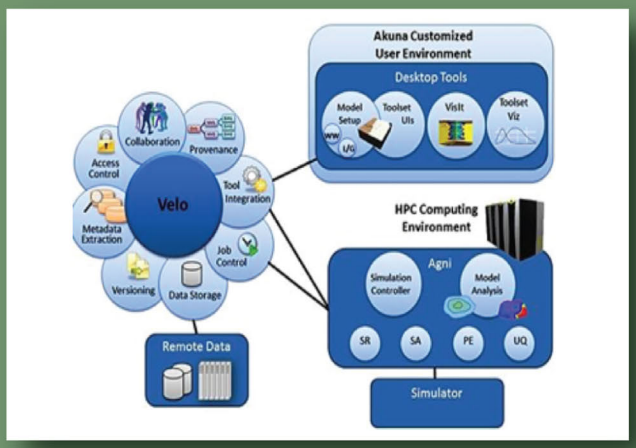
Technology Readiness Assessment Process

- Relationship to acquisition process (i.e., DOE Order 413.3B Critical Decision 1 [CD-1] and CD-2).
- Implementation of international standards in TRL definitions.
- Critical Technology Element definition.
- Technology Maturation Plans.

These programmatic exchanges are aligned with the DOE Strategic Plan, Goal 3, Strategic Objective 10.

EM collaborates with UK NDA via information exchanges for technologies and best management practices

Example Technical Collaborations



ASCEM

Initiated in 2010 by DOE EM, ASCEM is a scientific tool and approach for understanding and predicting contaminant fate and transport in natural and engineered systems through the use of a high performance computing modeling system for multiphase, multi-component, multi-scale subsurface flow and contaminant transport, and source-term degradation predictions. ASCEM's modular and open source toolsets will facilitate integrated approaches to modeling and site characterization that enable robust and standardized assessments of performance and risk for EM clean-up and closure activities. ASCEM will also help transform fundamental science innovation into practical applications deployed by site contractors across the entire DOE complex and is being integrated with the emerging EM endpoints initiative.

The ASCEM team, composed of scientists from eight National Laboratories, is leveraging DOE investments in basic science and applied research, as well as collaborating with the Offices of Fossil Energy, SC and NE. Additionally, through the EM International Program, Argentina is supporting ASCEM in development of fate and transport models for specific radionuclides.

Example Technical Collaborations

Glass Behavior

EM is working with NE and SC in a joint international Study of Glass Behavior over Geologic Time Scales. Since 2009, representatives from several nations, including the U.S. (Joint EM-NE-SC, plus four national laboratories), France (CEA, Nantes, AREVA), Belgium (SCK-CEN), United Kingdom (UK) (NNL, Sheffield), Japan (Kyushu and Japan Atomic Energy Agency (JAEA), Italy (SOGIN), Germany, and others have been collaborating in the field of Long-term Glass Corrosion.

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 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.

Developing Technologies

Leaders from EM headquarters and field offices and the UK's Sellafield nuclear site gathered during July 2014 in Washington DC to discuss developing technologies needed to address decommissioning challenges across the Cold War clean-up program. Participants identified key areas for the basis of a five-year technology development strategic plan for D&D including:

1) Improved characterization tools and techniques;
2) Robotic and remote system development to enable safe D&D;
3) Improved decontamination technologies and techniques;
4) Use of facility mock-ups to demonstrate innovative technologies.

A detailed plan is scheduled to be issued in FY2015 for developing and deploying the technologies needed by EM to accomplish safer, faster, and more cost-effective clean-up.

First, and foremost, as a direct support function to the EM mission, the EM International Program supports the strategic goals and objectives of the Department within the International arena, by ensuring that EM Senior Management is informed, prepared, and well-represented during all international interactions. Through coordination with EM Senior Management, the EM International Program also engages with the Office of the Secretary of Energy, as well as the Office of the Deputy Secretary of Energy, to ensure that they are accurately informed and well-prepared regarding ongoing or future collaboration opportunities within the EM mission during their respective International activities.

Additionally, the EM International Program maintains close engagement with other DOE Program Offices that are responsible for missions that interface with the EM clean-up mission. This provides opportunities to leverage existing international programs and avoid duplication of efforts, thus enhancing the EM return on investment. The EM International Program coordinates with the senior management of these DOE Program Offices to ensure that they are accurately informed and well-prepared regarding the EM mission and areas that are germane to their respective international interactions. These preparations may include briefing materials, country papers, information regarding ongoing collaborations, etc., as appropriate. The following describes the current strategic actions with these key DOE Program Offices.

Engaging DOE Program Offices

National Nuclear Security Administration

Established by Congress in 2000, NNSA is a semi-autonomous agency within the U.S. Department of Energy responsible for the management and security of the nation's nuclear weapons, nuclear nonproliferation, and naval reactor programs. It also responds to nuclear and radiological emergencies in the United States and abroad. Additionally, NNSA federal agents provide safe and secure transportation of nuclear weapons and components and special nuclear materials along with other missions supporting the national security.

The NNSA and EM missions coincide in the areas of nonproliferation, particularly related to management and disposition of nuclear materials (e.g., plutonium), as well as environmental and waste management challenges associated with peaceful uses of nuclear technologies. A key area of strategic collaboration with NNSA is on the Joint Coordinating Committee under the U.S. – China PUNT Agreement. This agreement, entered into in 1998, is a formal government-to-government mechanism established to support the civilian development of nuclear energy in both countries while addressing nuclear security, safety and proliferation risks. It identifies several areas of potential collaboration and technical exchange that are aligned with the EM mission, including radioactive and chemical waste management, spent fuel management, environmental remediation, and reactor facility D&D.

Through coordination by the EM International Program, EM co-chairs the PUNT Working Group III: Environment and Waste Management with NNSA. As part of the global interactions related to U.S. foreign and energy policies, the DOE provides workforce resources to support the Department's mission and strategic plan objectives and requirements in overseas assignments. The NNSA serves as the Executive Secretariat for the Overseas Presence Advisory Board (OPAB), which manages and coordinates the activities of the Department's overseas staff. Interaction with the OPAB is important to successful and effective communications and interactions with our International partners and other countries in which alliances are being established. The EM International Program represents EM on the OPAB, as well as its Working Capital Fund Working Group, to ensure that EM is well-represented and that the areas of interest to the EM mission are included in the OPAB planning and focus, as appropriate. As necessary, the EM International Program will work with OPAB in development of International Agreements that include areas of EM interest and equities (e.g., Japan).

U.S. DEPARTMENT OF ENERGY | Office of Nuclear Energy

The primary mission of NE is to advance nuclear power as a resource capable of making major contributions in meeting our Nation's energy supply, environmental, and energy security needs. NE seeks to resolve technical, cost, safety, security and regulatory issues through research, development and demonstration. By focusing on the development of advanced nuclear technologies, NE supports the Administration's goals of providing domestic sources of secure energy, reducing greenhouse gases, and enhancing national security.

NE serves present and future U.S. energy needs by developing critical technologies for the future and helping to train tomorrow's workforce. The benefits of nuclear power as a safe, carbon-free, reliable and secure source of energy make it an essential element in our Nation's energy and environmental future. A major area of interest related to sustainable nuclear energy is related to management and disposition of SNF, including legacy, newly generated, and future inventories. This is a key area of collaboration between EM, NE, and the international community.

Another key interaction between EM and NE is related to the IFNEC. IFNEC was established at a meeting held in Accra, Ghana during June, 2010, at which the Partner countries of the Global Nuclear Energy Partnership (GNEP) formally agreed to transform the partnership to IFNEC and adopt a new Statement of Mission. IFNEC rotates the location of its meetings amongst the IFNEC countries.

Among other things, it provides an opportunity for IFNEC countries to appreciate first-hand the vital role energy plays throughout the world and how nuclear energy is being used or considered. IFNEC consists of 63 countries and three international organizations representing every major geographical area globally and every major stage of economic and technical stage of development. It provides a forum for cooperation among participating states to explore mutually beneficial approaches to ensure that the use of nuclear energy for peaceful purposes proceeds in a manner that is efficient and meets the highest standards of safety, security and non-proliferation. Although the focus is on commercial nuclear power, the activities related to the back end of the fuel cycle, which includes research and development (R&D) activities on advanced waste forms, SNF management, and processing technologies, are of particular interest to EM. Because of this, EM participates as an observer during the IFNEC expert meetings.

U.S. DEPARTMENT OF ENERGY | Office of Science

The SC is the single largest supporter of basic research in the physical sciences in the U.S., 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.

In support of its mission, SC also 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.

EM actively taps into some of these unique resources and leverages ongoing R&D within SC to augment its technology development program, which also includes international collaborators. A prime example of ongoing leveraging is development of ASCEM. The 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. The high-speed and supercomputing platforms and expertise within SC will be key to validating algorithms and processing the data for predicting far-field fate and transport characteristics over geologic time periods. Another example would be coordinating on waste processing technologies that are transformational.

Another key area of collaboration between EM, NE, SC, and the International community is related to investigation of the long term performance of glass, as related to immobilization of HLW. Basic materials science research is needed to develop a more comprehensive understanding of the effects of the hydro-geological characteristics of specific subsurface environments and conditions on the chemical reactions and kinetics that occur as the glass interacts with its surroundings and degrades. This initiative will help develop an international consensus on the behavior and performance of glass waste forms over geological time periods. This will provide more representative predictive modeling for long term health and safety of the environment.

Peaceful Uses of Nuclear Technology

EM officials participated in the 8th U.S.-China PUNT Joint Coordinated Committee meeting in Beijing during April 2013. The U.S.-China PUNT framework provides a unique opportunity for the respective science communities to work together and explore options for addressing both national and international challenges. As nuclear science and applications continue to expand, international cooperation in science and technology will remain a vital part of enhancing safety, emergency response, and waste management measures at nuclear power plants; ensuring civil nuclear programs are not misused for non-peaceful purposes; and protecting nuclear operations from theft, sabotage, or unauthorized access.

NNSA and China's Nuclear Energy Agency, along with interagency participants from both countries, meet annually at the PUNT Joint Coordinating Committee meeting to manage and oversee bilateral technical cooperation pursued under the 1998 U.S.-China PUNT Agreement.

The PUNT committee offered the opportunity to discuss the EM program with high-ranking Chinese government officials, establish government-to-government relations with China and continue collaborations with Chinese institutions. PUNT cooperation has advanced many DOE international initiatives.

Engaging with Other U.S. Federal Agencies and Programs

The EM International Program also engages with other U.S. federal agencies and programs to foster EM involvement, as appropriate - prepare briefing materials, support EM involvement for specific international committees, working groups, programs, strategy meetings, etc.

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. The following describes the current strategic actions with other key federal agencies and offices.

U.S. DEPARTMENT OF STATE
DIPLOMACY IN ACTION

The mission of the DOS is to "shape and sustain a peaceful prosperous, just, and democratic world and foster conditions for stability and progress for the benefit of the American people and people everywhere".

A major component of that mission involves interaction with the international community on matters related to peaceful uses of nuclear technologies.

In recent years, the State Department activities on technical cooperation under the JSCNEC and JCM on Science and Technology have increased. The JSCNEC meeting includes a review of several joint projects between the United States and foreign nuclear research institutions. The JCM focus more on science focused research. At these annual meetings the Department of Energy has been responsible for coordinating between 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. EM, NE, and NNSA also participate in the DOS organized JSCNEC and JCM meetings held annually.

Both the JSCNEC and JCM meetings provide an important chance 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 meetings as the formal bilateral cooperation channel between them and the United States where nuclear and science policy consultations, exchange of technical information, joint R&D activities, etc., transpire. Currently, EM participates in JSCNEC meetings with Argentina and Korea, as well as the Joint Standing Committee on Civil Nuclear Cooperation with Taiwan.

The EM International Program also participates in the S&T Cooperation program within DOS, facilitating worldwide scientific exchanges, while providing protection of intellectual property rights. Other key roles that the EM International Program provides as part of the collaborative efforts with DOS include serving as the EM point-of-contact for requests for technical assistance by foreign governments (e.g. Iraq and Slovakia), as well as providing up-to-date information, communication, and engagement with DOE attachés in U.S. Embassies abroad in support of EM international initiatives.

THE WHITE HOUSE

The EM International Program engages with the White House in two key areas: the National Security Council (NSC) Civil Nuclear Team USA and OSTP Fukushima Sharing Forum.

The NSC is the President's principal forum for considering national security and foreign policy matters with his senior national security advisors and cabinet officials. Since its inception under President Truman, the Council's function has been to advise and assist the President on national security and foreign policies. The Council also serves as the President's principal arm for coordinating these policies among various government agencies. The EM International Program participates in the NSC Civil Nuclear Team USA meetings, which provides a direct forum for information sharing related to global management and disposition strategies of disused nuclear facilities and materials.

Congress established the OSTP in 1976 with a broad mandate to advise the President and others within the Executive Office of the President on the effects of science and technology on domestic and international affairs. The 1976 Act also authorizes OSTP to lead interagency efforts to develop and implement sound science and technology policies and budgets, and to work with the private sector, state and local governments, the science and higher education communities, and other nations toward this end.

The mission of the OSTP includes the charge to provide the President and his senior staff with accurate, relevant, and timely scientific and technical advice on all matters of consequence. The primary example of this in which EM is engaged is the OSTP Fukushima Sharing Forum. Because of the EM joint leadership role with EPA on providing environmental remediation expertise to Japan related to the Fukushima accident, this is an ideal forum for EM to maintain and strengthen its global leadership in areas related to radioactive waste management, remediation, and disposition.

..

U.S. DEPARTMENT OF COMMERCE

The DOC promotes job creation, economic growth, sustainable development and improved standards of living for all Americans by working in partnership with businesses, universities, communities and our nation's workers. DOC responsibilities involve multiple areas including trade, economic development, technology, entrepreneurship and business development, environmental stewardship, and statistical research and analysis. To drive U.S. competitiveness in the global marketplace, the DOC works to strengthen the international economic position of the U.S., facilitating global trade by opening up new markets for U.S. goods and services. The DOC also provides effective management and monitoring of our nation's resources and assets to support both environmental and economic health.

The EM International Program is engaged with DOC in a variety of forums, providing the benefit of keeping apprised of available mechanisms and opportunities for international trade of technologies and expertise in areas related to the EM mission, and in compliance with U.S. export policy. As a result, the EM International Program provides the following functions:

- Representing EM at the Trade Promotion Coordinating Committee;
- Participating on the Civil Nuclear Trade Working Group: Civil Nuclear Trade Policy Missions; and
- Participating on and contributing to the Environmental Trade Working Group: Environmental Technologies Export Market Plans, Environmental Technologies "Top Export Prospects" Study.

.

Participating in Multinational Forums and Agencies

The EM International Program provides benefit to the EM mission by promoting participation in multinational forums and agencies, such as the International Atomic Energy Agency and the Nuclear Energy Agency. We work with EM Senior Management and the various EM program offices to ensure that EM is well represented with these institutions, and participate in leadership roles, when feasible.

Establishing U.S. leadership world-wide through participation in these international organization forums positions EM to be cognizant of the most important ongoing international activities related to the EM mission, and the premier subject matter expertise in specific areas. These interactions allow EM to expand its role with multilateral international organizations in order to tap into the best science being used in the field. The following describes the current strategic actions with key multinational forums and agencies.

IAEA
International Atomic Energy Agency

NEA
Nuclear Energy Agency

EM International Collaboration – Support to the Fukushima Dai-ichi NPP Accident

Generally, EM's international collaborative activities are focused on solving problems at home. However, in the case of Japan's Fukushima Dai-ichi Nuclear Power Plant (NPP) accident, the reverse is the case. The Japanese government requested and the U.S. committed to provide technical expertise and support in addressing the significant environmental challenges resulting from the damage to the NPP by the tsunami that hit on March 11, 2011, considered the greatest nuclear disaster in the world since the Chernobyl accident in April 1986.

EM collaborates with several other U.S. government Program Offices and Agencies. Japanese counterparts working with EM include the Ministry of Economy, Trade, and Industry (METI) and the Ministry of Environment (MOE).

In July 2012, President Obama and Prime Minister Noda agreed to create a U.S.-Japan Bilateral Commission (BLC) on Civil Nuclear Cooperation. The first meeting of the BLC was held on July 24, 2012, in Tokyo, at which time five working groups were launched to coordinate bilateral cooperation. They cover the following subjects: Nuclear security; Civil nuclear energy research and development; Safety and regulatory issues; Emergency management; and Decommissioning and environmental management, which is co-led by EM and EPA along with METI and MOE. Through this working group, EM is supporting direct partnerships between U.S. National Laboratories, U.S. companies and Japan. Since the initial BLC meeting, two others have been held, the most recent, June 12, 2014, in Tokyo.

International Atomic Energy Agency

Established in 1957 within the United Nations, and headquartered in Vienna, the IAEA is the world's center of cooperation in the nuclear field. The IAEA works with its 162 Member States, including the United States, and multiple partners world-wide, to promote safe, secure, and peaceful nuclear technologies.

The EM mission comprises disposition of radioactive waste and management of nuclear materials. Accordingly, the U.S., along with 69 other nations, are signatories pledged to support the objectives of the IAEA 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 2012, the fourth Review Meeting of Contracting Parties to the Joint Convention reaffirmed the importance of taking into account spent fuel and radioactive waste management from the very beginning of any nuclear activities. While progress has been made, issues remain 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 still remains.

A recognized 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 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:

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

The EM International Program supports these areas by ensuring that EM is well represented and actively engaged, as appropriate. Specifically, the EM International Program serves as the primary point-of-contact for IAEA candidate nominations for participation in meetings related to the EM mission.

Nuclear Energy Agency

The Nuclear Energy Agency (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 further 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.

The NEA consists of 31 countries, including the United States, in Europe, North America, and the Asia-Pacific regions. Together these nations represent approximately 90% of the world's installed nuclear capacity. Nuclear power accounts for about one-fifth of the electricity produced in NEA member countries. The NEA works closely with the IAEA and with the European Commission in Brussels. Within the OECD, there is close coordination with the International Energy Agency and the Environment Directorate, as well as contacts with other directorates, as appropriate.

While the EM mission is to clean up 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 radiological protection, public health, and nuclear science. The interests of EM and the NEA coincide particularly in radioactive waste management. The NEA seeks to assist its member countries in developing safe, sustainable, and societally acceptable strategies for the management of all types of radioactive materials, with particular emphasis on the management of long-lived waste and spent fuel, as well as decommissioning of disused nuclear facilities. The EM mission could potentially benefit from the work of the NEA Radioactive Waste Management Committee, which has the following objectives to:

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

Accordingly, the EM International Program functions as the point-of-contact for NEA candidate nominations for participation in meetings related to the EM mission, including participation on the Radioactive Waste Management Committee. Additionally, through the Committee's WPDD, EM remains engaged with and knowledgeable of the ongoing D&D practices and lessons-learned within the international community.

Participating in Key International Conferences

The EM International Program participates with EM management in International Conferences that are aligned with U.S. policy and the overall DOE mission to both strengthen existing and foster new international relationships and partnerships. These International conferences provide the opportunity to promote the EM program to an international audience, at both programmatic and technology levels. Most importantly it allows for the EM program to stay abreast of science and technology developments of other countries that may benefit the overall EM mission. International conferences allow the opportunity to obtain current technical information related to environmental technologies being developed and deployed in other countries, and to facilitate contact with potential subject matter experts that could assist EM in future technical reviews of environmental 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 R&D collaboration. Important conferences that EM supports are the WM Conference held annually in Phoenix, Arizona and the ICEM and Radioactive Waste Management conferences held in various locations throughout Europe; as well as various topical meetings organized by the American Nuclear Society. The EM International Program in conjunction with the EM program offices will continue to identify key conferences focused on environmental remediation and radioactive waste management that allow EM to engage the technical skills and knowledge of foreign governments, industries, and universities to help identify transformational solutions that have the potential to assist with the EM clean-up mission.

WM Symposia

American Nuclear Society

icem

Establishing and Exercising International Collaborative Agreements and Other Alliances

Agreements, Memorandums of Understanding (MOUs), Statements of Intent (SOIs) and other formal alliances constitute a comprehensive network that is necessary to establish collaborative projects, technical exchanges, and other interactions in support of developing effective international waste management strategies with international partners. The EM International Program applies expertise in identifying existing international agreements that are aligned with the scope of interest, such that efforts are not duplicated.

Formal alliances with Canada, China, France, Germany, Hungary, Russia, Spain, and the United Kingdom currently exist. However, where agreements do not exist, we will work with the appropriate Federal organizations, such as the DOS and DOC, as well as other DOE Program Offices and/or Federal Agencies to modify existing or establish new agreements that support the scope, while in compliance with the DOE energy and environmental policies, as well as U.S. foreign policy. A list of the current active agreements and other alliances between EM and our international partners, as well as those in which EM is routinely engaged, are provided in Appendix B.

Signing of agreement with Spain ENRESA.

Development and Validation of Performance Characteristics for Salt Disposal at the Waste Isolation Pilot Plant (WIPP)

The DOE EM, through their Carlsbad Field Office (CBFO) is partnering with Germany's DBE Tech, the NEA Salt Club, and NE to develop state-of-the-art Pitzer data for improving the NEA Thermodynamic Database related to solubility of actinide and other ionic species in high ionic strength solutions. As part of this effort, WIPP salt cores have been provided to partners to test and validate models for the physical behavior of salt formations. Additionally, this is providing an opportunity to obtain independent validation of the planned implementation of a thermal test program for WIPP.

Validation and application of these improved Pitzer models will provide for more representative results for predicting long term performance of geologic disposal systems. This will allow such geologic disposal systems, including waste characteristics, to be optimized for more efficient use of resources.

Asst. Secretary Monica Regalbuto, EM-1, takes a tour of operations at WIPP

During FY2015, the team plans to complete and publish the Pitzer data report for review and eventual adaptation into models. Ultimately, this will lead to actual implementation of the improved Pitzer models into geologic disposal system design and optimization.

Conclusion

The EM International Program will continue to focus on identifying and leveraging international opportunities that can assist in reducing the cost and schedule of the EM clean-up mission; enhancing understanding of the processes related to environmental management; and accelerating and increasing innovative technology applications. 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, the EM International Program will ensure the implementation of appropriate international agreements, providing an effective global network that can support completing the EM mission. Through the various strategic actions identified, the framework established, and coordination with the EM Program Offices, the EM International Program will strengthen the EM ability to stay apprised of global advances in technology that have potential to reduce cost and optimize the efficiency of the Department's environmental clean-up responsibilities. Additionally, the EM International Program will be instrumental in obtaining and exchanging information on the global status of progress and policies in waste management. Finally, in its leadership role, the EM program will leverage these opportunities to assist other countries to adopt safe waste management and disposal practices that enhance international security, safety, and environmental integrity.

Signing of Statement of Intent with UK NDA and NNL
(Richard Maudslay, Chairman NNL on left, Asst. Secretary Monica Regalbuto, EM-1, center, and Adrian Simper, Strategy and Technology Director UK NDA on right)

Appendix A

Current Working Agreements, MOUs, SOIs, etc. Between EM and International Partners

COUNTRY	DATE SIGNED	TITLE	SIGNED BY
China	1998	Agreement Between the Department of Energy of the United States of America and the State Development Planning Commission of the People's Republic of China on Cooperation Concerning Peaceful Uses of Nuclear Technologies (PUNT)	DOS and DOE
U.K.	2007* 2012 2014	Statement of Intent between the Department of Energy of the United States of America and the United Kingdom's Nuclear Decommissioning Authority for Exchange of Information concerning Management of Radioactive Waste	DOE-EM and NE
Hungary	2009	Memorandum of Understanding between the Department of Energy of the United States of America and the Public Agency for Radioactive Waste Management of the Republic of Hungary for Information Exchange Relating to Operation of Modular Vault Systems for Storage of Spent Nuclear Fuel	DOE-EM
Germany	2011	Memorandum of Understanding between the Department of Energy of the United States of America and BUNDESMINISTERIUM FÜR WIRTSCHAFT UND TECHNOLOGIE for Cooperation in the Field of Geologic Disposal of Radioactive Waste	DOE's NE and CBFO
France	2012	Memorandum of Understanding between the Department of Energy of the United States of America and the National Radioactive Waste Management Agency of France Concerning Cooperation in the Field of Radioactive Waste Management	DOE-EM and NE
Russia	2012	Statement of Intent between the Department of Energy of the United States of America and the State Corporation for Atomic Energy "Rosatom" Concerning Collaboration in Innovative Technologies for Environmental Restoration and Radioactive Waste Management	DOE (Chu)
Canada**	2013	Statement of Intent between the United States Department of Energy and Atomic Energy of Canada Limited in the Field of Used Fuel and Radioactive Waste Management, Decommissioning and Environmental Restoration	DOE-EM
Germany	2014	Statement of Intent between the Federal Ministry of Education and Research of the Federal Republic of Germany and the Ministry for Innovation, Science and Research of the State of North Rhine-Westphalia on behalf of the North Rhine-Westphalia State Government, the Department of Energy of the United State of America for the Proposed Use of Savannah River Site Facilities for Disposition of German Research Reactor Pebble Bed Fuel	DOE's NE and CBFO
U.K.	2014	Arrangement between the Office of Nuclear Regulation of Great Britain and the United States Department of Energy for the Exchange of Information and Co-operation in the Area of Nuclear Safety Matters	DOE-EM
Spain	2014	Memorandum of Understanding between the Department of Energy of the United States of America and the National Company of Radioactive Waste of Spain Concerning Cooperation in the Field of Used Nuclear Fuel and Radioactive Waste Management	DOE (Chu)

* 2007 (original SOI with UKNDA and DOE EM) / 2012 (to include DOE NE) / 2014 (to include UK's NNL)

** On November 3, 2014, AECL made the following announcement: 'Atomic Energy of Canada Limited is advising you of an important milestone for Canada's premier nuclear science and technology organization. When business opened this morning, November 3, 2014 the experience, expertise and facilities you have long associated with Atomic Energy of Canada Limited (AECL) is now offered through a new organization – Canadian Nuclear Laboratories Limited (CNL), a wholly owned subsidiary of AECL.

Appendix B

List of Acronyms

ACRONYM	FULL TITLE
ASCEM	Advanced Simulation Capability for Environmental Management
BLC	Bilateral Commission
D&D	Deactivation and Decommissioning
DOC	U.S. Department of Commerce
DOE	U.S. Department of Energy
DOS	U.S. Department of State
EM	Office of Environmental Management
FY	fiscal year
GNEP	Global Nuclear Energy Partnership
HEU	highly-enriched uranium
HLW	high level radioactive waste
IA	Office of International Affairs
IAEA	International Atomic Energy Agency
ICEM	International Conference for Environmental Restoration and Radioactive Waste Management
IFNEC	International Framework on Nuclear Energy Cooperation
JAEA	Japan Atomic Energy Agency
JCM	Joint Coordinating Meeting
JSCNEC	Joint Standing Committee on Nuclear Energy Cooperation
METI	Ministry of Economy, Trade, and Industry
MOE	Ministry of the Environment
MOU	Memorandum of Understanding
NDA	Nuclear Decommissioning Authority
NE	Office of Nuclear Energy
NEA	Nuclear Energy Agency
NNL	National Nuclear Laboratory
NNSA	National Nuclear Security Administration
NPP	Nuclear Power Plant
NSC	National Security Council
OPAB	Overseas Presence Advisory Board
OSTP	Office of Science and Technology Policy
PA	Performance Assessment
PUNT	Peaceful Uses for Nuclear Technology
R&D	research and development
SC	Office of Science
SEAB	Secretary of Energy Advisory Board
SNF	spent nuclear fuel
SOI	Statement of Intent
UK	United Kingdom
WM	Waste Management
WPDD	Working Party of Decommissioning and Dismantling

EM INTERNATIONAL PROGRAM

1000 Independence Ave. SW
Washington, DC 20585
(202) 586-5000

Printed on recycled paper

U.S. DEPARTMENT OF ENERGY