WM2015 Conference Panel Report

PANEL SESSION 094: Progress towards Cleanup of Fukushima Daiichi NPP

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Panelists:

- **Kazuhiro Suzuki,** *Managing Director, Nuclear Damage Compensation and Decommissioning Facilitation Corporation (NDF) (Japan)*
- **Horst Monken-Fernandes**, *Environmental Remediation Specialists, Decommissioning and Environmental Remediation Unit, IAEA (Austria)*
- **Martin Wenban**, *Vice President, Strategic Nuclear Programmes, Amec Foster Wheeler (United Kingdom)*
- ***John Raymont**, President, Kurion, Inc.*
- **Jim Braun**, *President, AVANTech, Inc.*
- **Steve Rima,** *Vice President, Radiological Services and Engineering, Amec Foster Wheeler*
- **Wayne Johnson**, *representing the US DOE National Laboratories*

About 125 people attended this panel session, which focused on the progress of U.S. National Laboratory support to Japan since the earthquake and tsunami that crippled the Fukushima Daiichi Nuclear Power Station in March 2011. The session opened with seven panelists presenting updates to actions underway, including deployment of various waste water treatment systems, observations from and international policy overview, a unique perspective on the way the country is pulling together and what the nuclear industry as a whole should be learning about recovery. The session was divided into four areas of interest 1) the actions underway within the Fukushima Daiichi operating footprint, 2) the impact to nuclear industry policy and cultural aspects of the event and what is needed to recover from it, 3) technology being deployed, and 4) the impact to the surrounding areas known as the Special Decontamination Area.

Summary of Presentations:

Current status of Fukushima Daiichi

Kazuhiro Suzuki presented an overview of the recently established Nuclear Damage Compensation and Decommissioning Facilitation Corporation (NDF) organization (August 18, 2014) and discussed the NDF roles of this government agency. NDF is to provide support for decommissioning of damaged reactors including facilitating compensation and supervise the management of TEPCO. The presentation described in detail the interfaces between the various government agencies and the road map to recovery. He offered detailed remarks on the Decommissioning Support Activities such as the strategic plan, technical support on key issues, planning of research and development and the management of progress in the R&D programs, including facilitating international cooperation. The current status of the reactors at Fukushima Daiichi was provided along with photographs that showed progress over the previous years. The strategic plan for recovery was discussed in terms of the five guiding principles for risk reduction: 1) Safety; 2) Reliability; 3) Reasonable; 4) Speediness; 5) Site reality-oriented. Suzuki-San concluded his presentation by sharing the next area of focus is strengthening

international relationships. He indicated that agreements had been reached with the United Kingdom and France and that work was underway to generate similar agreements with the United States.

International Policy and Cultural Awareness

Horst Monken-Fernandes presented the International Atomic Energy Agency's review mission and offered lessons learned associated with the remediation of large contaminated areas outside of the operating footprint. The leading lesson learned is that countries should establish Policy and Strategies on Environmental Remediation prior to an accident. Industry regulations require a certain level of planning however the magnitude of this situation brought to the forefront the need to have integrated strategies between the operating envelope and the potentially affected areas. Care must be taken in adopting conservative values as an end-point for site remediation. The adopted value should result from an optimization process. However, it is to be recognized that more guidance on how to derive these values and harmonization of procedures are needed. Remediation measures – in case that external exposure is the major component of the total dose – should be assessed in terms of individual monitoring as compared to area monitoring. This enables a more fully informed awareness of how the activities and responsibilities of the individual may need modification based on the exposure scenario.

Comprehensive monitoring schemes (food safety measures) were very effective in averting doses that might have been incurred by the population due to the ingestion of contaminated food. They also contribute to public reassurance of care being taken to protect the health and well-being. Although it may seem repetitive our industry cannot emphasize enough that communication of the entire remediation and reconstruction program is essential to reduce some uncertainties and provide greater confidence in the decisions being made. Engagement of stakeholders in the decision making process is also essential to rebuilding trust when it is lost and reassuring those who are supporters of the industry.

Decontamination is not solely the solution. Relevant activities: reconstruction, assistance and care for affected peoples, compensation etc. and decontamination work are to be implemented in a consolidated manner to fit the needs of the affected population and be tailored to the cultural needs and values. This alignment of the technological approach blended with the values of the affected populations is likely the area where we have the most to learn and share.

Martin Wenban reviewed Fukushima incident statistics for context with Waste Management Symposia attendees, based on the time that has passed we may have lost track of the magnitude of the events that occurred. The impact that this series of events has had on the global nuclear industry presents quite a challenge - perception is that everyone in the industry is part of the problem. He reminded the attendees how important it is to remember the crisis that occurred, recognize that all crises are exhausting, then debilitating. The industry stands to learn much from our Japanese colleagues through a quick overview of the difference between "Anzen" (security, safety, safeness) and "Anshin" (peace of mind, relief) and the impact it has if you lose one or lose both, trust is everything and very difficult to rebuild. The amount of progress in the short time that has passed is remarkable and a true test of the resiliency of the Japanese people.

In the nuclear industry the transition from operations to D &D is a conscious decision that requires integrated planning and carefully sequenced events. The events that occurred on March 11, 2011 necessitated the mandatory change from nuclear power operations to a D&D

organization over the course of a day. This represents a huge cultural and mindset shift in the workforce, the industrial organization and the regulatory framework. In the world of nuclear operations everything runs according to well defined procedures and protocol. In the day to day activities of D&D of the damaged facilities uncertainty is the new 'normal'. It's time for international partners to help as we already understand and work in these types of situations. While similar activities have been encountered before, the sheer magnitude of the work means there is no "blueprint" to follow, this has not been done before thus we are learning together. The global collaboration has begun with Sellafield and Fukushima Daiichi shared Memorandum of Understanding, swapping seconded employees and open Best Practice discussions.

The industry has learned is that it is important, in fact necessary, to fast track access to what works and share lessons learned as to what does not work. The international nuclear community must share the challenge to receive from this event to help restore trust in the benefits of the nuclear industry as our legacy must be to demonstrate we can correct our problems.

Technology Being Deployed

John Raymont presented the approach used by Kurion to deliver various technologies to the Japanese through focus on discriminating technologies, developing a partnership, and helping to rebuild public trust. An early indicator of the ability and desire to be a partner was the demonstrated awareness of the technical challenges and commitment to deploy an external reactor water cooling system in 8 weeks. The understanding of the challenges enables improved operations, reduced salinity and raised the decontamination factor which enabled reactor shut down ahead of schedule. As time passed being able to refine the operating design to match the changing conditions has proven to be important from both operational efficiency and demonstrated commitment to improving the site conditions. The integrated nature of the team has helped decrease the delivery time by approximately 3 months. The ability to work with the operators to develop and deploy mobile processing systems for tank water and being the first-of-a-kind at-tank isotope removal system has satisfied rigorous regulatory requirements and exceeding contracted decontamination factor goals. Many of the modular treatment systems require adaptive design approaches to enable the operators to maximize the effectiveness given the often harsh and changing conditions.

The D&D requires many first-of-a kind solutions due to the unplanned nature of this event. While classical D&D enables planning the significance of the Fukushima event has demonstrated the need to respond to those operational conditions the industry takes great strides to prevent such as explosions, melt downs, torn primary containments, cracked foundations, groundwater in-leakage and further compounded by the scale of the challenges that mirror the complexity found a nuclear plants and across the weapons complex. The partnership while underpinned by the successful use of new technology has the added benefit of helping to rebuild public trust in the institutions charged with a return to normalcy.

Jim Braun presented the approach used by AVANTech to deliver nuclear wastewater treatment in response to the Fukushima Daiichi event based on experience at DOE sites. The comprehensive evaluation of the crystalline silicotitanate had already undergone thermal, radiological and material stability testing. The emergency response nature of the event however posed new challenges with the need to capture higher levels of activity, provide adequate shielding and effectively manage the heat generation. In similar fashion to what other panelists

presented the partnership with Japanese companies and awareness of the ever-changing treatment challenges is crucial to deploying technology that provides an integrated solution. The groundwater remediation need is quite different than what the DOE sites have encountered thus far. The ability to adapt to the scale of the groundwater challenge while striving to meet remediation goals crucial to enabling the nuclear industry to stabilize in the public's view ripples across the entire industry. The design test, build and deploy paradigms all were challenged by the shortened duration and the operational demands of these systems. Multi-nuclide removal technologies are evaluated on treatment volume, number and size of units (due to small operational footprint), pre-treatment methods, seismic resistance class, removal capabilities and the waste generated. Overarching goals include multiple operations to minimize down-time, use of multiple technologies to optimize performance and maximize throughput.

The initial need to deploy technology was met and now the focus is on sustainable long term progress and continuous improvement. The use of advanced manufacturing techniques has proven valuable in customizing the system components to physically fit the application and have resulted in production capacity of 400%. Realizing the complex regulatory framework and again building upon the experience from US based requirements the advanced manufacturing concepts put in place all for efficient fabrication flow, streamlined facility operation and automated documentation. In addition to providing support to our global nuclear industry partners it's important to keep in mind that as we advance the technology and techniques for Fukushima the applicability to the US DOE EM cleanup must be considered as well.

Remediation Challenges

Steve Rima presented a perspective on the lessons learned related to the remediation challenges in the Special Decontamination Area (SDA). As a result of the damage to Fukushima Daiichi from the tsunami, citizens were evacuated from 11 municipalities less than 20 km from the nuclear power plant or where the annual cumulative dose is estimated to be greater than 20 mSv (2000 mrem). The land mass included in the SDA was approximately 1300 square kilometers. Additionally an Intensive Contamination Survey Area (ICSA) was established. The ICSA encompassed 104 municipalities in 8 different prefectures based on an air dose rate equivalent to greater than 1 mSv/yr was observed. In these areas the decontamination was implemented by each municipality based on the needs of their citizens and primary economic industry constraints.

Immediately the challenge of waste management was evident. The volume of storm related waste to be managed is alone astounding. To compound the problem the SDA and the ICSA began decontamination measures immediately in some cases with no oversight or preplanning for the generation and subsequent management of the radioactive waste. The most pressing matter was the absence of an existing disposal option for radioactive waste within the country. The diverse nature of the waste being generated and the rate of generation is something not previously experienced by the nuclear industry. As mentioned by other panelists the effect the Japanese culture would have on the recovery from such an event is another source of lessons to be learned. In this case many property owners outside of the SCA began remediation of their property with no oversight or expectation of the government performing the service. The primary approach taken by citizens was physically removing all of the surface soil to a discrete depth and burying the removed contaminated soil on site; pressure washing and grinding surfaces were the primary methods of decontamination used by the citizens. The challenge this poses in understanding where the contaminated materials have been relocated to and how to

factor these waste streams into the comprehensive interim storage plans. Technological approaches have been used to scan large areas of land to look for hot spots and enable planning of an interim storage facility concept. The Japanese are eager to incorporate lessons learned from the global nuclear industry on mature approaches to minimize and treat the huge volume of waste that is being generated as a result of the cleanup.

Wayne Johnson presented information of the role of the national laboratories in support of cleanup. These areas address items such as complex site cleanup challenges using a risk-informed / systems-based approach; engagement with various elements of the government of Japan; current partnership with Tokyo Electric Power Company and direct support on high priority initiatives, specifically water management. The national laboratories role in clean up within the DOE EM complex is to provide the technical underpinning enabling cleanup decisions and technology development and deployment to address high level tank waste and to provide scientifically defensible exit strategies for active remediation systems and resolving subsurface cleanup challenges. In this role the laboratories have strong partners with the contractors charged with executing the cleanup scope. This model of engagement aligns well with the desire from the Japanese to bring in proven technology and offers opportunity to test new approaches in conditions not experienced before.

Complex site clean-up requires a risk-informed/systems-based approach and the DOE EM complex has been dealing with many of the same challenges now presented to the Japanese. The Fukushima recovery brings with it with added challenges of high dose rates, contamination levels, damaged facilities and historical operating data (versus site characterizations data) to inform decisions. The model used by the DOE EM complex is to develop and deploy enabling tools, technologies and processes that are timed for incorporation into facility life-cycle at the end of operation continue through deactivation, surveillance & maintenance and enable decommissioning. Being able to integrate D&D through the understanding of the nature and extent of the contamination as environmental remediation an end states are determined helps ensure data collection and use is optimized.

DOE –EM has partnered with the Ministry of Trade and Industries (METI) and the Ministry of Environment (MOE) to conduct joint workshops, assign Embassy Science Fellows, participate on a bilateral working group and hosts several visits and tours in specific areas of interest. The national laboratories are engaged in collaborative research with the Japan Atomic Energy Agency (JAEA), International Research Institute for Nuclear Decommissioning (IRID) proposal review team, development of Muon detectors with Toshiba and Nuclear Compensations and Decommissioning Facilitation Corporation (NDF) development of risk-informed planning methodologies. In addition to these activities the complex water management challenges faced by TEPCO is one of the most urgent priorities and is the focus of much of the work of an integrated national laboratory team under contract to TEPCO.