Nuclear weapons

Power Sources Group 2520 submitted a new thermal battery for the **W76-1 Lifetime Extension Program** on schedule and within budget. This is the **first new thermal battery designed** by Sandia in nearly two decades. The design incorporates new electrochemistry using an advanced cobalt disulfide cathode material and a low-melting-point ternary-salt electrolyte in order to meet tightly constrained, multiple voltage requirements over an extended performance period. Final development and production activities were completed in less than two years, including recovery from a late-stage supplier change. (2500, 12300, 1800, EaglePicher Technologies) NW


Thermal batteries, diamond stamped July 2006

An 18-month New Mexico/California **design competition for a Reliable Replacement Warhead (RRW)** culminated in August 2006 with delivery of the final design data packages. This aggressive development yielded designs to the customer in only nine months that are certifiable without the need for underground testing while providing significant improvements in weapon safety, security, and manufacturability. **Transformation of both the complex and stockpile** are enabled with these designs. The teams made their final presentations in September 2006 and are ready to begin development on the preferred design. (240, 1400, 1500, 2100, 2400, 2500, 2600, 2700, 2900, 5300, 8200, 12300) NW

The New Mexico Reliable Replacement Warhead team produced high-fidelity designs using a **classified model-based collaborative environment.** Design iterations were done in days rather than weeks or months. Sandia managed the Pro/E models and direct classified network access was provided to both design teams. This supported real-time control of component volume and mass properties requirements. Hydrotest hardware was built directly from solid models in a digital environment, which is now being used to guide transformation of nuclear weapons complex work processes and infrastructure. (2900, LANL, production agencies) NW

The Manufacturing Science and Technology Center provided key support for a recent Los Alamos National Laboratory **hydrodynamic explosive test** to evaluate the New Mexico Reliable Replacement Warhead (RRW) design. The Sandia team solved a critical test hardware design problem with a creative approach to building a near-net-shape part with a design that provided the strength required for proper machining and performance. The successful hydrotest provided additional confidence in the RRW-NM design. (2400) NW


The expanding fireball from a Sept. 6, 2006, Reliable Replacement Warhead hydrotest at Los Alamos National Laboratory's Dual Axis Radiographic Hydrotest (DARHT) facility is shown a fraction of a second after detonation. Center 2400 personnel built critical components used in the test.

Sandia was chosen by NNSA's Deputy Administrator for Defense Programs as the **lead for technical services for system integration within the nuclear weapons complex.** Under the guidance of the Principal Assistant Deputy Administrator for Operations, Sandia will provide technical services for federal program managers in planning, research, analyses and studies, integrated schedule management, and maintenance and improvement of federally directed requirements processes. Systems Integration Technical Support Center 500 has been established to focus efforts on key topics such as program integration and planning, analyses supporting Complex 2030, and future stockpile planning. NW

The Qualification Alternatives to the Sandia Pulsed Reactor (QASPR) project accomplished key testing and modeling milestones in FY06. In 132 days of testing, more than **3,900 transistors were characterized at SPR** prior to its shutdown. The testing included unique collection of data at low temperature (20 K) to aid in the understanding of neutron damage to electronics. The development and demonstration of two-dimensional computational modeling of a silicon bipolar junction transistor's response to neutron damage was a critical step to developing a predictive capability. (1100, 1300, 1400, 1700, 2100, 6700, NNSA Sandia Site Office) NW

After 5½ years dormancy, the **Sandia Pulsed Reactor (SPR-III)** was removed from an in-ground storage vault, reassembled in the SPR Kiva, and activated as a nuclear facility in the beginning of FY06, with the first programmatic operation taking place on Jan. 18, 2006. The reactor operated safely for 159 days and conducted 563 operations before being shut down Sept. 30, 2006, per the Secretary of Energy's directive. This complex experiment campaign supported critical survivability **qualification testing for the W76-1 Lifetime Extension Program** and the Qualification Alternatives to the Sandia Pulsed Reactor (QASPR) project. (1300, 10300, 4200) NW

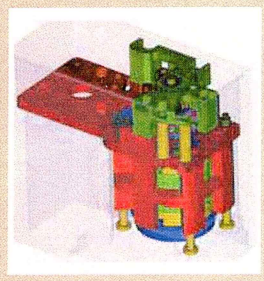
The hostile-environment **qualification of the replacement W78 neutron generator** was supported by key calculations performed using the Red Storm supercomputer. These calculations involved radiation transport analysis with Sandia's Integrated TIGER Series (ITS) code. On Red Storm, these calculations ran 14 times faster than on the retired ASCI Red supercomputer, allowing for more timely design and qualification decisions for this stockpile component. (1300, 1400) NW

As part of Phase 6.4 Production Engineering efforts, the W76-1/Mk4A Lifetime Extension Program matured the design definition and achieved successful **component producibility reviews.** System and arming, fuzing, and firing (AF&F) qualification activities included successful testing as well as significant progress in modeling and simulation of system performance in normal, abnormal, and hostile environments. The project **flew four test bodies on FCET-35,** the submarine-launched ballistic missile Follow-On Commander's Evaluation Test. These major milestones are critical to the overall W76-1 project and helped to build significant confidence with our customers. (2100, 1500, 1600, 1700, 1800, 2500, 2600, 2900, 8200, 5300, 12300) NW

Sandia met first production unit and product qualification deliverables for the **W76-1 intent stronglink, trajectory stronglink, and launch accelerometer.** These components are complex electromechanical subsystems that are key elements in the normal and abnormal nuclear safety capability of the W76-1 arming, fuzing, and firing systems. (2600, 1500, 1700, 1800, 2100, 2900, 12300, Kansas City Plant) NW

New materials sets and designs were developed for **header applications for an intent stronglink.** Glass ceramic-to-metal sealing technologies and header designs that are hermetic during exposures to 500 psi (3.4 MPa) and 1,292 degrees F (700°C) were prototyped using single-pin seal tests. The successful design depended on materials compatibility, minimization of residual stresses, and meeting electrical performance requirements. The design and materials sets are compatible with manufacturing constraints and capabilities, enabling the development of new more **producible and reliable designs for weapon components.** (1500, 1800, 2400, 2600) NW

The W76-1 intent stronglink (ISL) previously demonstrated the potential to unlock when the W76-1 was dropped, raising a nuclear safety issue. **Tests at various drop heights** demonstrated dynamic characteristics of the ISL that were highly chaotic and unpredictable. A team of systems and components engineers, analysts, and experimentalists was tasked with resolving the problem. Using experimentally validated computer simulations, advanced statistical methods, and a new energy-based method for synthesizing input shocks, handling gear was designed that allowed "remain-locked" reliability predictions to reach levels greater than 99.99 percent. (1500, 2600, 2100) NW


Structural finite-element model of the W76-1 intent stronglink

Engineering modeling and simulation analysis played an important role in the **redesign of the B61 spin rocket motor (SRM).** A team from Centers 1500 and 2500 provided timely engineering analysis to assess design requirements associated with the SRM, as well as recommendations to improve various aspects of the design. Sandia's expertise in reactive materials, compressible fluid flow, material thermal response, and stress analysis, and the availability of multiphysics modeling and simulation capabilities, were critical to understanding the fundamental physics and providing timely recommendations for redesign. (1500, 2500, 2100) NW

In support of NNSA's Pantex Throughput Improvement Plan, Sandia teamed with Pantex and Lawrence Livermore and Los Alamos national laboratories to ensure **safe, secure, and effective operations at Pantex.** Sandia led a value-stream analysis with anticipated improvements in efficiency of 30-50 percent for Pantex weapon operations (assembly, disassembly, dismantlement), streamlined requirements for dismantlement and inspection operations, helped achieve SS-21 (Seamless Safety for the 21st Century) safety authorizations for the W87 and B61, led an effort to expand the use of electrostatic dissipative flooring, and helped meet critical special tooling needs. (200, 2100, 8200) NW

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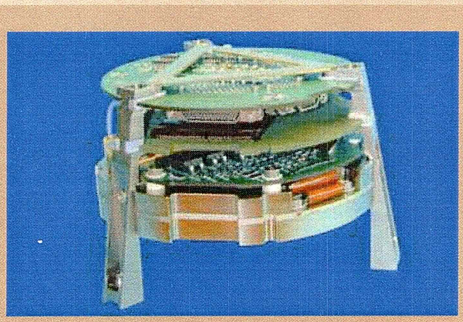


The W76-1/Mk4A arming fuzing subsystem (AFS) flew on the **submarine-launched ballistic missile Follow-On Commander's Evaluation Test (FCET-35).** This critical program milestone proved the AFS integrates into the arming, fuzing, and firing subsystem, interfaces with other Sandia-designed subsystems and the D5 missile, and accurately fuzes in a flight environment. FCET-35 was the first flight test of the Permafrost application-specific integrated circuit (ASIC) designed and fabricated at Sandia. This allowed the AFS team to continue preproduction activities at the Kansas City Plant and remain on schedule and under cost targets. (5300, 2100, 1700, many others) NW

Nuclear weapons

(Continued from preceding page)

As the culmination of three years of effort, the Nuclear Weapons Strategic Management Unit (NWSMU) earned a quality management system registration from the International Organization for Standardization. **ISO 9001 registration** was presented after the ISO organization, which has representation in more than 90 nations, determined the quality system of the NWSMU, including its manufacturing science and technology and neutron generator production activities, meets international standards. The NWSMU management information system was identified as a best practice during the pre-audit. (200) NW

Six W76-1 thermal qualification tests were performed in FY06, five in the newly commissioned Thermal Test Complex. Keys to the tests were an integrated test/modeling and simulation approach, extensive instrumentation and diagnostics on test articles, uncertainty quantification of measurements and simulations, and tight integration with customer requirements. **Environmental fire conditions** created during these tests included the use of high-intensity radiant heat quartz lamps to simulate mock fires, weapon exposure to a real propellant fire, and a first-of-a-kind wind-driven jet fuel fire test. (1500) NW

W76-1 re-entry body qualification test in wind-driven pool fire

A multi-site team led by Center 2400 completed a successful **first-ever qualification of the Laser Engineered Net Shaping™** (LENS®) process for a weapon component. LENS, developed and licensed by Sandia, builds and repairs components directly from a computer model using metal powder and a laser. This NNSA Office of Stockpile Technology-sponsored project also evaluated mechanical properties, machinability, hydrogen compatibility, and corrosion resistance of LENS parts. (2400, 8000, Kansas City Plant, Savannah River National Laboratory, Y-12 National Security Complex) NW

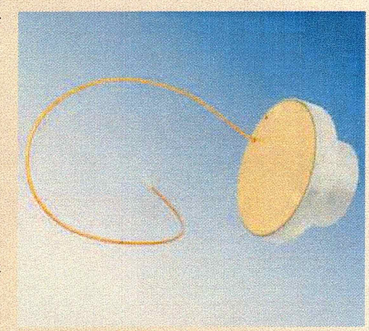
The Concurrent Design & Manufacturing (CDM) program completed development and qualification of **38 custom-made high-reliability components for the W76-1** Lifetime Extension Program (LEP). Twenty-five of these components were newly developed for the W76-1 LEP, and 13 were previously designed for use in other weapon systems. During FY06, CDM completed the qualification evaluation lots for 17 separate components. As of the end of the fiscal year, all 38 components were fully qualified for use in the W76-1 warhead, joint test assemblies, and trainers. (2600, 1700, 2500, 2100) NW

The Nuclear Weapons Strategic Management Unit created a process that enhanced the ability to deliver on time the **Performance Evaluation Assurance Report** to the NNSA's Sandia Site Office. Improvements in project management and data collection were accomplished using the Lockheed Martin Lean Six Sigma tools for establishing a better way of conducting business. The results provided a timely and thorough descriptive evidentiary summary of all nuclear weapon related work at Sandia as defined in the NNSA Performance Evaluation Plan for FY06. (200) NW

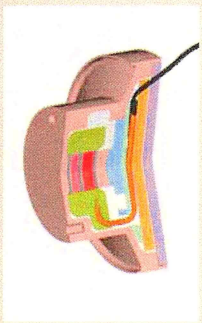
Impact Fuzing and Firing Dept. 2626 received a **qualification evaluation release for a Terminal Protection Device (TPD)** authorizing product builds to support the W76-1/MK4A Lifetime Extension Program. The TPD is an electromagnetic radiation filter designed to protect the arming, fuzing, and firing system electronics from damage due to system-generated electromagnetic pulsed voltages and currents. The product began entering the W76-1 cycle beginning in November 2006, with production at the Honeywell/Kansas City Plant to continue for several years. (2600) NW

Expansion of the Code Management System's (CMS) capabilities has been completed and the system is now fully implemented by all military users. On Sept. 29, 2006, the software, training products, technical publications, and training were completed for the US Strategic Command/Air Combat Command/Navy Depot application of CMS. CMS now supports the W80-0 and the code enabling switch in addition to the B61-3,4,7,10,11; W80-1; B83-0,1; and W84-0 warheads previously supported. Thirteen months of development culminated in the completion of this NNSA Level 2 Milestone ahead of schedule. (1700, 1800, 2000, 2100, 2400, 2900, 4200, 5600, 5900, 6300, 12300) NW

The W76-1 Impact Fuze Product Realization Team (PRT) obtained an acceptable qualification evaluation release. This allows the Kansas City Plant to **proceed with production**. The PRT was challenged with reclaiming 30-year-old impact fuzes from W76-0 arming, fuzing, and firing systems and converting them to W76-1 impact fuzes. This involved harvesting W76-0 impact fuzes while maintaining interface compatibility, verifying functional performance following stockpile exposures, physically modifying the hardware to meet the W76-1 configuration, and proving the refurbished units met functional performance requirements. (2600, 2900) NW



Refurbished W76-1 impact fuze with coaxial cable



Impact fuze cross section

In August the standard approach for verifying a key parameter for War Reserve neutron generator targets became temporarily unavailable. A team was assembled to **formally qualify ion beam analysis (IBA) as an alternative test method.** IBA qualification was accomplished in three weeks, far less time than is normally required. Subsequently, 110 targets were qualified using IBA during the shutdown of the primary test method, allowing neutron tube and neutron generator products to continue to flow and be delivered on time. (2700, 1100, 12300) NW

The Neutron Generator Data Analysis System (NGDAS) realizes a 99 percent reduction in the time required to correlate design, manufacturing, and processing data with **neutron generator test and yield.** NGDAS integrates the data from the unclassified Oracle manufacturing system with the classified Product Tester System in a classified data warehouse. The system has been developed to dynamically accommodate ever-changing data-collection requirements while providing access to an infinite number of data combinations to meet the ad hoc data analysis needs of the various engineering disciplines (process, product, design, etc.). NGDAS received a **2005 Defense Programs Award of Excellence** for impact to the Stockpile Services Program. (2700, 4500, 6200) NW

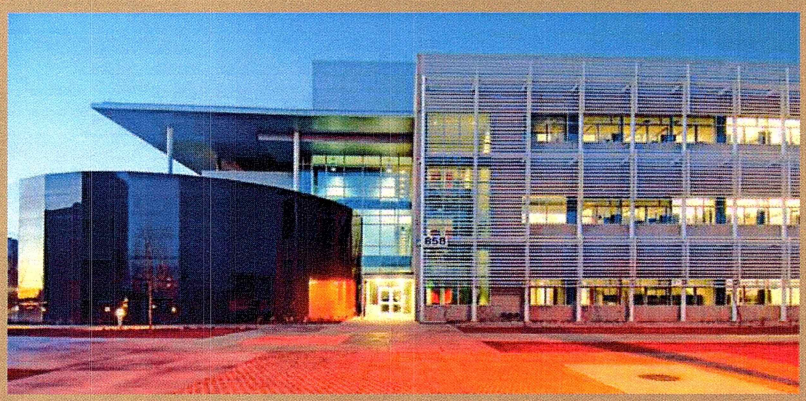
QC Inspection Services Inc. successfully **integrated with the Responsive Neutron Generator Product Deployment Materials Value Stream** in 2006. The partnership facilitates incoming materials acceptance and aids in meeting center cost and schedule goals. This nationally accredited supplier completes inspections per Sandia inspection plans and uploads results from its site in Burnsville, Minn., to the Purchased Material Acceptance Application, an Oracle-based system used to manage acceptance. This resulted in real-time data at Sandia, a 32 percent decrease in cycle time, and an inspection cost reduction of $500,000. (2700, 12300) NW

In September Neutron Generator Production was **awarded a Public Sector Shingo Prize.** The Shingo Prize is considered the "Nobel Prize of manufacturing" and is awarded to companies that have demonstrated application of lean principles to obtain world-class results and provide the best value to customers. By applying lean concepts, Neutron Generator Production increased capacity by 67 percent, reduced inventory by 55 percent, realized cycle-time reductions of up to 75 percent, and accepted three new mission assignments without increases in budget or staff. (2700) NW

A joint Sandia/Kansas City Plant (KCP) team developed **major improvements in the Engineering Authorization (EA) release process.** EAs are the official agreements between the design agencies (such as Sandia) and a production agency (KCP) that authorize a product to be produced. After process improvements were implemented, 93.5 percent of EAs were released in less than 24 hours, and 99.8 percent of EAs were completed within 4.3 days — significant improvements over the previous average release time of 45 days. (2900, 8900, KCP) NW

Seventy-seven Man Portable Air Defense System (MANPADS) missiles were fired at the Tonopah Test Range in support of development of **next-generation missile warning systems.** The customer for this data was the Air Force Air Mobility Command, but the event was monitored by the Department of Homeland Security and allied participants from Canada, the UK, Australia, and New Zealand. The shoulder-fired missiles included both foreign and domestic assets. Ultraviolet, infrared, visible-spectrum, and acoustic signatures were obtained from the firings. Tonopah Test Range Dept. 2915 provided operational support. (2900) NW

MESA Microsystems Laboratory



The MESA (Microsystems and Engineering Science Applications) project achieved major milestones, including the **startup of the MicroFabrication Facility and new Microsystems Laboratory** that house 274 people from seven Sandia organizations. Overall the MESA project is ahead of schedule and on budget. The MicroFab is a 90,000-square-foot industrial facility that includes an ISO Class 4 clean room, 120 new semiconductor tools, and approximately 60 relocated tools from the Compound Semiconductor Research Lab. When complete, the MicroFab and MicroLab will replace the 50-year-old CSRL (Bldg. 893). NW (Photo by Bill Doty)

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