WM2015 Conference Panel Report

PANEL SESSION 052: **SRS Innovative Technology Integration Means Success – Part 3 of 3**

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Panelists:

- **Jim Folk**, *Deputy Director and Assistant Manager, Waste Disposition Project, US DOE Savannah River Office*
- **Sharon Marra**, *Acting Associate Laboratory Director, Savannah River National Laboratory*
- **Kent Fortenberry**, *Chief Engineer, Savannah River Remediation*
- **Tom Burns**, *Vice President and Director of Engineering, Parsons*
- **Monica Regalbuto**, *Associate Principal Deputy Assistant Secretary, US DOE – EM*

This report summarizes the final of three panels convened at the 2015 Waste Management Symposium to discuss innovations in technology and integration used to accelerate DOE-EM missions at the Savannah River Site (SRS) in Aiken, South Carolina. The panel was composed of leaders from the SRS liquid waste contractor, the contractor for construction of the Salt Waste Processing Facility (SWPF), Savannah River National Laboratory (SRNL), and the Department of Energy, both at the Savannah River Field Office and EM Headquarters. Highlights of recent technology integration efforts were discussed by each panelist.

Summary of Presentations:

Jim Folk discussed DOE's focus on technical integration at SRS, both what has been done over the past several years and what is needed in the future. His presentation provided a general overview of SRS activities as well as future endeavors, and focused first on the flow sheet for the liquid waste system. It was noted that there are no missing, unknown, or future components in the SRS liquid waste flow sheet. The system is up and running, although there are several opportunities to improve performance with new technology and innovation, as will be highlighted here. The challenge is to identify the most impactful improvements with the current situation of limited funding. While there is little ability to control funds or unexpected issues, DOE has leveraged its ability to look ahead to find opportunities for process improvements. Examples include:

- Opportunities to reduce risk – Implementation of the next generation solvent at the ARP/MCU Facility
- Integrating with new facilities – Bringing SWPF online on time
- Upgrading aging infrastructure and equipment
- Meeting and accelerating production demands – e.g., when salt processing is providing feed to DWPF, there is only a few days of storage space available; thus, each unit operation has to run effectively in order to keep entire system on line

Challenges remain in addressing the SRS liquid waste inventory. For example, waste rheology is difficult to address (e.g., difficulty in pumping sludge long distances). There may be alternatives or solutions available in industry than can be utilized. Other waste processing needs pose challenges, such as tank integrity during waste storage and retrieval; standard methods don't work due to unique complexities of the systems (e.g. cooling coils). The amount of water currently needed for tank waste retrieval is difficult to handle (e.g., 1.3 million gallons of salt cake results in roughly 3 million gallons of dissolved salt).

An example of addressing challenges at SRS is the use of interim salt waste processing facilities. These facilities have been used to develop and demonstrate the basis for SWPF operation. SWPF will reduce the waste volume sent for vitrification by using technologies already demonstrated via the interim facilities, and will ultimately process over 90% of SRS tank farm liquid radioactive waste. Another example is the design and construction of new Saltstone Disposition Units (SDUs). A large amount of effort has been directed toward evaluating the performance of the disposal facility. Success has been demonstrated in tank closure, with six waste tanks closed and two more in process. Contractor innovations have accelerated tank closure, such as the use of skilled mechanics to solve issues with tank cleaning robots. Experience with the application of technology can be equally as valuable as innovative engineering.

Sharon Marra discussed the importance of integration as a key part of technology and innovation. The entire solution has to be considered – basic science to deployable technology. Teaming across the SRS and across the DOE complex is important to achieving success. The value of an integrated approach has been recently demonstrated via advances at DWPF and interim salt processing. Along with the addition of bubblers to the DWPF melter, there have been significant improvements in chemical processing and glass formulation. The transition from a global approach – blending waste to a fairly uniform composition – to a batch approach with glass frit compositions tailored to specific waste compositions has allowed for waste loading increase from 25% to 40%. This integrated change in strategy has resulted in a significant reduction in canister count, mission life, and cost. Glass melting rate is impacted by chemical processing of the waste prior to being fed to the melter. Additions of formic and nitric acid are used in the baseline process to control redox and rheology, and steam strip mercury. However, this process can produce hydrogen, which requires flammability controls. Replacing formic acid with glycolic acid in the pretreatment process can alleviate flammability concerns. Teaming has been used effectively to integrate innovative ideas from researchers with the practicality understood by facility operations staff. The result is that the operating windows have now increased, providing more processing flexibility for the facility.

Examples of the success of integrated teams can also be found in interim salt processing. The Next Generation Solvent (NGS), which is new to an operating radioactive facility, was developed from a basic science study at Oak Ridge National Laboratory (ORNL). Since the NGS cannot be implemented without developing a new technical baseline, pilot and full scale testing was conducted at SRNL, including characterization of mechanical properties, other physical testing, and chemical performance validation. This approach also provided an opportunity for facility operators to see a full scale system prior to implementation, and included analytical and real waste testing. The system served as a test bed for off-normal conditions, providing for the development of response procedures prior to field implementation.

Teaming of engineers, scientists, and operations staff across the SRS has been successful in developing solutions that can be implemented in operating facilities. The teams span the development from preliminary modeling to development, testing with simulants and real waste, and deployment in the field. For example, cementitious materials are used extensively at SRS – in waste forms, tank closure, and in-situ decommissioning of facilities such as SRS reactors. In all cases, technology and lessons learned from development of the Saltstone waste are used to accelerate these other missions. This innovation extends beyond SRS, via technology transfer to other DOE sites, and internationally. It is recognized that there is no desire to build large scale EM facilities; instead, teams focus on Process Intensification – increasing productivity with smaller footprints – as demonstrated to be viable for various processes at SRS, like interim salt processing.

Kent Fortenberry discussed the challenges, opportunities, and successes involved with an operating liquid waste processing system. Technology improvements in each part of this system were illustrated throughout the symposium through panel discussions and presentations. In addition to accelerating the mission, there are also opportunities to reduce risk, such as personnel exposure, etc. A consistent challenge is working around aging infrastructure issues. Glass waste storage was first given as an example of a recently identified opportunity. The DWPF is close to completing 4000 high level waste (HLW) glass canisters. SRS currently has 4583 canister storage spaces, although the total mission is estimated to require a total of 8500-8600 canisters. The current storage capacity is projected to be exceeded in fiscal year 2019. Thus, there is a need to either create additional storage or innovate with the currently available facilities. In the SRS glass waste storage buildings, canisters are stored above a poured concrete floor in storage rack below a thick operating floor and covered with a shield plug. Conservatism has been identified in the facility cooling requirements, providing an opportunity to double stack canisters in the existing facilities. This would involve removal of the support bars and redesign of the shield plug to double stack canisters, while maintaining adequate shielding for operators. Considerations include the heat load, seismic safety, etc. The double stack strategy would provide storage capacity through fiscal year 2026, eliminate the need for construction of a third building glass waste storage building, and defer interim storage (pad waiting for transport) to FY18. This project is now underway.

Several improvements are under development for the Saltstone Disposal Facility. Processing improvements, such as the development of a cement free grout formulation, will provide operational flexibility, as well as cost and facility equipment advantages. Studies on Technetium release from grout to are underway to confirm performance assessment assumptions. New, large scale disposal units are being designed and constructed. SDUs at SRS initially transitioned from rectangular units to cylindrical tanks, each with a capacity for about 3 million gallons of grout. A further transition to 30 million gallon units based on commercial water storage tanks is underway. These large scale units are projected to be half the cost per gallon as compared to 3 million gallon tanks, with an estimated $300M lifecycle cost savings. Integrated teams evaluated the higher grout drop height, longer grout flow distance, and the expected effects of multiple cold joints on the strength and hydraulic properties of grout poured into the large scale tanks. The first of these units is about 50% complete, and on track to receive grout in fiscal year 2017.

Other examples of innovation in the SRS liquid waste system were briefly reviewed. In the tank integrity program and tank closure, increases in efficiency and improvements in accuracy have been achieved via the use of sonar waste volume measurements, laser determination methods, and untethered crawlers for residual waste sampling and characterization. Specifically, the use of sonar provides a potential opportunity to determine the amount of waste remaining in a tank without draining residual water. This alleviates tank volume and water management challenges. Use of untethered crawlers has eliminated issues with entanglement of the tether, and challenges with in-tank battery charging are being addressed.

Thomas Burns reviewed status of the Salt Waste Processing Facility (SWPF), a first of a kind capital project. SWPF is about 83% complete, with 91% of the mechanicals installed and 76,000 welds complete. Cabling and instrumentation are now being installed. Integration of the SWPF into the SRS liquid waste flow sheet has been a focus of recent technology innovation efforts. Technology development among DOE, Parsons, SRR, and SRNL has been successful in demonstrating safety, enhancing plant availability, and increasing plant throughput. The result of these efforts is that there are no open technical issues remaining for the facility.

Full scale and large scale air pulse agitator (APA) testing (similar to pulse jet mixing) was completed for SWPF. APA involves no moving parts, has high reliability, and demonstrated mixing capability. The Defense Nuclear Facilities Safety Board (DNFSB) closed all SWPF mixing questions in a December 2013 report to Congress. SRNL rheology measurements established key physical parameters supporting APA testing, using sludge and MST simulants.

Monthly exchange meetings with DOE, Parsons, SRR, and SRNL provided a beneficial exchange of lessons learned, several of which have been incorporated into the SWPF design to improve plant availability and maintainability. Examples include new pump designs to preclude unplanned maintenance and enable rapid recovery from unplanned high solvent carryover, as well as the addition of a capability to flush the contactor vent system to minimize maintenance down time. The anticipated facility throughput has been increased via full scale cold CSSX testing by Parsons. The work demonstrated an increase in throughput from the 6M gallons per year baseline up to of 9M gallons per year. Testing identified hydraulic operational parameters to achieve stability at 100% of contactor rated flow.

The next generation solvent, developed through a partnership between ORNL and SRNL, allows less solvent to be used to achieve the required decontamination, facilitating higher throughput and an equivalent capacity of up to 12M gallons per year. Testing of the NGS is now underway with the interim salt processing facilities, with preliminary results demonstrating superior decontamination factors. Testing with a higher concentration salt feed, as recommended and supported by DOE-SR, may provide for an effective throughput capacity of more than 15M gallons per year. Overall, the integrated approach to salt waste processing has developed a complete liquid waste solution path, with support from DOE-EM, South Carolina state regulators, operating contractors, and national laboratories.

Monica Regalbuto provided closing comments and acknowledged the outstanding work of DOE-SR and the SRS contractors. SRS missions have been accelerated despite aging infrastructure and a challenging funding environment. Teaming has been used successfully to integrate innovative technology into operating facilities while maintaining safety. These innovations are transferrable to both other DOE sites and other nations. The commitment to safety, innovation and, compliance at SRS is leading to success. Most of the straightforward challenges have been addressed at SRS, and there is now a need for focused innovation to solve remaining problems. Integration of technology and D&D with advanced processing is putting great ideas into practice; these are not just paper solutions but demonstrated improvements. The examples discussed by the panel have all reduced lifecycle costs and provided for the integration of process, products, and innovation. Innovation needs to be valued as a core product as it is key to site success. The DOE-EM mission is complex and requires building upon successes realized at various sites. EM missions across the DOE complex align with global challenges in the nuclear industry.