PNNL technologies reduce extremity dose

Pacific Northwest National Laboratory is developing a way to immobilize excess weapons-grade plutonium. As part of the project, researchers are assessing the effects of radiation on the long-term stability of the ceramic material selected to contain the plutonium by incorporating the highly radioactive plutonium isotope plutonium-238. This process requires laboratory personnel to periodically monitor various properties of the crystalline ceramic phases.

XRD Sample Holder with a mounted mono-lithic specimen

Two PNNL technologies that reduce extremity dose were acknowledged with the ALARA Award (ALARA means As Low As Reasonably Achievable), which recognizes noteworthy accomplishments in the implementation of the ALARA philosophy at the laboratory. The technologies also received favorable attention from the Department of Energy's Office of Environment, Safety and Health and the DOE Richland Operations Office.

"Development and implementation of these technologies to achieve real dose savings demonstrates an important commitment by project management and staff," said Joel Hoyt, PNNL Environment, Safety and Health ALARA coordinator. "For radiological work to be safe and successful, it is critical that everyone involved with the work own and exercise the ALARA philosophy."

The PIP team

To effectively reduce extremity dose and increase the accuracy of measurement, the Plutonium Immobilization Project (PIP) team, led by Denis Strachan of PNNL Environmental Technology, designed and built a laser-based system to perform the measurements. The development team included Bill Buchmiller and Randy Scheele of PNNL Environmental Technology and Tim Munley and Walt Park of PNNL National Security.

Strachan and members of the PIP team also designed a sample holder to contain both radioactive powder and solid specimens. Members of this development team included Bob Elovich, Randy Scheele and Mike Schweiger of Environmental Technology, Kevin Simmons of Energy Science and Technology and Les Woodcock of Facilities and Operations.

The Laser-based Dimension Measurement System is used to measure simultaneously the height and diameter of the specimen. The specimen is placed on a rotating table and several thousand measurements are made, with every four averaged and recorded by a computer-based data acquisition system. In contrast to measuring the dimensions with a hand-held micrometer, with this system the specimen needs to be handled only as it is transferred from its storage container to the table and returned. That dramatically reduces the dose to the worker and the potential for spreading contamination.

Sample holder disposable

X-ray diffraction is used to monitor the chemical identity and the crystalline phases in the ceramic. To protect workers from potential internal radiological exposure and to eliminate the need to locate the X-ray diffraction

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The laser-based Dimension Measurement System

unit in a contamination area, the team designed a special X-ray Diffraction Sample Holder that provides sealed containment of both solid and powder specimens and provides for the recovery of the sample. The sample holder contains the sample while providing an X-ray transparent window.

Because the X-ray diffraction device can be used outside of a contamination area, the need for release surveys is eliminated and the time a worker must spend handling the highly radioactive specimens is reduced. In addition, because the sample holder costs less than $20, it's disposable. This eliminates the need to clean the device for reuse and further reduces the potential for worker exposure. ✦