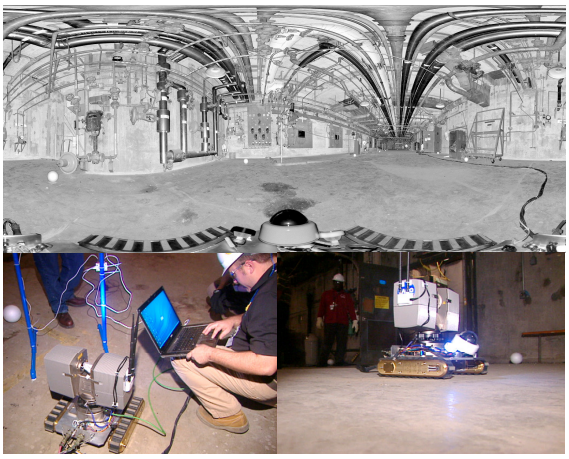
Tech Fact Sheet

Savannah River Site ***South Carolina***
Michigan

D&D Toolbox
Robotic Deployment of High Resolution Laser Imaging for Characterization

Challenge
The characterization of complex and/or hazardous facilities for the purposes of planning D&D projects can be excessively time consuming and present unacceptable hazards for personnel who enter or access the facility. Planners must know the condition of facilities which may have been abandoned in years past with little or no maintenance. Further, unknown hazards such as radiological, chemical, and questionable structural integrity, as well as unavailable "as-built engineering drawings" must all be addressed prior to risking workers safety and committing resources. Ultimately, effective job planning depends on advance knowledge of facility conditions, including the availability of as-built/as-found drawings thus allowing for job sequencing, hazard mitigation and the estimation of waste types and volumes. A remotely deployed characterization platform would address many dangers presented by unknown or questionable conditions at the work site.

Technical Solution
A substantial amount of the data acquisition needed for planning D&D activities can be accomplished using robotically deployed configurations of existing sensor systems for facility data acquisition and processing. With a wide range of expendable robotic platforms, from high-end to simple robotic-data acquisition systems, the real potential is presented for reducing worker exposure to the many hazards present during D&D related operations along with the potential of achieving operational efficiencies in cost reduction and schedule acceleration. For this demonstration, a simple robotic platform was integrated with a commercially available laser imaging/surveying system. The system was used to generate as-build configurations of complex piping and equipment in the Purification Room of P-Reactor at SRS.



Tech Accomplishments
The robotically deployed laser surveying system was deployed in the Purification room of SRS P-Reactor in September 2008. Over the course of 5 hours, the entire room was surveyed by remotely navigating the robot through the room to obtain optimal line-of-sight images that will be merged to produce a high resolution representation of the room and all of its features. This was accomplished while avoiding personal contact with all contaminated areas. The resulting product can be imported into standard CAD packages for analysis of installed equipment, piping systems (many labels can be read at this resolution) and obstacles that could represent hazards for workers. The top figure is a raw, hemispherically distorted image of the facility at one of ten locations within the room.

Site Project & Identifier	Tech Stage: Demonstration
D&D Toolbox: Project OR-071203, OR-071303; Deployed at SRS P Reactor Area Closure Project PBS SR-0040	The robotically deployed laser surveying system was demonstrated in the Purification room of SRS P-Reactor on September 24, 2008.

Impact
Application of this technology will allow detailed visualization/mapping of visible structural components in facilities without incurring the risk to personnel from hazardous levels of radiation or chemicals, or structural deterioration. Use of this approach allows prolonged presence in the facility, while enabling detailed, digital characterization data to be captured. The data can be interpreted in real time for preliminary determinations or following post-processing to allow detailed work planning using the CAD information that is developed. Even in non-hazardous environments, this imaging technology will expedite work planning by allowing a significant portion of the work planning (e.g. sequencing, waste volume estimation) to be conducted in the office rather than in the field, and with greater precision. Had this facility been heavily or broadly contaminated, this approach would have avoided multiple dress-out events and possible personnel contamination to obtain comparable information.

Lessons Learned
Wireless communications were planned but were problematical in this case because of the thick concrete walls in the reactor building. Wireless data transfer may not be essential if the robot must be tethered for adequate power supply. However, real-time video is essential for navigation and positioning. If the system is to be used routinely in contaminated environments, the facility must consider purchasing dedicated equipment. Laser imaging acquisition and data processing systems are available on the open market. Additionally, cleared personnel will be required for analyzing data from restricted access facilities.

Impact and Features

- Reduces worker risk by eliminating worker as first entry to hazardous facilities; degree of reduction dependent on type and magnitude of hazard.
- Addresses need for robotic characterization methodologies
- Provides high resolution structural data for D&D work planning
  - Sub-centimeter resolution for estimation of waste take-off volumes
  - Capable of reading signage and labels
  - Reduces field time for D&D engineers, thereby saving cost while providing a better product
- Can operate in tethered or wireless mode
- Simple, off-the-shelf component robotic platform with commercial imaging equipment
- Small size and simple operation facilitates deployment at any site

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Challenge Category	Tech Solution Category
• Characterization • Dismantlement • Deactivation • Remote Access	• Characterization • Waste Handling & Packaging • Robotic & Remote Systems • Worker Safety