Hardware from old nuclear weapons systems becomes valuable teaching resource

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Retired Sandia National Laboratories Executive Vice President and Deputy Labs Director Jerry McDowell gives an impromptu talk to a Weapon Intern Program class that toured Sandia's Nuclear Weapon Legacy Hardware collection.

Sandia National Laboratories is preserving the history of nuclear weapons in hardware developed since the start of the nuclear era as a way to connect new generations of weapons engineers to the engineering work of past generations.

"Tremendous amounts of knowledge are represented by this hardware, and being able to pick up and examine these legacy items can often greatly enhance learning over just studying archive drawings and reports," said John Whitley, a manager in Weapon Engineering Professional Development.

The Nuclear Weapon Legacy Hardware project complements Sandia/New Mexico's Weapon Display Area and Sandia/California's National Security Resource Center, which focus on the current stockpile, by preserving previous generations of legacy hardware for study, he said. The collection, years in the making, is a teaching tool for new weaponeers, and is not open to everyone.

It includes the first neutron generator designed by Sandia, a cylinder roughly a foot tall and about 8 inches in diameter, a giant by today's neutron generator standards. It includes a 1951 technical and specification manual for the first Sandia-designed nuclear weapon component, the first Sandia design of a fuzing radar system and works of art by Sandia's former technical art department.

Retired Executive Vice President and Deputy Labs Director Jerry McDowell, who helped get resources to preserve the hardware, called it "a collection to inspire and inform where we're going, not to admire where we've been."

It was initially proposed by John C. Hogan, retired senior Sandia scientist and former lead instructor for Sandia's weapon training programs. Hogan, a senior mentor for Weapon Intern Program (WIP) classes, started setting aside hardware about two decades ago. Staff members throughout Sandia had held onto crates of legacy pieces, uncomfortable about their destruction, but unsure what to do with them.

"Each division or group was responsible for its own hardware, so as soon as a program ended, they could get rid of it or keep it," Hogan said. In some cases, they kept too much; in others, they destroyed or discarded legacy items without thought to the history of nuclear weapons development. Hogan and WIP instructor Dave Tenorio started identifying hardware in 1998, the intern program's inaugural year. Sandia had hundreds of crates of material stored awaiting disposition.

Collection has been years in the making

A December 2007 letter to Sandia directors with classified material prompted a study of Sandia's legacy hardware, including material at the Nevada Test Site, Tonopah Test Range, Kauai Test Facility and Pantex. In 2013, the project was assigned to the Weapon Engineering Professional Development department, which hired Pete Terrill to head the project and start putting the collection together. Tenorio was brought on as his deputy this year.

The facility has been operating since October 2014 but is far from finished. "It'll always be a work in progress," Terrill said.

Just getting items ready can be challenging. Classification requirements have changed over the decades, so everything in the collection must be reclassified under today's guidelines. In addition, crates stored for years may lack detailed documentation about what's inside, which leads to exhaustive analysis. "If something was stored decades ago, I guarantee our processes are a lot different today," Terrill said.

The archive offers examples of advanced concepts and innovative methods but also includes hardware that never made it into the stockpile because engineering chose a different design. It houses devices that led to a path to develop something safer. Some pieces are the first ever made of a particular item. Some are rare because few were ever made.

Collection also represents some current equipment

Some equipment represented is still in use, such as refrigerator-size, vacuum pump-driven AMPEX reel-to-reel analog recorders at the front of the gallery.

"We still use those machines today to recovery legacy flight test data from nuclear weapons Joint Test Assemblies and to recover data from legacy underground nuclear tests," said Gary Ashcraft of Sandia's Enhanced Systems and Data Analysis department.

The reel-to-reel analog recorders were a telemetry range standard starting in the 1960s, although Ashcraft's date from about 1984. "The machines didn't change too much over the years in their basic operation," he said. "Fifty years of the same technology said a lot about how well they were designed, and many companies made them." One 1-inch-wide 14-track tape holds about 70 gigabytes of analog waveform data, which Ashcraft calls "pretty impressive for the time."

McDowell toured the collection shortly before he retired earlier this year. In an impromptu talk to a weapon intern class viewing the hardware, he brought up Thomas Cahill's "How the Irish Saved Civilization," the story of monks in a remote corner of Ireland during the European Dark Ages who prevented knowledge from disappearing by copying Christian and non-Christian manuscripts.

"While the rest of the world is spinning around, you are our Irish monks," said McDowell, nodding toward shelves of hardware in the warehouse-like storage area. "We're going to look to you to preserve all this."

Provided by Sandia National Laboratories