

Stockpile Stewardship

U1a Complex

The U1h hoist at the U1a Complex.

One-of-a-kind Facility

As the civilian steward of the nation's nuclear weapons complex, the U.S. Department of Energy's (DOE) National Nuclear Security Administration (NNSA) is responsible for the safety and reliability of the nation's nuclear arsenal.

The U1a Complex, an underground laboratory at the Nevada National Security Site (NNSS), is a signature component of that effort.

At the Complex, scientists conduct subcritical and physics experiments used in the NNSA's Stockpile Stewardship Program (SSP), to obtain technical information about the U.S. nuclear weapons stockpile to ensure its safety and reliability now, and in the future.

It is the only place in the nation where subcritical experiments using plutonium in weapons-relevant quantities can be conducted.

Stockpile Stewardship: A Brief History

When the NNSS was established in 1951, then known as the Nevada Test Site, it provided a base for a nascent U.S. nuclear weapons program. The Site served as the location for 100 atmospheric and 828 underground nuclear weapons tests before full-scale testing ended with a moratorium in 1992.

Shortly thereafter, the DOE's Defense Programs Office created the SSP to certify the safety and reliability of the nation's nuclear stockpile in the absence of full-scale nuclear testing.

As a result, the SSP conducts a wide variety of physics experiments, coupled with scientific analysis and computing, to obtain data relevant to nuclear warhead performance. The experiments are necessary to track changes as components within a warhead age or are replaced with newly manufactured components through the Stockpile Life Extension and modernization process. Data from these experiments and advanced computer modeling allow scientists and engineers to develop a better understanding of the dynamic properties of aging or replaced components and ensure confidence in the current stockpile.

Subcritical Experiments

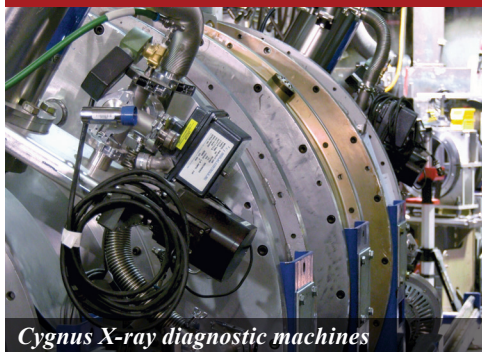
Nearly 1,000 feet underground in the U1a Complex – a secure, protected and environmentally controlled laboratory – physics experiments use chemical high explosives to generate extreme



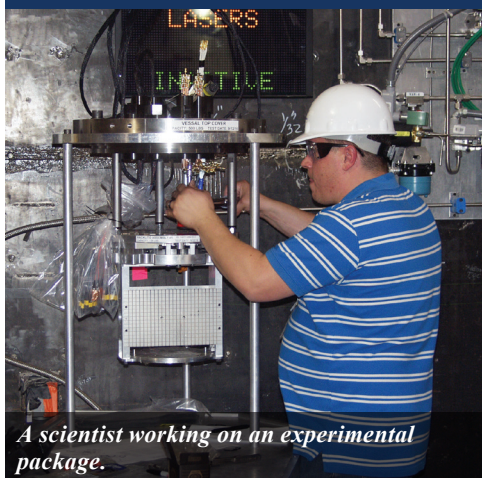
Zero room instrumentation setup for a subcritical experiment includes high bandwidth coaxial signal cables, optical fibers, instrumentation for imaging radiographs and time-resolved capture of surface motion.

pressures that are applied to special nuclear materials. In contrast to full-scale testing, what makes the experiments subcritical is that the configuration and quantities of explosives and weapons-relevant quantities of plutonium do not allow a self-sustaining nuclear chain reaction, or criticality, to occur.

Originally, subcritical experiments were conducted in single-use alcoves mined into the walls or in vertical boreholes in the floor of the U1a Complex. Today, the experiments are conducted in a mined space known as a "zero room." Experiments in the zero room are contained within a robust confinement vessel which prevents the release of radiological material and allows the room to be used again in future experiments. The U1a Complex is also in close proximity to the Device Assembly Facility at the NNSS, enabling efficient and flexible experimental component assembly in a controlled environment.



Cygnus X-ray diagnostic machines



A scientist working on an experimental package.

Advanced Diagnostics

During these experiments, state-of-the-art diagnostics collect data from special nuclear material as it is subjected to extreme pressures and temperatures. These diagnostics include:

- Multiplexed photonic Doppler velocimeter to measure shock wave velocities
- Broadband laser ranging to measure shock wave position
- Additional advanced implosion diagnostics that characterize the shock waves in materials

The data collected from the subcritical experiments are analyzed by the Nuclear Weapons Laboratories.

Cygnus Machine

Cygnus, a pulsed X-ray radiography system located at U1a, is a principal diagnostic source machine used for current subcritical experiments. Cygnus is a medium-energy radiography system designed to take at least two equivalent, time-separated radiographs of an explosive-driven experiment. The geometry is such that each of the two radiographs show the experimental package under dynamic shock. Cygnus

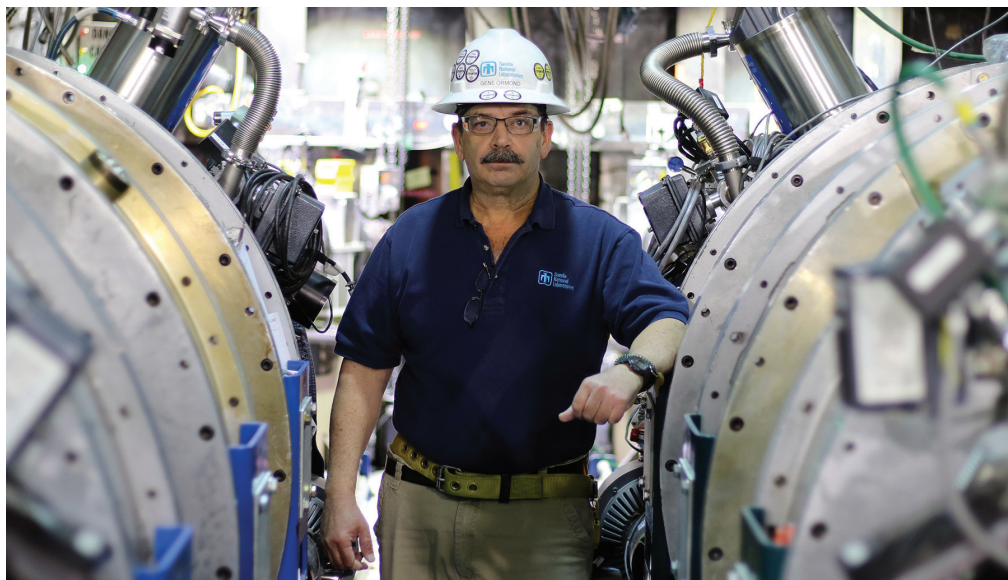
has been used for multiple experiments executed at U1a and has provided relevant, useful data for more than 20 years.

U1a Complex: Next Generation

The U1a Complex continues to strengthen its existing experimentation capabilities, and current investments will expand and optimize the facility to support increased mission activities.

Construction is currently underway on new testbeds – a signature investment in the underground laboratory – that will be home to the Advanced Sources and Detectors Scorpius machine and the Neutron Diagnosed Subcritical experiments machine named ZEUS (Z-Pinched Experimental Underground System).

Scorpius and ZEUS will enable subcritical experiments that image special nuclear material during multiple stages of detonation, yielding essential data on stockpile safety and certification. The new scientific instruments will also enable the NNSS to offer federal and private partners three parallel operational testbeds for new and enhanced subcritical experiment capabilities.



NNSSSM
National Nuclear Security Administration

For more information, contact:

www.nnss.gov

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