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SRNL is a DOE National Laboratory operated by Savannah River Nuclear Solutions.

Facts about Savannah River National Laboratory

U.S. DEPARTMENT OF ENERGY • SAVANNAH RIVER SITE • AIKEN • SC

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SRNL Fast Facts

- National Laboratory for DOE Office of Environmental Management
- Supporting customers at SRS, DOE and other federal agencies nationally and internationally
- Applied research, development and deployment of practical, high-value and cost effect technology solutions in the areas of national security, clean energy and environmental stewardship
- Operated by Savannah River Nuclear Solutions for the U.S. Department of Energy near Aiken, S.C.

Contact Information

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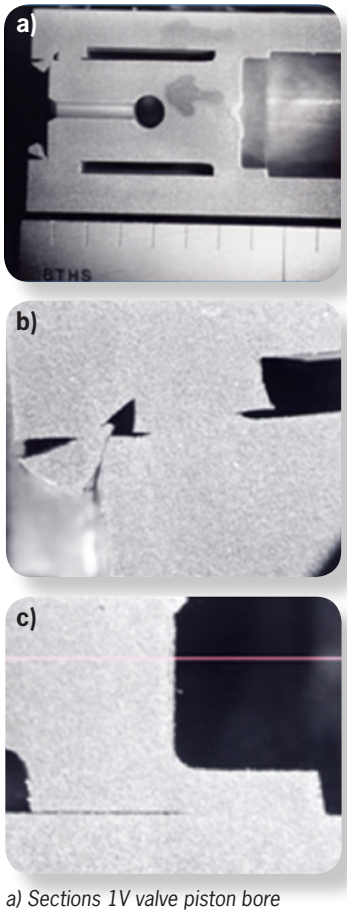
EDM Sectioning of Tritiated Materials

Electric Discharge Machining (EDM) is a machining method that allows researchers to use electric discharge to finely slice metal so that a sample can be created for testing. The EDM capability at the Savannah River National Laboratory (SRNL) is unique to the Savannah River Site. It allows for very fine, precise cutting of metal without destroying mechanical properties.

Tritium and its decay product, helium-3, change the structural properties of stainless steel, which is used to fabricate tritium reservoirs for our nation's nuclear warheads. The degradation of mechanical properties depends on the tritium exposure history, the exact alloy used, and the microstructure. Two main sources of data regarding reservoir material performance exist within the National Nuclear Security Agency, long-term storage and burst tests of age accelerated units and indirect measurements on tritium-exposed and aged tensile and fracture toughness specimens. Accurate data is needed for complete structural integrity assessments.



a) Sections 1V valve piston bore
b) Damage caused by piston over-travel
c) Leak path in piston skirt

EDM of Materials Exposed to Tritium Environment

When testing tritium reservoirs, special challenges exist. Some reservoirs are difficult and expensive to burst test and machining methods used to obtain test specimens can induce stress on materials. It is also difficult to machine test samples from reservoirs in tritium affected areas due to the reservoir size and geometry, the steep concentration gradients of tritium/helium in the affected region, and shallow depth of the affected region (less than 0.020 of an inch). To address some of these challenges, SRNL has adapted a commercially available EDM for use in a tritium environment. This allows our researchers to perform testing of items in a clean environment, as well as to do work on tritiated parts.

Facts about Savannah River National Laboratory

Using EDM to Find Solutions

SRNL is called upon by weapons design agencies to test materials used in of our nuclear weapons stockpile. Design agencies also call upon the laboratory for its expertise in new designs. While researching a prototype reservoir for the W76-1 weapons design, it was discovered that the 1V valve wasn't sealing properly. Scientists at SRNL were able to use EDM techniques on this delicate prototype to not only discover that the problem existed, but to also pinpoint the leak path in the valve that was causing an issue. This information was relayed to the design agency, which was able to correct the problem by tapering the valve piston bore. As a result the design agency is implementing changes into several of its valve designs to eliminate this problem. The parts involved in this prototype unit are very delicate and operate with such high precision that most metallurgical examinations would have resulted in damage to the valves, making it impossible to determine the leak path. It was through SRNL investigation and expertise that the problem was detected, the reservoir design was able to stay on schedule and the design agency was able to redesign the valve before they had been made in large numbers and installed in fielded weapons systems. This capability is unique to SRNL, making it an integral part of our nation's weapons design system.

Debris trap showing pinch weld sheared by piston

Using EDM for Routine Surveillance

EDM technology at SRNL is used for more than just new development. EDM in a tritiated environment is vital to the routine surveillance of reservoirs in our weapons stockpile. At SRNL, it isn't just a matter of Research and Development; it's also stockpile evaluation where precision is vital.

- Use of EDM is specified in W76 surveillance requirements to harvest the pinch weld from the 1V debris trap and to harvest other delicate items of interest
- Use of EDM is now the method of choice for harvesting surveillance metallographic samples from tritiated reservoirs
- Use of EDM will be necessary to support B61 Life Extension Program surveillance for the 3X Reservoir System

EDM has provided a means to surgically harvest metallurgical samples from reservoirs that could not be obtained using conventional machining processes. It is also helpful for metallographic examinations at multiple depths through a part, also known as serial metallography. The use of the EDM makes the metallurgical evaluation process more efficient while significantly reducing the risk of operator exposure.

SRNL EDM operations not only provide the necessary equipment for such delicate tasks, they provide the talent and the perfect collection of experts to make stockpile surveillance a success.

Electric Discharge Machining (EDM) – D-0150

- Precision machining using a commercially available EDM adapted for tritium service
- Identical non-radiological EDM system used to develop sectioning procedures and fixtures in order to reduce operator exposure (ALARA).
- Specified in W76 surveillance requirements to use EDM to harvest pinch welds from the 1V debris traps
- The method of choice for harvesting surveillance metallurgical samples from tritiated reservoirs
- Fabricate tensile test specimens from tritiated reservoir bodies/forgings in support of Structural Materials R&D
- Supported W76-1 Development: Examination using the SRNL EDM uncovered the cause of a problem and drove a change to the 1V valve on the W76-1 LEP – discovered as part of Life Storage Testing

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