WM2014 Conference Panel Report

PANEL SESSION 84: Innovations to Nuclear Decontamination and Decommissioning: Progress in Fukushima

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Panelists:

1. **Kazuhiro Suzuki**, *Executive Director, International Research Institute for Nuclear Decommissioning (Japan)*
2. **Andrew Szilagyi,** *Director, D&D and Facility Engineering Program, US DOE*
3. **Jeff Griffin**, *Associate Laboratory Director, Savannah River National Laboratory*
4. **Sang Don Lee**, *Embassy Science Fellow to Japan 2013, US Environmental Protection Agency*
5. **Mark Triplett,** *Embassy Science Fellow to Japan 2013, Pacific Northwest National Laboratory*

Panelists from Japan and the U.S. familiar with the nuclear clean-up in Japan described the unprecedented and complex clean-up challenges, both on-site and off-site from the Fukushima Daiichi Nuclear Power Station, and efforts undertaken to implement innovative approaches and technologies to address the challenges and identify what is still unknown. A question and answer session followed.

Summary of Presentations

Kazuhiro Suzuki addressed the Importance of Innovation for D&D at Fukushima Daiichi Nuclear Power Station (NPS). Mr. Suzuki described the complex and extremely adverse conditions of the devastated Fukushima Daiichi reactors and reactor buildings. Those conditions included high dose rate, high temperature, high humidity, rubble, elevated places, narrow places, places under water, and continual injection of water. Mr. Suzuki outlined the current efforts of the International Research Institute for Nuclear Decommissioning (IRID) to identify innovative approaches to deal effectively with those conditions that collectively are unprecedented. Mr. Suzuki focused upon one of the first tasks that must be performed toward decommissioning the reactor facilities, retrieval of reactor fuel debris. IRID is seeking assistance from industry, academia, and government-affiliated agencies globally through a phased approach. That phased approach includes issuance of a Request for Information to identify innovative approaches to fuel debris retrieval followed by workshops in locations around the world to discuss the information received and encourage follow-up collaboration among entities with complementary approaches. Requests for Proposals are then issued; follow-up workshops are held; and ultimately, the research and development program for fuel debris retrieval is formulated and executed. A consequent hurdle will be disposing of the huge volume of radioactive waste.

Andrew Szilagyi described three examples of technologies pursued by the Department of Energy (DOE) to support U. S. decommissioning of nuclear facilities with potential applicability at Fukushima:

1. DOE collaborated with CBI Polymers, Inc. to optimize DeconGel®, which is spread or sprayed on surfaces contaminated with radiological and/or hazardous chemical substances, allowed to dry, and then peeled away, taking with it the encapsulated contaminants. DeconGel® was used in Japan in the wake of the Fukushima Daiichi NPS crisis.
2. In accordance with established regulatory review and approval processes, DOE developed the scientific basis to decommission large nuclear facilities *in situ*, avoiding the potential hazards and costs of demolition. Entombing two large reactor complexes at the Savannah River (SRS) established a roadmap for in-situ decommissioning (ISD) of other large nuclear facilities in the U. S. and around the globe. A third SRS reactor is being prepared for ISD.
3. DOE has developed an innovative process that could replace hazardous, time-consuming, and costly traditional survey methods to determine the extent of radiological contamination in facilities: scintillating phosphor is sprayed on the surface, and if it lights up, it's a hotspot of radioactivity. DOE is currently investigating use of the spray in the U.S. nuclear clean-up program.

Jeff Griffin presented an overview co-authored with **Wayne Johnson**, Pacific Northwest National Laboratory (PNNL), on Innovations in Nuclear Decontamination and Decommissioning: Global Support to Fukushima Challenges. Dr. Griffin pointed out that the circumstances at Fukushima were unprecedented; for example, unlike Chernobyl, the reactor meltdowns occurred immediately following a pair of catastrophic natural disasters, and unlike Three Mile Island, the radioactive contamination was dispersed widely. Prompt, practical application of innovation and technology was therefore imperative to address the vast and complex challenges both on the reactor site and in the population region off-site. Those challenges included every category of nuclear remediation, such as management of waste and application of grouting technologies, as well as the sub-elements of each. For waste management, for example, those sub-elements would include waste forecasting, identification of key radionuclides, and evaluation of treatment and disposition options. Recognizing that collaboration with the global nuclear community would expedite discovery and application of innovative technologies, Japan had solicited input and pursued collaborations worldwide. Ongoing U. S. DOE support included formal work-for-others agreements between the U. S. National Laboratory partnership of SRNL/PNNL and Tokyo Electric Power Company (TEPCO); the mission of the U. S. Embassy Science Fellows; and U. S. technical expert support to IRID. Dr. Griffin concluded by noting that the knowledge exchanged through international engagement benefited not only Japan but the global nuclear community as well.

Sang Don Lee reviewed the Progress of Offsite Decontamination in Fukushima. Dr. Lee was one of the three U. S Embassy Science Fellows (ESFs) supporting the efforts of the Government of Japan (GOJ) Ministry of the Environment (MOE) to remediate the region off-site from the Fukushima Daiichi NPS. Focusing upon the key challenge of decontamination, Dr. Lee described the contaminated region off-site from the NPS, including the Special Decontamination Area and the Intensive Contamination Survey Area, which are defined by lesser and greater levels of dose rates per year. Dr. Lee recommended that because residents were beginning to be allowed to return to some low-dose areas within the Special Decontamination Area, urgent radiation protection strategies for people living in areas with residual contamination (re-entrainment) and for re-population of evacuated areas should be developed and applied. Dr. Lee described methods used to decontaminate various surfaces as well as decontamination results. Dr. Lee recommended that MOE and its contractors optimize decontamination efforts by

employing the systems perspective provided by the ESFs. Specifically, he recommended development and maintenance of a comprehensive decontamination strategy complete with life-cycle cost estimates, resource (e.g., manpower) allocation strategies, and critical strategic alternatives. Feeding that decontamination strategy would be the results of regular environmental monitoring and dosimetry as well as the results of systematic evaluation as to how well individual decontamination methods performed in particular applications. Periodic evaluations of the interactions of decontamination efforts with other elements of the overall remediation framework—such as understanding cesium behavior in the environment and long-term monitoring—would optimize the decontamination strategy as well as improve the other components of the overall remediation.

Mark Triplett presented an overview of Remediation and Waste Management Challenges for Fukushima Offsite Recovery Efforts. Mr. Triplett described what he and the other two U.S. ESFs had observed and recommended during their two-month mission to Japan in February-March 2013 and in subsequent interactions with Japan. The ESF mission was to provide expert support to GOJ MOE in its clean-up efforts in the region off-site from the Fukushima Daiichi NPS. Mr. Triplett focused primarily upon two key challenges to the clean-up off-site: 1) remediation of population areas to enable citizens to return and 2) management of the enormous volumes of waste generated by decontamination efforts. The challenges of remediating population areas to allow citizens to return included allocation of resources among the areas for which municipal governments were responsible and those for which the national government was responsible; completion of full-scale remediation in low-dose portions of the evacuation zone; recovery of economic and community infrastructure; compensation; and determination of the viability of full-scale remediation in high-dose areas. Mr. Triplett also described the current strategy for waste management, which comprises decontamination of diverse surfaces and at-location storage of the decontamination waste, followed by transfer of waste to Temporary Storage Facilities for up to 3 years, then transfer to Interim Storage Facilities for up to 30 years, and, ultimately, transfer to Disposal Facilities within 30 years. Challenges of that waste management strategy include thousands of storage locations, the design and locations of Interim Storage Facilities, transportation to storage and disposal facilities, volume reduction, and final disposal.

Questions and Answers

In response to the observation that Japan seemed reluctant to engage U.S. businesses in the clean-up at Fukushima, Jeff Griffin pointed out that since 3/11, Japan had been in upheaval, undergoing institutional and social changes similar to those the U.S. underwent after 9/11. Dr. Griffin also noted that before 3/11, TEPCO had been a power company but suddenly had been thrust into the unfamiliar roles of emergency management, decommissioning, etc. Mark Triplett said that the U.S. Embassy in Japan was working with Japanese agencies and companies to find means of engagement. Mr. Suzuki said that IRID had been established in August 2013 to actively seek engagement from foreign companies, government agencies, and universities.

Paul Bredt of PNNL observed that in the U.S., a risk-based approach is taken to closure of radiologically contaminated sites. Mr. Triplett agreed that normal clean-up standards did not apply to emergency conditions. Sang Don Lee said that the clean-up goals in Japan were necessarily evolving.