

**Department of Energy National Nuclear Security Administration
FY 2001 Appraisal of
The University of California and Los Alamos National Laboratory**

FUNCTIONAL AREA: SCIENCE AND TECHNOLOGY

DP Stockpile Stewardship Program (SSP)

Directed Stockpile Work – Weapons Systems Activity

OVERALL DOE ADJECTIVAL RATING: Excellent

NUMERICAL SCORE: 89

	<u>Quality of Science</u>	<u>Programmatic Performance and Planning</u>	<u>Relevance to National Needs and Agency Mission</u>	<u>Operation of Major Facilities</u>	<u>Overall Evaluation Score</u>
Rating	Excellent	Excellent	Outstanding	Excellent	Excellent

DOE narrative evaluation of LANL's performance:

Quality of Science: The rating for this criterion represents a composite rating of several sub-elements that may have differing evaluation scores. Regarding Stockpile Maintenance, the science, technology, and engineering basis established by LANL for its product lines paid off in the form of high yields and prompt resolution of any production issues that have arisen. In particular, the science-based manufacturing approach to neutron tube target loading provided for extremely high yields that have continued to be essential to the DOE's ability to meet stockpile delivery commitments for neutron generators. Regarding Surveillance, LANL established a strong science, technology, and engineering basis for this program. LANL's engineering and scientific support for the new material and stockpile laboratory and flight test programs was outstanding. Regarding the Hydrotesting program, recent analysis of the results of hydrotest 3588 demonstrated the utility of the high quality Dual-Axis Radiographic Hydrodynamics Testing facility (DARHT) data for validating and improving simulation code algorithms. This experiment returned important data for the national program. LANL's performance in this effort was outstanding. The successful completion of 3589 (shot after the evaluation period) indicated that DARHT and the technical staff supporting the shot are fully capable of performing essential stockpile stewardship experiments. LANL's performance in this effort was outstanding. No subcritical experiments were executed during this evaluation period, but preparations for FY02 subcritical experiments in the Stallion series appear to be well on track. LANL's performance in this effort was outstanding. Progress on developing certification methodologies along the goals of campaign one is needed. LANL's performance in this effort was marginal. Regarding the B61 and W76 activities, LANL accomplished significant work in developing ACORN boost systems for the W76 that contributed to on-time deliveries to the United States Navy. In support of the Integrated Weapons Activity Plan (IWAP), LANL supplied weapons response across the board has been late due to a shortage of personnel working on weapons response and an apparent lack of Laboratory commitment to supply this vital support to Pantex operations. This has negatively impacted DOE's ability to meet the IWAP schedule. Additionally, weapons response provided has become increasingly conservative requiring the implementation of large numbers of controls at Pantex. In some cases this is warranted based on new information but in many cases the Laboratory appears less willing to provide a realistic assessment. While LANL performance was good on supporting closure of DNFSB issues on command disable and canned sub-assemblies their response was not timely. Both issues took months longer to resolve than would have been necessary if a concerted effort had been made.

LANL informed Pantex of potentially major safety issues concerning slow heat and near-by explosion (NBE) which could have major impacts on operations at Pantex. These issues were not formally communicated to DOE in writing providing a sound technical basis (e.g., technical reports, experimental/modeling results, test data) for the concern. Additionally, LANL has not taken responsibility to ensure they appropriately apply the resources of the Laboratory to mitigate the impact of these issues on Pantex meeting its stockpile surveillance, maintenance, and dismantlement responsibilities.

Participation in the development of D&P Manual Chapter 11.8 was extremely valuable in defining the weapons response process, especially in the LANL/Sandia National Laboratories (SNL) co-development of the rules table format.

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Programmatic Performance: The rating for this criterion represents a composite rating of several sub-elements that may have differing evaluation scores. Regarding Stockpile Maintenance, despite setbacks beyond their control (e.g., Cerro Grande Fire), LANL met virtually all production commitments during this evaluation period. In several cases, this was due to efforts above and beyond the call of duty to ensure delivery (e.g., production by personnel who had lost homes, production very early in the day to avoid humidity issues). In addition, LANL expects to address its principal production readiness issue (detonator production in out years) through design of a new facility combined with commercial purchase of some products. Regarding Surveillance, LANL's performance was strong this year. Work is progressing to address shortfalls attributed to the Cerro Grande Fire. In addition, some progress was made to work off the surveillance backlogs. LANL/Engineering Sciences and Applications Division's Surveillance program management and the Design Agency Surveillance Points of Contact provided outstanding support at all of the production agency reviews, sampling rationale meetings, 150 Day Study efforts, and Nuclear Explosives Package reliability assessment meetings. Core surveillance personnel were extremely customer focused and provided outstanding support to the overall needs of the surveillance program. However, the Type A investigation at TA-55 was the cause for lost time on the surveillance program. LANL did an excellent job in completing the testing of valves, detonators, and radioisotope thermoelectric generators.

Regarding the W80 activity, LANL provided critical support during the W80 Life Extension Program (LEP) Ninety-Day Study and follow-on activities. W80 LEP integrated planning, resource loading, and risk management were significantly enhanced due to LANL's participation and willingness to share W80-0/1 experiences and expertise. LANL fully supported the effort to resolve a Defense Nuclear Facility Safety Board (DNFSB) concern with a W80 Pantex operation by providing supporting data and answers to DNFSB requests and questions. DNFSB's concerns were resolved and preparations are underway to resume the operations at Pantex. The W80 LEP Phase 6.2 Study was completed providing the basis for a Project Officers Group and NWC Option downselect and subsequent entry into Phase 6.3. The completion of the Implementation Plan was slower than anticipated. The W80 Annual Assessment Certification Report was completed on time with all significant W80 issues addressed. W80 Core Surveillance activities were adequately supported throughout the FY. A major significant finding investigation (SFI) was closed and the accompanying LANL recommendations were implemented throughout the complex and at DoD sites. Although some SFIs were closed, the closure rate of open SFIs remains a concern. W80 baselining activities were completed in a timely matter so that the basis for the W80-2/3 can be established.

Regarding the Hydrotesting program, through clear and consistent management focus, LANL made noteworthy progress in its ability to plan and execute major hydrotests. The successful conclusion of shots 3588, H2735, and 3589 indicated a much improved ability to plan, assemble, and execute these very complex experiments, and provided a positive measure of confidence in the maintenance of essential skills and capabilities for stockpile stewardship. The baselining of DYNEX experiments brought clarity to the cost and complexity of the tasks necessary to perform those essential experiments. The coordination of the use of hydrotest facilities to accomplish construction goals and meet the requirements of the hydrotest program was much improved (excellent – commendable improvement noted). Successful development of a path forward for DYNEX vessel certification reflected a much-improved approach to environment, safety, and health (ES&H) issues, and a much-improved effort at communications and cooperation with the DNFSB. Improved senior management involvement in ES&H issues associated with routine hydrotesting was an important component in improving the conduct of these experiments. While the execution of experiments was much improved, the prioritization of experiments and management of resources to accomplish experiments to support stockpile requirements requires better coordination. In particular, the hydrotesting program suffered from lack of integration between the experimental programs (DX division) and the design divisions (X-4) to ensure that experimental programs were executing experiments whose need was well justified by certification requirements. LANL did not lay out a program of work to accomplish the certification goals of campaign one. LANL was slow in reacting to identified shortfalls for the technical resources (engineers, technicians, and facilities) to support fabrication, assembly, and fielding of major hydrotest experiments or prioritizing activities to reduce the impediments imposed by competition for these resources. LANL committed to meeting a number of high priority goals without adequate appreciation of the constraints imposed by these shortfalls and without a clear program to commit funding to address these shortfalls. Regarding the B61 and W76 activities, timely completion of 90-Day LEP studies, completion of W76 Phase 6.2 Study, but slower than anticipated completion of Implementation Plans was noted. LANL did an excellent job in supporting the W87 programmatic needs. LANL experienced a fairly high turnover in

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the production area, but managed to meet next assembly requirements. The absence of a LANL DP-21 detailee, in comparison to prior years, did not go unnoticed.

Relevance: LANL's production mission and performance are critically important to national needs and to the DOE mission. LANL's support of weapon surveillance activities is vital to the nation's ability to assess the safety, reliability, and performance of the nuclear weapons stockpile. Hydrotesting, including subcriticals and the DYNEX program, is vital to primary certification. LANL has critical involvement in nuclear explosive safety and use control. LANL's support of the W87 LEP is highly relevant to national needs.

Operation of Major Facilities: Regarding Stockpile Maintenance, facilities critical to production were in an operating status as necessary to support production. Restart of operations after the Cerro Grande Fire was prompt and effective for facilities associated with production activities. Regarding Surveillance, development and operation of facilities that are critical to this mission area met or exceeded expectations during this period, with the exception of the TA-55 downtime associated with the Type A investigation. That downtime contributed to an extended outage for pit surveillance activities. Regarding the Hydrotesting program, DARHT I demonstrated exceptional radiographic capability and LANL made excellent progress in improving the rate of the conduct of experiments. At the same time, the current shot rate requirements were not anticipated during project planning and, therefore, LANL had to adjust the shot schedule to minimize interference with construction of DARHT II. Increased senior management attention to the conduct of operations at principal facilities and to the optimization of the use of all national facilities to support the National Hydroprogram would lead to improved efficiencies of operation. LANL did an outstanding job managing the U1A facilities at NV for the conduct of subcritical experiments. Regarding the "DX detonator facility," LANL improved its operations and enhanced its facility footprint to meet future needs.

Notable Accomplishments/Recommendations: Regarding Stockpile Maintenance, LANL's prompt restart of production operations after the Cerro Grande Fire and the delivery of products in accordance with schedules was notable. In addition, performance on required "unplanned" (by DOE) beryllium inserts was outstanding. Regarding Surveillance, LANL's progress made on surveillance backlogs and the effort on the pit surveillance program, despite the loss of the facility for a good portion of the year, was notable. LANL was instrumental in the timely delivery of the 150 Day Study and its implementation strategy. Regarding W80 activities, LANL was supportive of the tri-laboratory "Agreement on Assignment of W80 Responsibilities" and the subsequent tri-laboratory "W80 Knowledge Sharing and Baseline Agreement." LANL's support of Lawrence Livermore National Laboratory (LLNL) and SNL access to W80-0/1 data and archives played a key role in LLNL/SNL W80-2/3 design and development activities. Regarding the Hydrotesting program, the successful completion of shots 3588 and H2735 was outstanding. Regarding B61 and W76 activities, the ACORN deliveries were notable.

Notable Deficiencies/Recommendations: Regarding Surveillance, the Type A investigation at TA-55 was the cause for lost time on the surveillance program. Substantial progress could have been made on pit surveillance backlog if the facility was available during this period. More emphasis needs to be placed on eliminating testing backlogs. LANL placed some additional emphasis on the timely closure of SFIs, but additional emphasis is necessary. Regarding the W80 activity, an updated Major Assembly Report (MAR) for the W80-0/1 is required due to a change in a Limited Life Component Exchange (LLCE) interval. The LLCE interval was changed in May 2001, but no MAR update was submitted. The delivery of W80, B61, and W76 Implementation Plans was less than timely. Regarding the Hydrotesting program, progress on developing certification methodologies along the goals of campaign one is needed. LANL still does not consciously plan and participate in a "National" Hydroprogram including sharing of experimental resources and planning for the acquisition of critical materials. LANL should further enhance their flexibility to ideas from other production agencies and design agencies. The Kansas City Plant's (KCP's) ability to derive contingency plans is a good source of information and lessons learned. Regarding the W78 activity, progress on key W78 technical issues was impeded due to the draw out of the hydrotest schedule. Deliberate planning and resourcing of specific warhead programs was a deficiency, not only in executing yearly workload, but also developing solid expectations of what is achievable.

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DP Stockpile Stewardship Program (SSP)

Directed Stockpile Work – Non-nuclear Manufacturing Activity

OVERALL DOE ADJECTIVAL RATING: Outstanding

NUMERICAL SCORE: 92

	<u>Quality of Science</u>	<u>Programmatic Performance and Planning</u>	<u>Relevance to National Needs and Agency Mission</u>	<u>Operation of Major Facilities</u>	<u>Overall Evaluation Score</u>
Rating	Outstanding	Excellent	Outstanding	N/A	Outstanding

DOE narrative evaluation of LANL's performance:

Quality of Science: LANL continued to solve fabrication issues associated with the production of pellet can assemblies for the mechanical safing and arming detonator (MSAD) used in the W87 warhead. The initial process produced many parts that did not meet specifications; consequently, the scrap rate was high. With the process improvements implemented, the scrap rate was reduced significantly and approximately 1000 WR pellet can assemblies will be produced and shipped to the Kansas City Plant (KCP) this year. In addition, LANL supported Sandia National Laboratories (SNL) in the determination that the cleaning process used on preloads for detonator-production-caused problems with performance of the detonators. The KCP performs the cleaning process after an SNL specification. About 800 targets, including targets for use in W76 neutron-generator manufacturing, were delivered to SNL this year, and over 99% of the targets shipped have passed the loading verification process at SNL, while production capacity kept pace with delivery requirements.

Programmatic Performance: LANL accomplished its Program Control Document/Master Nuclear Schedule (PCD/MNS) work including all Limited Life Component Exchanges and alterations schedules (includes detonators, tritium-loaded neutron tube targets, selected beryllium parts, and mock pits). In addition, LANL improved product delivery performance and efficiency for manufactured products. LANL produced approximately twice the number of detonators in FY01 compared to FY00 at an essentially flat budget. This continued the trend for the last three years. LANL produced and shipped approximately twice the number of loaded targets in FY01 compared to FY00, with an increase in budget of approximately 20%. This continued the trend for the last three years. Success in loading neutron tube targets for shipment to SNL was near 100%. Beryllium inserts required for the stockpile were produced on extremely short notice, meeting the DOE's war reserve (WR) quality requirements for these parts. In addition, the Beryllium Technology Facility was started up and successfully produced the first parts supporting LANL experimental programs within three months of initial operation. Six mock pits for joint test assembly (JTA) surveillance support were produced in 2000 and some have been refurbished. In addition, detailed planning for the production of the Type 125 Structural Mockup (SMU) was accomplished, PRT was formed and is functioning, and early, long-lead activities have started. The 2001 Los Alamos Production Readiness Assessment was produced for integration by DP-20 as part of DP-20 program-planning activities. Modeling and analysis were performed as a process improvement tool to support detonator production planning, mock pit production, beryllium supply requirements, and potential pit retube and refurbishment activities. LANL also performed risk analysis in support of the weapon life extension planning activities. LANL supported numerous quality assurance survey audits and assessments, and coordinated responses to those audits. After the relocation of bonded storage for values in the first quarter of FY01, surveillance operations resumed at the valve surveillance test laboratory. LANL was current with the Pantex disassembly schedule for detonator surveillance, and during FY01, LANL processed about 80 stockpile return detonators. The High-Power Detonator Facility General Plant Project, which will provide detonator production with a facility able to support simultaneous production of up to three WR products, received critical decision phase 0 (CD-0) with an expected startup date at the end of FY03. As part of detonator production, packaging materials and transportation containers needed for shipping small assemblies containing explosives were produced and shipped to all laboratories and plants.

Relevance: This activity is a critical element of DOE's Stockpile Stewardship Program.

Operation of Major Facilities: N/A

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FUNCTIONAL AREA: SCIENCE AND TECHNOLOGY

Campaigns

OVERALL DOE ADJECTIVAL RATING: Excellent

NUMERICAL SCORE: 89

	<u>Quality of Science</u>	<u>Programmatic Performance and Planning</u>	<u>Relevance to National Needs and Agency Mission</u>	<u>Operation of Major Facilities</u>	<u>Overall Evaluation Score</u>
Rating	Outstanding	Excellent	Outstanding	Excellent	Excellent

DOE narrative evaluation of LANL's performance: The evaluation of the Campaigns area is composed of six sub-areas: Weapons Physics Activity, Materials Science Activity, Weapons Engineering Research and Development (R&D) Activity, Advanced Radiography Activity, Simulation and Computing Activity, and Pit Program Campaign Activity. Each of these sub-areas is individually evaluated below.

Campaigns

Weapons Physics Activity

OVERALL DOE ADJECTIVAL RATING: Excellent

NUMERICAL SCORE: 89

	<u>Quality of Science</u>	<u>Programmatic Performance and Planning</u>	<u>Relevance to National Needs and Agency Mission</u>	<u>Operation of Major Facilities</u>	<u>Overall Evaluation Score</u>
Rating	Excellent	Excellent	Excellent	Excellent	Excellent

DOE narrative evaluation of LANL's performance:

Quality of Science: The rating for this criterion represents a composite rating of several campaigns that may have differing evaluation scores. Regarding the Primary Certification Campaign, LANL completed upgrades to archiving computer platforms and cyber-security protocols for UGT data. LANL completed re-analysis and advanced electronic archiving of prompt diagnostics data for about 10 Nevada Test Site (NTS) events. LANL demonstrated proof-of-principle for high-explosives-driven quasi-isentropic compression experiments (ICE) and completed initial follow-on experiments. High-explosives-driven ICE development is targeted at plutonium experiments at U1a, which could provide unique high-pressure off-Hugoniot data. Regarding the Secondary Certification and Nuclear Systems Margins Campaign, advanced electronic archiving of prompt diagnostic data was completed for five NTS events. The PINEX Handbook was completed and the preparation of the Recording Practices Handbook was expedited. In radiation chemistry, primary systematics were completed for the W88, several reports were published on enhanced techniques and methods, and W76 yields were reassessed for the dual revalidation effort. LANL completed measurements of the $^{239}\text{Pu}(n,2n)^{238}\text{Pu}$ cross section at the Los Alamos Neutron Science Center (LANSCE), developed new evaluated cross sections based on those data, and applied the resulting new database to primary certification calculations. For these efforts, LANL was awarded a DOE Award of Excellence for the joint LANL/LLNL team. LANL completed the detector array support structure of the device for advanced neutron capture (DANCE) at LANSCE and began the development of its neutron flight path. DANCE will provide neutron-capture cross sections for radioactive nuclei connected with radiochemical diagnostics from past nuclear tests. Data from DANCE will help to convert the radiochemical information from the NTS into a detailed set of constraints on weapon performance models used in stockpile certification. LANL completed data-taking at LANSCE toward measurements of several sets of neutron cross sections needed for secondary certification, including (n,2n) reactions on uranium-235, yttrium-89, and zirconium-90. The first experimental resolution of a shock-front rise profile in a shock wave by the femtosecond laser project HERCULES was accomplished for both high explosives and metals, and the corresponding analysis technique proof-of-principle was completed. This capability will allow probing of the "initial conditions" which govern the postshock response of the radiation case. The HERCULES project team completed and made operational an ultrahigh-vacuum chamber for thin-film organic deposition, the assembly of the miniature (precision) two-stage gas gun, and the short-pulse (laser-driven) mass spectrometer. Regarding the Nuclear Survivability Campaign, LANL completed a series of reactor experiments to support certification of aged components exposed to hostile neutron environments. LANL's analysis of the resultant data is in progress, and

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LANL disseminated the available findings. LANL optimized quality and quantity of experimental results, and coordinated computer analysis between independent teams at the two national laboratories. In modeling and validation efforts, LANL supported an effort to rebuild the ability to analyze fratricide environments supporting U.S. Strategic Command target modeling. Furthermore, LANL brought the development of Redbook and Bluebook calculations back on track, fulfilling U.S. Navy requirements. LANL also contributed to the effort to achieve a significant improvement in the hostile environments sections of the Mk 4 and Mk 5 stockpile-to-target-sequence documents. Regarding the Inertial Confinement Fusion (ICF) Ignition and High Yield Campaign, LANL had outstanding success in performing quantitative radiation hydrodynamic experiments at Z and Omega that have been compared with the most advanced modeling methods. The LANL team was very effective at using shot availability at both machines. The resulting comparisons of the data to theory led to a number of suggestions for computational code modifications, and in turn the modeling suggested new measurements that will be undertaken in future experiments. In some cases, weapons-system-specific issues (as opposed to generic) motivated experiments.

Programmatic Performance: The rating for this criterion represents a composite rating of several campaigns that may have differing evaluation scores. Regarding the Primary Certification Campaign, evaluation and archiving of past nuclear tests in support of this campaign proceeded systematically. The high-explosives-driven isentropic compression experiments (ICE) development effort is progressing rapidly and has a clearly defined path forward to capability demonstration. Regarding the Secondary Certification and Nuclear Systems Margin Campaign, advanced electronic archiving of past nuclear tests proceeded systematically (with the crucial addition and training of a new generation of radiation chemistry experts), and associated new analyses provided valuable new insights into weapons performance. Initial case dynamics work was initiated this year. LANL developed plans this year for a concerted effort in case dynamics and associated radiative effects to begin in FY02, and received DOE support and concurrence. LANSCE cross-section measurement suites and detector development projects are on track, with clearly defined paths forward. Regarding the Nuclear Survivability Campaign, this emergent program has already effectively addressed SLEPs and has applied a science-based method to survivability in hostile environments. Progress was good and the DoD sponsor complimented LANL. LANL's efforts led to a nomination for a DOE Award of Excellence. Regarding the ICF Ignition and High Yield Campaign, a strong effort was made to target the work of the program in order to emphasize responsiveness to both near and intermediate needs of the nuclear weapons program. The ability to plan and execute a strong science program at non-LANL facilities became routine for this campaign, and reflected the effectiveness of the interactions of LANL with those facilities and the efficiency of the technical teams in fielding the experiments. The outstanding scientific record of the program during this period indicates that the objective of delivering weapons-relevant data was met.

Relevance: This activity is a critical element of DOE's Stockpile Stewardship Program.

Operation of Major Facilities: The LANSCE accelerator provided record neutron beam intensity and duration to the Weapons Neutron Research Facility, enabling timely completion of the Pu(n,2n) cross-section project and enabling several new initiatives in neutron cross-section measurements on uranium isotopes and other nuclear species needed for weapons radiochemistry analysis.

Notable Accomplishments/Recommendations: LANL was awarded a DOE Award of Excellence for the joint LANL/LLNL work on $^{239}\text{Pu}(n,2n)^{238}\text{Pu}$ cross section.

Notable Deficiencies/Recommendations: None.