Future Direction of Science and Technology at SRS

Susan Wood

Abstract

The future for the Savannah River Site (SRS) is bright as we move into the new millennium. Several new missions are underway or are being planned for SRS that will revitalize the Site and set the future direction of science and technology. SRS has been selected as a key asset and resource to continue to support the Department of Energy's three Stewardship programs:

- Stockpile Stewardship
- Nuclear Materials Stewardship
- Environmental Stewardship

Mission responsibilities are projected for at least 30-40 years, expanding considerably beyond the current canyon and facility capabilities present today. Extensive new facility construction projects are planned for plutonium and tritium processing facilities over the next 10 and possibly 15 years.

The technological challenges of the upcoming missions make this an exciting time to be involved in science and technology at SRS. Research, development, and technology application will provide major contributions to ensuring these new facilities operate with today's requirements for nuclear materials management, security, and safety. The Site will exploit the rapid pace of technology development in commercial industry, but reapply these technologies for the specific environments and remote operations unique to SRS processes. Extensive partnering with National Laboratories for joint research and development and technology transfer to SRS is ongoing and will expand. Each stewardship program will be discussed individually with respect to mission and science and technology needs

Nuclear Weapons Stockpile Stewardship

SRS is the only DOE site that has produced tritium for the stockpile and still performs routine tritium recovery and recycle operations. Field units are refilled with purified gas, and excess capacity is stored for future use. Separations and storage processes, which use solid-state technology, rely on continued research and development to support efficiency enhancement.

Because tritium reservoirs are experiencing longer field life, there is an increased emphasis on data collection and analysis from the reservoir surveillance and life storage programs to ensure material behavior can be predicted. This leads to an ever-increasing need for computational tools to analyze large and complex data sets for trends and changes.

In the coming years, the new Stockpile Missions for SRS are expected to include tritium extraction from rods irradiated in the Tennessee Valley Authority (TVA) reactor (the Commercial Light Water Reactor [CLWR] option for tritium production). In the Tritium Extraction Facility currently being designed with a capital investment of $400 million, there are two areas of major technical challenge—remote operations and tritium extraction. Bundles of long target rods received from TVA will be handled, and the entire process will be sequenced remotely. The extraction process will use geometries and temperatures very different from those used in the previous SRS facility because of different target configuration and composition. Process verification and technology integration are key to operational success.

Another potential new mission for SRS is Pit manufacturing, or the manufacturing of plutonium weapons components for the enduring weapons stockpile. Los Alamos has a small capacity for Pit manufacturing but recent Congressional reports delineate a national need for a higher production capability. DOE has stipulated that a new pit production facility will use the process steps employed at Rocky Flats, thus limiting R&D for new materials processes. However, the environmental, safety, and security requirements of this new facility stipulate next generation glovebox operations and scrap recycle. It is anticipated that DOE will begin in the NEPA process for the large-scale pit manufacturing facility by FY02.

Nuclear Materials Stewardship

SRS continues to stabilize and store materials left from the Cold War era, including support for the cleanup of Pu residues and other nuclear materials (including spent research reactor fuel) from other DOE sites such as Rocky Flats and Hanford. This effort requires ongoing flowsheet development for stabilization and disposition of previously unprocessed materials such as Rocky Flats Sand Slag and Crucible. Expanded storage of Pu necessitates new safeguards and securities technologies for surveillance, inspection, and non-destructive assay (NDA). International Atomic Energy Agency (IAEA) oversight requirements drive the development and implementation of remote monitoring and measurement capabilities with real-time data analysis and long distance communication. This is one area where advanced sensors and measurement systems will make a major contribution, ensuring unique signature analysis of each package, its integrity, and security.

The need to disposition surplus plutonium from pits, metals, and oxides has also provided major opportunities for technology development to support the Plutonium Immobilization Program (PIP) and the Pit Disassembly and Conversion Facility (PDCF). Together with the Mixed Oxide (MOX) Fuel Fabrication Facility, these facilities are scheduled for start-up during the period 2006–2008. The PIP will implement a process to produce stable Pu-containing ceramic "pucks" that are subsequently loaded into canisters to be filled with radioactive glass by the Defense Waste Processing Facility. This is the "can-in-canister" concept.

Significant development has already been accomplished by the PIP but the PDCF has some major challenges, particularly given the variety of pit designs it will be required to handle. In addition to scale-up of the metals conversion process, there are major R&D needs in remoting the disassembly of incoming components. In-plant safeguards and security technologies are essential. Implementing processes to meet safety and radiation control requirements needs detailed modeling for design input. SRS is teamed with LLNL, lead laboratory for PIP and LANL and lead laboratory for Pu conversion, in bringing these missions to reality.

SRS will continue to manage research reactor spent nuclear fuel well into this century. "Melt and Dilute"—undergoing development by SRTC—has been recommended as an alternative technology to aqueous processing. Pilot-scale facility implementation in process in L Area and a new Treatment and Storage Facility (TSF) has been proposed for installation in L Area to make the fuel ready for dry storage and transport to the national high-level waste repository at Yucca Mountain. The final decision on spent fuel is imminent. If "Melt and Dilute" is selected, the development work will proceed toward process optimization following pilot-scale demonstration.

Environmental Stewardship

Overall, this area requires technologies for acceleration of cleanup, closure, decontamination, decommissioning; for reduction of risk and cost; and for long-term stewardship. SRS, with its DWPF vitrification facility, leads the DOE complex in the treatment of high-level waste (HLW). We are also meeting or exceeding schedules for cleanup of groundwater contamination and legacy waste sites. But, major challenges remain.

As of this writing, the alternative HLW salt treatment technology has not yet been selected. In partnership with several National Laboratories, parallel R&D continues on options that include small tank tetra phenyl borate (TPB) precipitation and crystalline silico-titanate ion exchange. Once the final down-select has occurred, process optimization will be required. Current and projected HLW inventories at SRS drive the need for an operational facility by ~ 2008.

In addition, new technologies for removing HLW from tanks and new formulations for tank closure are also needed, together with the ever present requirement for improved cost effectiveness for DWPF. Pursuit of increased waste loading and plant throughput (including enhanced system life) are key approaches to accomplishing this latter objective.

For environmental remediation activities, there is a continuing need to deploy new technologies to reduce cost. There is, however, also a significant new emphasis on monitored and/or accelerated natural attenuation for subsurface contaminant cleanup. Application of soft-computing technology, such as neural networks and genetic algorithm technologies, will expand and allow better integration of multi-dimensional factors for determining improved approaches to management and remediation of waste units. Enhanced understanding of exposure pathways and transfer coefficients is necessary to determine appropriate aquatic and sediment compliance limits. Risk management and impact assessment of contamination on environmental media continue to be important areas of study.

Finally, there is now recognition of the need to develop more cost-effective, reliable technologies for long-term monitoring of waste and waste unit closures. This long-term stewardship responsibility encompasses the need to ensure closure integrity or provide corrective actions, if needed.

Decontamination and decommissioning (D&D) will mostly seek to exploit technologies developed by the commercial marketplace. There will be a continuing need to ensure appropriate application and tailoring of these technologies for SRS needs, particularly as the D&D program transitions to dealing with large-scale facilities. There are also areas of technology that are poised for further research and development, such as bioprocesses for chemical decontamination of surfaces.

Summary

Science and technology are critical to the future of SRS. DOE's three stewardship programs and the new missions they bring will set the future direction of Science and Technology (S&T) at SRS. The S&T demands will continue to be varied, covering many areas of research and disciplines, and range from fundamental research to technology tailoring and application. Our strategy for supplying the most effective S&T will be to partner with National Laboratories, universities, and industry. Effective technology transfer will be critical to our success. SRS will ensure implementation of the best and most cost-effective technology to ensure safe, secure nuclear materials management. SRTC will continue to do what it does best: "We put Science to Work."

Biography

Susan Wood, Vice President and Director
Savannah River Technology Center, WSRC

Education
Victoria University of Manchester
Bachelor of Science, physics, 1969
University of Pittsburgh
Master of Science, metallurgical engineering, 1973
Ph.D., materials engineering, 1976

Experience
In her position as vice president and director of the Savannah River Technology Center (SRTC), Susan Wood brings to the Savannah River Site (SRS) many years of experience in industrial research and development executive management in Westinghouse Electric Corporation. In her present assignment, she is responsible for managing SRTC research and development programs and activities in support of the U.S. Department of Energy and SRS operations. The center is an applied R & D organization active in transfer of technology to American industry, industrial partnerships, university partnerships, and economic development initiatives.

She came to SRS from several years in at Westinghouse Electronic Systems in Baltimore, Maryland.; most recently as manager of the Manufacturing Technology Department. She served as the chief manufacturing engineer representing Electronic Systems at Air Force Systems Command.

She also served as general manager of the Materials Technology Division and in other research management positions at the Westinghouse Science and Technology Center in Pittsburgh, Pennsylvania.

She holds patents in materials engineering and has performed extensive work in advanced analytical techniques with a wide variety of materials, and is the author of more than 30 papers for scientific journals, seminars, reports, and presentations.