

**Building upon Historical Competencies: Next-generation Clean-up Technologies for World-Wide Application – 13368**

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**ABSTRACT**

The Department of Energy's Savannah River Site has a 60-year history of successfully operating nuclear facilities and cleaning up the nuclear legacy of the Cold War era through the processing of radioactive and otherwise hazardous wastes, remediation of contaminated soil and groundwater, management of nuclear materials, and deactivation and decommissioning of excess facilities. SRS recently unveiled its Enterprise•SRS (E•SRS) strategic vision to identify and facilitate application of the historical competencies of the site to current and future national and global challenges. E•SRS initiatives such as the initiative to Develop and Demonstrate Next-generation Clean-up Technologies seek timely and mutually beneficial engagements with entities around the country and the world. One such ongoing engagement is with government and industry in Japan in the recovery from the devastation of the Fukushima Daiichi Nuclear Power Station.

**INTRODUCTION AND BACKGROUND**

For almost forty years—from the early 1950s to the late 1980s—the Savannah River Site (SRS) mission was to produce plutonium and tritium for nuclear weapons to be used as deterrents to nuclear war. The Savannah River National Laboratory (SRNL) on the site provided the scientific and engineering expertise that enabled accomplishment of that site mission, including reactor design, chemical separations, tritium science, and environmental monitoring. Following the end of the Cold War, the focus of the site and the laboratory changed and broadened. Rather than producing nuclear weapons materials, the focus shifted to safely containing and disposing of nuclear waste and materials, cleaning up the environment, and decontaminating and decommissioning excess nuclear facilities, capitalizing on the attributes that had created the successes of the past.

The challenges faced by the nuclear industry today can be solved through the integrated use of two key components that have been essential to SRS's historical mission success--nuclear knowledge and the requisite infrastructure.

The initial essential attributes include pioneering experience in almost every scientific and engineering discipline, including, in addition to those mentioned above, analytical chemistry, computational modeling, engineered specialty systems, applied meteorology, and biotechnology.

Second, a full spectrum of laboratory facilities enables innovative radiological and chemical testing and demonstration; those facilities include the shielded cells, in which highly radioactive

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materials are manipulated remotely, and the Engineering Development Laboratory, in which large pilot-scale demonstrations are conducted.

Finally, SRS's knowledge, experience, and innovation coupled with its diverse facilities and natural assets have created an extensive portfolio of accomplishments and capabilities in protecting the safety and security of the United States.

The assets and capabilities of SRS and SRNL are now needed to address both urgent and intractable challenges worldwide.

## **ENTERPRISE SRS STRATEGIC VISION**

SRNL's focus on outcomes and the site's talent to deploy technical solutions and approaches make SRS uniquely valuable to the global nuclear community.

In 2011, the DOE Savannah River Operations Office and all major SRS contractors joined in a consolidated site endeavor to identify and facilitate application of the historical competencies of the site to address national and international needs of the twenty-first century and beyond.

While continuing to focus upon site needs, SRS is seeking to apply the laboratory and operational experience and knowledge gained through our traditional environmental stewardship and national security missions to new national and global challenges, strengthening the viability of the site.

The E•SRS vision seeks to bring together site organizations collaborate in taking on new challenges. SRNL's proven capabilities and contacts constitute the engine that powers E•SRS. E•SRS seeks mutually advantageous engagements that return scientific and technical knowledge back into the U.S. arsenal to benefit the U.S. Government and future nuclear science and engineering.

## **NEXT-GENERATION CLEAN-UP TECHNOLOGIES**

One E•SRS initiative is Development and Demonstration of Next-generation Clean-up Technology. Since its focus shifted to cleaning up the nuclear legacy of the Cold War era, SRNL's accomplishments include design of major waste processing flow sheets, waste forms, and facilities, including the Defense Waste Processing and Saltstone Facilities at SRS, and support to the Waste Treatment and Immobilization Plant at Hanford. SRNL's recent maturation of such technologies as rotary microfilter, small column ion exchange, and next-generation solvents will expedite the processing and permanent disposition of the millions of gallons of radioactive waste stored in large underground tanks. SRS and SRNL also offer unique expertise in sample method development and the analysis of various radiological sample media.

SRNL has adapted remote technologies such as the GrayQb™ to characterize and stabilize conditions inside facilities prior to decommissioning to mitigate the risks to workers of potential radiological and chemical contamination and structural deterioration. SRS has permanently entombed and stabilized residual contamination and debris through in situ decommissioning of

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two SRS reactors and spent fuel pools. SRNL also has developed a sensor system for long-term monitoring of the physical and chemical stability of large nuclear facilities decommissioned in situ.

Further, SRNL has developed attenuation-based approaches to immobilize or detoxify metal and radionuclide contamination in place in the subsurface, such as a funnel and gate sequestration system, base injection to neutralize tritium and radionuclide plumes, and silver chloride injection to remove radioactive iodine.

SRNL also provides sensitivity and uncertainty analyses to predict performance attributes of chemical and nuclear treatment processes (safety and performance assessments).

### **COMMUNICATION REGARDING FUKUSHIMA TECHNICAL ISSUES**

In the aftermath of the March 11, 2011, catastrophic damage to the Fukushima Daiichi Nuclear Power Station, SRS and SRNL recognized that the skills and knowledge we had developed over almost sixty years of nuclear experience could assist the Japanese in their recovery effort. As described above, those skills and knowledge encompass both nuclear plant operation and disposition of nuclear and other hazardous wastes, materials, contamination, and facilities. More importantly, we wanted to help. We reached out initially through government-to-government channels and then began to engage directly with the Japanese company responsible for conducting the power station clean-up.

In the immediate aftermath of the accident, SRNL sent personnel to Japan as part of the DOE Radiological Assistance Program to assess the consequences of releases. SRNL personnel also served on the Nuclear Energy Response Team, providing information on experience and options for treating radiologically contaminated water. SRNL served on the Science Advisory Panel that counseled the Secretary of Energy on U.S. impacts of the accident. SRNL assisted the Government of Japan as part of the DOE Consequence Management Home Team, analyzing approximately 250 soil and air samples.

SRNL participated in the first Japan/U.S. DOE Workshop in October 2011 in Tokyo, Japan; the workshop was designed to bring experienced U.S. DOE researchers together with Japanese personnel to facilitate sharing of clean-up experience and lessons learned from implementation of state-of-the-art technologies. SRNL sent additional researchers to the second Japan/U.S. DOE Workshop at the Hanford site in early February 2012 to further pursue technical discussions as well as to talk about policy and planning.

Following up on those workshops, SRNL provided written responses to more than one hundred technical questions from Tokyo Electric Power Company (TEPCO), operator of the Fukushima plant. In late February 2012, SRNL hosted a TEPCO delegation at SRS for a series of technical discussions on a broad range of topics pertinent to the Fukushima clean-up. A delegation from SRNL and Pacific Northwest National Laboratory (PNNL) then toured the Fukushima site itself in September 2012.

As the response effort evolved and the Japanese were better able to assess the situation and share their assessment, those who were responsible for the clean-up and those who were prepared to offer their expertise to help accomplish the clean-up held more specific discussions. Those more specific information-sharing exchanges among SRS/SRNL, DOE, other national laboratories, the Japanese government, and Japanese industry identified particular areas of technical need and led to direct collaboration on solutions. In October 2012, a group of technical experts from SRNL and PNNL spent one week in Japan conferring with technical experts from TEPCO about those identified needs and the feasibility of alternate solutions.

In the two years since the earthquake and tsunami, the global nuclear community has coalesced into a more coherent entity as it strives to respond to the greatest disaster within its ranks in the twenty-first century. SRS and SRNL are integral players in that response because of our unique and successful history of deploying innovative technical solutions to complex environmental challenges.

E•SRS provides the mechanism to expand our traditional site-centric roles to serve as national and international resources.

## **CLOSING**

Facilitated by E•SRS, the expanded roles of SRS and SRNL—and our engagement in Japan in particular—have the benefits of strengthening the U.S. Environmental Management program through knowledge and experience in conducting business in Japan/Asia and a unique opportunity to bring critical technical knowledge back to U.S. as well as international credibility and demonstrated ability to negotiate successfully on the world stage.

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