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Title: LANL Contributions to the B61 LIfe Extension Program

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# LANL Contributions to the B61 Life Extension Program

## Scope

The Los Alamos National Laboratory (LANL) has a long, proud heritage in science and innovation that extends 70 years. Although the Laboratory's primary responsibility is assuring the safety and reliability of the nation's nuclear deterrent, Laboratory staff work on a broad range of advanced technologies to provide the best, most effective scientific and engineering solutions to the nation's critical security challenges. The world is rapidly changing, but this essential responsibility remains the LANL's core mission.

LANL is the Design Laboratory for the nuclear explosive package of the B61 Air Force bomb. The B61-12 Life Extension Program (LEP) activities at LANL will increase the lifetime of the bomb and provide safety and security options to meet security environments both today and in the future. The B61's multiple-platform functionality, unique safety features, and large number of components make the B61-12 LEP one of the most complex LEPs ever attempted. Over 230 LANL scientists, engineers, technicians, and support personnel from across the Laboratory are bringing decades of interdisciplinary knowledge, technical expertise, and leading-edge capabilities to LANL's work on the LEP.

## Facilities

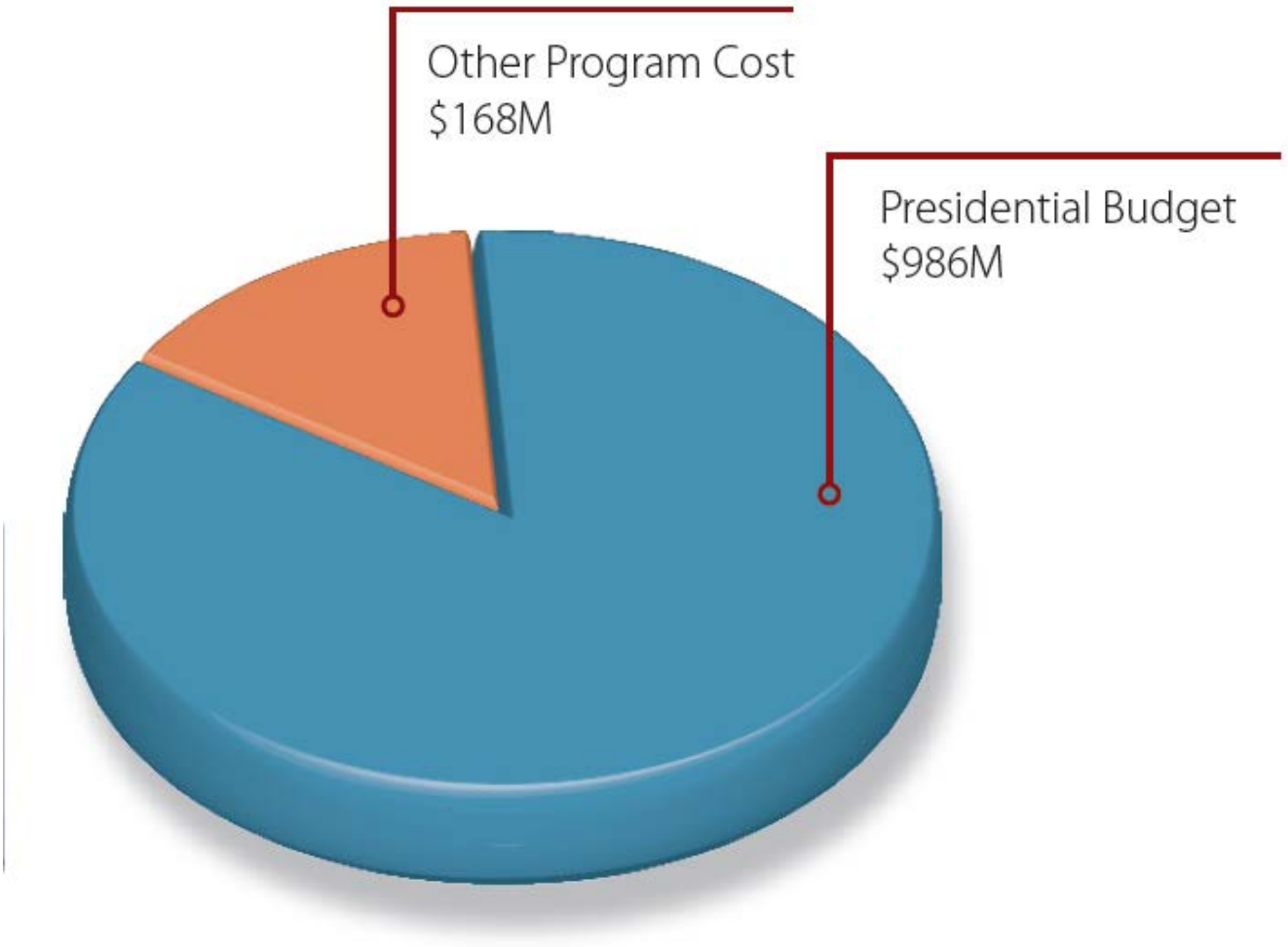
The nation's continued investment in the physics and engineering capabilities at LANL and LANL's advanced scientific, experimental, and high-performance-computing capabilities allow the service life of the B61 gravity bomb to be extended with confidence without the need for full-scale underground nuclear testing.

LANL's B61 LEP staff use the Laboratory's world-class facilities to meet the nation's needs for a continued safe, secure, and reliable weapon stockpile.

- **Dual-Axis Radiographic Hydrodynamic Test (DARHT) Facility**. The DARHT facility allows LANL scientists and engineers to study the implosion of mock nuclear weapon primaries in three dimensions. DARHT's first axis, completed in 1989, has produced world-class images with significantly higher resolution than is possible at any other facility. The second axis of DARHT, operational since 2009, provides three-dimensional data and time-sequenced images taken within billionths of a second at specifically selected times during an implosion. The B61 LEP uses images from DARHT to tie the B61-12 back to the B61 legacy system and underground testing.
- **Proton Radiography Capability at the Los Alamos Neutron Science Center.** Invented at Los Alamos, proton radiography (pRad) provides high-resolution, high-speed, multi-snapshot imaging of a variety of materials in extreme conditions, both dynamically and during experimental processes. The images allows the B61 LEP to assess component behavior in extreme environments.
- **High Explosive Laboratories and Firing Sites.** The Laboratory maintains world-class research and development capabilities in high explosive science and engineering. Experimental work performed at firing sites provides the B61 LEP with critical information on explosive behaviors under a wide range of conditions.
- **Sigma Complex.** The Sigma Complex's primary mission is prototype fabrication and materials research. B61 LEP development activities using Sigma Complex include understanding the behavior of various metals in different thermal/mechanical environments.
- **Supercomputing.** Experimental activities carried out by the B61 LEP generate very large data sets. These data are compared with computer calculations and simulations, allowing scientists and engineers to make informed design decisions. Los Alamos' Nicholas C. Metropolis Center houses some of the world's most powerful supercomputers, including two petascale machines (capable of performing a million billion calculations per second): Roadrunnner (the world's first), which has been decommissioned, and Cielo. Other classified high-performance supercomputers include Luna and Typhoon. Los Alamos is planning for its next supercomputing platform, Trinity

**LANL B61-12 Life Extension Program Accomplishments**

- Bullet Shots into Insensitive High Explosive (IHE)
  The first set of bullet impact tests using B61 LEP components and high explosives were conducted at LANL's Technical Area 36, the Eenie Site, during the week of November 16, 2015. Three tests were executed successfully at 23°C, 80°C, and 120°C with LANL's high explosives being directly impacted by a 0.50-caliber bullet moving at 900 m/s. All three tests resulted in no detonation of the high explosive assembly. These results re-iterate the safety of the B61's IHE in these types of bullet impact scenarios, even at elevated temperatures.
- First Pair of B61 LEP Hydro Tests
  LANL successfully fired two B61-12 LEP hydrodynamic shots that are key to the B61–12's certification process. The shots, which were fired at ambient temperature, used developmental hardware from both LANL and SNL. The preliminary data return was excellent for both shots.
- Using pRad to assess the Detonation Initiation Train
  LANL, using B61-12 developmental hardware, completed the first set of pRad experiments the week of 26 October 2016. The primary objective of these experiments is to produce direct visualization of the detonation initiation train (DIT) to establish that the performance of the B61-12 LEP's hardware is consistent and very similar to the performance of the B61-12 Legacy's hardware. The results provided essential assurance for continuing detonator development and meeting B61-12 LEP deliverables leading up to the first production unit.




LANL B61 Life Extension Program Funding Profile.