DOE Hanford Achieves First Fully Remote Closure of Radioactive Waste Canisters Using Adaptive Welding Technology

2025 TECHNOLOGY TRANSFER AWARD

The U.S. Department of Energy's (DOE) Hanford Site needed a fully remote, code-compliant welding solution to safely seal 18 dry storage systems containing high-activity cesium/strontium (Cs/Sr) capsules, a critical cleanup milestone for the site. Manual or mechanized welding was not feasible due to high radiation, restricted access, and a shortage of qualified gas tungsten arc welding (GTAW) welders. The project required a system that could deliver repeatable, high-quality, leak-tight welds while meeting ASME code requirements and reducing rework risk in a mission-critical nuclear waste remediation environment.

To meet this challenge, Fluor Enterprises, Inc., Central Plateau Cleanup Company (CPCCo), and Liburdi Dimetrics applied adaptive welding research from EPRI's Welding and Repair Technology Center to deploy a fully autonomous GTAW system at Hanford.

Benefits

The project is expected to save an estimated $12 million USD over its two-year welding campaign by avoiding delays, weld repairs, and retraining, while eliminating worker exposure to high-radiation areas. The autonomous, remotely operated system allows work in environments where manual welding isn't possible, eliminating both operator exposure and human-factor variability while ensuring consistent, code-compliant welds. The adaptive controls, including real-time parameter adjustment, along with extensive qualification testing, make it possible to safely perform the ASME code-compliant closure welds on the 18 Cs/Sr capsule-loaded dry storage systems. The capsules represent nearly a third of Hanford's total radioactive inventory.

Application

EPRI, Liburdi, CPCCo, and Fluor worked together to achieve the first fully autonomous GTA welds used for sealing radioactive materials canisters. EPRI laid the technical groundwork with its adaptive welding research and development as well as expertise in welding optimization, materials performance, and non-destructive evaluation. Liburdi turned those algorithms into a field-ready, remotely operated welding system and carried out the qualification testing. CPCCo and Fluor completed the final step, integrating the technology into Hanford's workflow for executing the first deployment in a real radioactive-waste environment. The team spent roughly two years developing, testing, and qualifying the system for application at Hanford. The result was a reliable, code-compliant welding process capable of performing mission-critical work in locations where manual welding simply can't be done. This breakthrough now sets the stage for broader use of advanced and AI-enhanced adaptive welding across nuclear, defense, aerospace, petro-chemical, and advanced manufacturing industries.

The key EPRI resource driving this project was:

- Development of Adaptive Feedback Welding Technology for Fabrication and Repair Applications, 3002032300

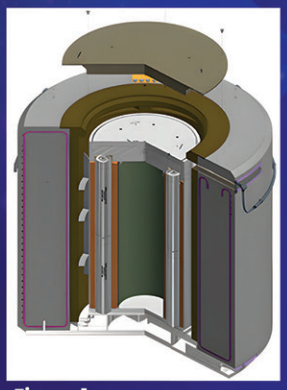

Figure 1
Illustrates a Cs/Sr capsule-loaded canister within a dry storage system.

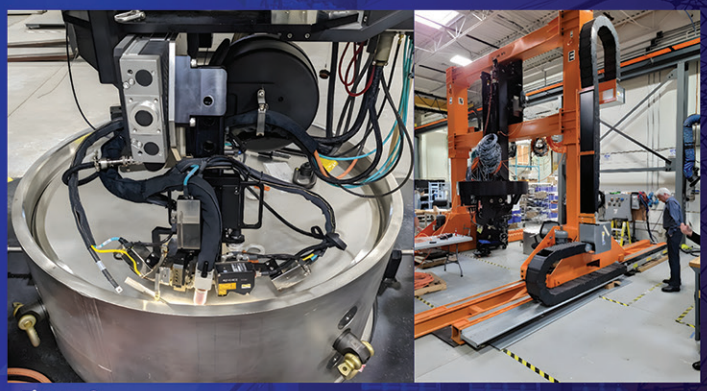

Figure 2
Shows a close-up (left) of the adaptive welding system attached to a Cs/Sr storage canister mockup and the adaptive welding system (right).

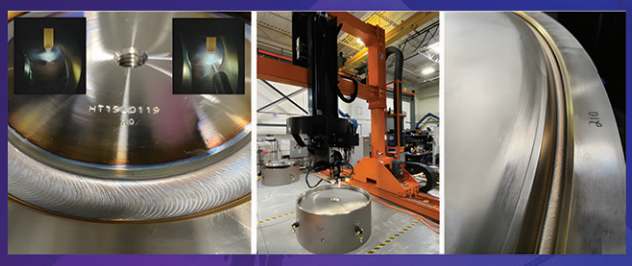

Figure 3
Shows completed root (left) and final (right) closure weld passes during factory acceptance testing using the adaptive welding system (center).

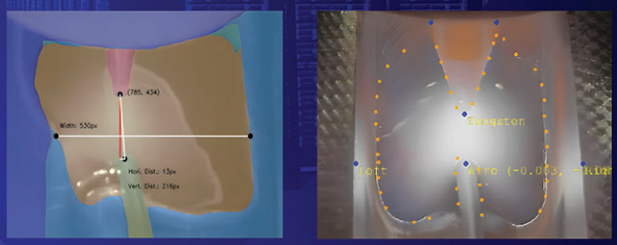

Figure 4
Shows screenshots of the remote adaptive system during weld operations and examples of dimensional and geometric weld features tracked in real-time.

EPRI