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Innovations

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Impact

SRNL tailors robotic and remote systems to perform diverse jobs in the particular radiological, chemical, physical, or other conditions of environments that are hazardous or inaccessible to workers.

SRNL Development of Robotic & Remote Systems for Nuclear Applications

Savannah River National Laboratory (SRNL) has been developing custom equipment since 1953, specializing in the design, fabrication, and deployment of robotic and remote systems to mitigate risk to workers in nuclear and other hazardous environments.

Camera boom designed by SRNL confirms conclusions regarding cause of WIPP radioactive release.

SRNL tailors new or modifies existing radiation-hardened or disposable equipment for particular uses in nuclear and other environments that are hazardous to human beings.

SRNL designs, fabricates, and deploys equipment to perform numerous activities, including performing remote inspections (visual, ultrasonic thickness, eddy current, non-destructive examination) of facilities to assess conditions for life extension. Other remote applications include taking measurements (radiation levels, physical dimensions, mapping) and gathering material samples for laboratory analysis. Equipment is also designed to investigate process upset and aid in recovery planning.

In addition to ad hoc or off-normal applications, equipment also is designed to automate ongoing operational processes in hazardous environments, such as radiological gloveboxes and cells, both to reduce opportunities for worker exposures and to improve the quality of the operations.

The Challenge

Performing work in nuclear environments is challenging not only because the environments present the risk of worker exposure to hazardous materials but also because the structures containing those nuclear environments are designed to prevent the hazardous materials from getting out, which also hinders access into the structures.

Nuclear environments contain not only radiation and radiological contamination but also chemical and physical hazards, including unknown conditions.

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Access is limited by small entry ports, long internal distances, and circuitous routing.

Tethered remote systems present the potential for tangling and catching. Untethered remote systems can operate for only a limited time on battery power, cannot operate in some areas because the robust concrete structures limit wireless range, and cannot be retrieved if the system fails.

Radioactive contamination limits reuse or maintenance of equipment.

Innovative Solutions

SRNL creates robotic and other remote equipment for singular or routine deployment in environments (vessels, pipes, basins, tanks, repositories, etc.) that are hazardous and inaccessible to workers. Uses include inspection, repair, automation, clean up, nuclear material recovery, contamination sampling, radioactive waste sampling, non-destructive examination, and video recording. Here are a few recent examples:

SRNL camera boom confirms WIPP release-event scenario

In February 2014, an incident in the Waste Isolation Pilot Plant (WIPP) underground repository resulted in the release of radioactive material into the environment. SRNL was asked to design, build, and deploy a remote system to confirm the conclusions of the WIPP Technical Assessment Team and Accident Investigation Board that a thermal event had occurred in a particular waste drum and caused a radiological release. In January 2015, SRNL deployed an elongated boom carrying sophisticated dome and drop-down video cameras that used a laser locator to pinpoint the exact remote location and long-range wireless technologies to transmit signals and images. “Project REACH” safely captured video supporting the characterization of the event scene.

SRNL modifies crawler to clean up DWPF melt cell

Prior to installation of a new melter in the Defense Waste Processing Facility (DWPF) at the Savannah River Site in 2017, the tank waste management contractor consulted SRNL to help identify remotely operated vehicles to clean up the highly contaminated melt cell floor. After continuous operation of the previous melter for almost 14 years, a considerable amount of irradiated glass and other debris had accumulated on the floor. To get DWPF back up and running quickly, SRNL and SRR selected a readily available crawler normally used to assist EOD (Explosive Ordnance Disposal) and SWAT (Special Weapons and Tactics) and compact enough to maneuver in the confined space of the melt cell. In seven weeks, the crawler was procured, modified for cell operations by SRNL, used to train SRR & SRNL operators, and placed into the melt cell for service. SRNL modifications included adapting the crawler for tethered power via an AC/DC convertor and adding a bail for use with canyon and cell cranes. The tools needed to remove and containerize the contaminated glass debris also were provided.

SRNL robots enable inspection of H Canyon air exhaust tunnel

In 6 deployments, SRNL robotic expertise and capabilities have enabled various inspections (such as exhaust duct and concrete tunnel integrity and clearance) of the essential air exhaust tunnel in the H Canyon at the Savannah River Site. H Canyon is the only operating, production-scale, radiologically-shielded chemical separations facility in the United States. In the successful 2017 inspection, a tethered robotic crawler was deployed through the 30” manhole to send video images of more than 600 feet of tunnel walls and ceiling. Considered disposable, the robot was simply designed using inexpensive components.

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Robotic crawler (top) with SRNL modifications used to clean up DWPF melt cell.

(bottom) H Canyon Air Exhaust Tunnel

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