WM2014 Conference Panel Report

PANEL SESSION 99: Technology Support and Implementation for Clean Up of Fukushima Daiichi NPP

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Panelists:

1. **Wayne Johnson,** *Director, Energy and Environmental Sciences, Pacific Northwest National Laboratory*
2. **Robert Sindelar,** *US Embassy Science Fellow to Japan 2013, Savannah River National Laboratory*
3. **Irena Mele,** *Special Advisor, Division of Nuclear Fuel Cycle and Waste Technology, IAEA (Austria)*
4. **Paul Flemming,** *Director, Transformational Growth, Nuclear Services, AMEC (United Kingdom)*
5. **John Raymont,** *President, Kurion, Inc.*
6. **James Braun,** *President, AVANTech, Inc.*

This panel session focused on the continued global support for Fukushima clean-up efforts. Representatives from the U.S. Department of Energy (DOE), national laboratories, and industry who had been involved in nuclear clean-up described particular clean-up challenges faced by Japan both on-site and off-site and some of the ways U. S. nuclear entities were assisting Japan to identify, develop, and implement practical solutions. A brief question and answer session followed.

Summary of Presentations

Wayne Johnson presented an overview co-authored with Jeff Griffin, Savannah River National Laboratory, on Technical Support and Implementation for Cleanup of Fukushima Daiichi – Groundwater Challenges. For the last two years, an SRNL/PNNL integrated team has been providing technical support to Tokyo Electric Power Company (TEPCO) in its effort to clean up the Fukushima Daiichi Nuclear Power Plant (NPP) site. One of the areas in which TEPCO has requested support from the SRNL/PNNL technical team is addressing the complex groundwater challenges. The overview described the principal groundwater challenges, technological solutions, and cross-cutting actions at Fukushima Daiichi NPP. Groundwater challenges include source control, minimizing impact to the harbor, and hydraulic control. Source control actions underway include removal of contaminated water and isolation of seawater intake pipe and cable trenches; seaside pump and treatment of contaminated groundwater along with stabilization of the subsurface; second-generation tank storage, revetments, leak monitoring, and runoff control to prevent leakages from water storage tanks; and development of feasible alternatives for isolating Reactor and Turbine building basements. Harbor impact minimization actions underway include construction of a sea-side impermeable wall; conduct of a feasibility study for a land-side frozen soil barrier; and testing for potential use(s) of permeable reactive (Apatite)

barriers for sequestering Sr-90. Hydraulic control actions underway include design, construction and testing of systems for groundwater bypass, sub-drain pumping, and pumping and treating water near the harbor. A number of cross-cutting efforts also are being undertaken to support full implementation of groundwater countermeasures, including site characterization plans and data acquisition, site conceptual model, fate and transport predictive modeling, source mitigation and isolation through advanced technology (including testing and demonstration of permeable reactive barriers and freeze barriers), and comprehensive monitoring plans used to understand how actions taken are affecting the overall system. The SRNL/PNNL team has been asked to provide technical assistance in a number of these areas going forward.

Bob Sindelar presented an overview of the System Perspective on Environmental Remediation of Lands Contaminated from the Fukushima Accident developed by the Embassy Science Fellows (ESFs) during their two-month mission to Japan in 2013. Focusing primarily upon the region off-site from the Fukushima Daiichi NPP that was contaminated by the nuclear explosions, Dr. Sindelar described the framework of program elements for environmental remediation of a population region contaminated by cesium developed and provided to the Government of Japan's Ministry of the Environment (GOJ MOE) by the ESFs. The inter-related program elements include radiation protection, decontamination methods, waste management system, environmental modeling, cesium behavior in the environment, and remediation strategy. Such a total system perspective is necessary to address the complexity of the off-site remediation. That complexity includes diverse surfaces contaminated by cesium, such as roads (various materials and designs), soils (agricultural soils, playgrounds), grassy fields, home lawns and landscapes, building structures (various materials and designs), roofs (various materials and designs), bodies of water, and forests. Systematic selection and maturation of advanced decontamination treatment options proposed/provided by numerous entities would benefit remediation. The objectives of an advanced decontamination approach are to leave the surface essentially intact, improve decontamination effectiveness, achieve decontamination more quickly than by present methods, and achieve decontamination more cost-effectively than by present methods (that is, by avoiding unnecessary waste handling, transportation, storage, and disposal costs). The major challenge for the off-site remediation indeed is the management of waste—its treatment, transportation, storage, and disposal—for the large volume (28 m^3) estimated for the clean-up.

Irena Mele discussed IAEA activities centered on a nuclear safety action plan adopted in 2011. Ms. Mele recounted IAEA commitments to sharing information and lessons learned as efforts for the decommissioning and remediation at Fukushima moved forward. Ms. Mele provided discussion points on the IAEA review missions related to Fukushima performed in 2011 and the follow-up performed in 2013 that observed various activities, assessed progress in remediation and special decontamination areas with respect to the IAEA advice from the 2011 review. IAEA acknowledged a shift from remediation efforts based on reducing surface contamination to use of an air dose limit and the good progress on establishing temporary storage facilities. Ms. Mele also provided specifics of a remediation strategy that could include personal dosimetry, consideration of natural processes for Cs reduction, and continued optimization of remediation of forests balanced against worker safety. Ms. Mele provided an overview of the decommissioning efforts reviewed by IAEA twice in 2013. The reviews included Decommissioning Roadmap categories of strategy and planning, current conditions, removal of spent fuel, water ingress, and reactor and primary containment vessel inspection. The reviews concluded that better

communication with stakeholders and proactive steps on contaminated water issues would be beneficial and recommended that the Japanese Ministry of Economy , Trade and Industry (METI) establish a Fukushima advisory board and that the contaminated water issue needed a sustainable solution that should not preclude releases to the sea.

Paul Flemming discussed the project management, consultation, and engineering function AMEC is working in partnership for offsite cleanup. Mr. Flemming described the difficulties of cleanup and how lessons learned in other international cleanups need to be applied. Paul also described the success of decommissioning planning that defined the end state and engaged stakeholders in the decisions. He provided insight into the importance of collaboration and technical integration. He described that AMEC has been successful working with several Japanese partners and has staff located in Japan. He went on to describe an encapsulation technology that could be an alternative to other immobilization efforts for difficult waste streams with a significantly higher waste loading. He also briefly described a leak sealing technology and the proprietary Orion ScanPlot^{SM} and ScanSort^{SM} Technology for remediation of contaminated lands.

John Raymont described the successful approach Kurion used to deliver timely solutions under emergency conditions, relating the five-week turnaround required for a deployed decontamination system. He described the process of delivering a proven system complicated by the highly dynamic requirements, and how Kurion took on the complex engineering and their customer's problems as their own to be successful in the very short timeframe. He reported they are looking at improvements to their existing system (longer Cs vessel life, higher throughput, etc.) and examining other proven treatment systems that may alleviate some of the waste congestion at Fukushima.

James Braun of AVANTech relayed their early understanding of the Fukushima waste problems and recognition that they were in a position to provide a response to the crisis. He described the complexities of the waste water and the subsequent treatment complexities at Fukushima. He described the five phase approach employed by the SARRY system and their level of knowledge and experience in the successful deployment of the system. He described the system engineering challenges they faced, which included activity capture, shielding, and thermal response. He also relayed the lessons from the effort, which included understanding the subtle differences between JASME and ASME for testing and monitoring, quality documentation requirements, efforts for continual system improvement, and good communications.

General Questions and Answers

When asked under what conditions people were allowed to return to contaminated areas, **Bob Sindelar** said that the policy of the GOJ MOE was that it was acceptable for inhabitants to return to an area in which exposure was expected to be less than 20 mSv/year. Other considerations included the condition of infrastructure and the capability for emergency response. Decisions were ultimately made by the GOJ Cabinet Office and the Reconstruction Agency. The repopulation of one city (Tamura) was underway. **Irena Mele** pointed out that some areas in the contaminated region had been determined to meet the minimum safe exposure level and ambitious revitalization initiatives (infrastructure and jobs) as well as financial compensation encouraged people to return, though it was recognized that not every former resident would

choose to return. The high levels of radiation in other areas would prohibit residents from returning there for a long time, and return to still other areas with more moderate levels of radiation would take a while. She noted that the numbers of people evacuated and returned were publicly available.

The presidents of Kurion and AVANTech were asked whether their companies had joined the response immediately after the events of 3/11 at the direction or as part of the response of the U. S. government. **John Raymont** and **Jim Braun**, respectively, said that their companies had offered their services on their own accord. **Steve Schneider**, Director, DOE Office of Tank Waste Management, noted that DOE had been working with the Government of Japan since the immediate aftermath of 3/11.

Consultant **Chuck Vandergraaf** asked whether costs to the population in addition to financial losses (e.g., suicides) were being followed. **Bob Sindelar** answered that he was not aware of government efforts to collect such data. **Gary Benda,** Senior Vice President of Business Development at AVANTech, pointed out that because the nuclear releases had followed immediately upon the devastating earthquake and tsunami, which had caused all the losses of life as well as loss of habitat and attendant emotional distress, it would be difficult to distinguish whether the nuclear accident per se was responsible for social consequences.

When asked what new technologies were being developed, **Jim Braun** said that AVANTech was pursuing full-scale deployment of a crystalline silico titanate (CST) system to remove cesium that could have implications in U.S. cleanup efforts. **John Raymont** reported that Kurion was pursuing deployment of a system to remove tritium from water that had shown improvements in the economics (power) required to perform the operation.