Campaigns

Program Mission

Campaigns are focused scientific and engineering efforts involving the three weapons laboratories (Los Alamos, Sandia and Lawrence Livermore National Laboratories), the Nevada Test Site, the weapons production plants (Kansas City, Pantex, Y-12 National Security Complex and the Savannah River Site), and selected external organizations, which develop and maintain special capabilities and tools needed for continued certification of the stockpile, now and into the future, in the absence of underground nuclear testing. These efforts directly support Strategic Goal NS-1, to maintain and enhance the safety, security, and reliability of the Nation's nuclear weapons stockpile to counter the threats of the 21st century.

Campaigns are multi-year, multi-functional efforts to provide the capability to address current or future questions or issues concerning the stockpile by employing the best scientists and engineers, and using the most advanced sciences and technologies. They focus research and development activities on clearly defined deliverables; they have defined milestones, specific work plans, and specific goals. Production readiness campaigns assure the Nuclear Weapons Complex a means of developing and maintaining critical manufacturing capabilities. In FY 2003, funding is requested for 16 individual campaigns and associated major programmatic line-item construction projects.

Program Strategic Performance Goals

NS 1-1: Conduct a program of warhead evaluation, maintenance, refurbishment, and production, planned in partnership with the Department of Defense.

Performance Indicator

Demonstrate an increasing scientific and technical ability to sustain warhead safety, security and reliability. (NS 1-1)

Performance Standards

Blue: Not Applicable

Green: All FY 2003 planned program milestones and deliverables are met; or, for any FY 2003 planned program milestone or deliverable not met, a corrective action plan or adjusted program plan is in place.

Yellow: Major FY 2003 planned program milestones or deliverables are not met, and corrective action plan or adjusted program plan is under development.

Red: Major FY 2003 planned program milestones or deliverables are not met, and corrective action plan or adjusted program plan is not in place and is not achievable within fiscal year or within Weapons Activities appropriation.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Target (Revised Final)	FY 2003 Proposed Target
Reported to the President on the need or lack of need to resume underground testing to certify the safety and reliability of the nuclear weapon stockpile.(NS1-1-1)	Report annually to the President on the need or lack of need to resume underground testing to certify the safety and reliability of the nuclear weapon stockpile. (NS1-1-1)	Report annually to the President on the need or lack of need to resume underground testing to certify the safety and reliability of the nuclear weapon stockpile. (NS 1-1-1)

Program Strategic Performance Goals

NS 1-2: Develop the scientific, design, engineering, testing, and manufacturing capabilities needed for long-term stewardship of the stockpile.

Performance Indicators

Demonstrate cradle-to-grave, science-based stockpile stewardship, including the capability to design and certify new nuclear warhead types. (NS 1-2)

Demonstrate that the scientific campaigns are increasing our understanding and capability to maintain the stockpile. (NS 1-2)

Demonstrate that production-readiness campaign activities are reestablishing or developing capabilities necessary for warhead maintenance and refurbishment. (NS 1-2)

Demonstrate that the ability to conduct underground nuclear testing, if necessary, is adequate to meet policy requirements. (NS 1-2)

Successfully establish the capability to manufacture and certify nuclear weapons primaries (pits). (NS 1-2)

Provide a reliable source of tritium to support planning and policy requirements. (NS 1-2)

Performance Standards

Blue: Not Applicable

Green: All FY 2003 planned program milestones and deliverables are met; or, for any FY 2003 planned program milestone or deliverable not met, a corrective action plan or adjusted program plan is in place.

Yellow: Major FY 2003 planned program milestones or deliverables are not met, and corrective action plan or adjusted program plan is under development.

Red: Major FY 2003 planned program milestones or deliverables are not met, and corrective action plan or adjusted program plan is not in place and is not achievable within fiscal year or within Weapons Activities appropriation.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Target (Revised Final)	FY 2003 Proposed Target
Successfully implemented the Program and Implementation Plans for the Scientific, Engineering, HEDP, ASC and Readiness campaigns and campaigns. (NS1-2-1) Completed conventional construction of the National Ignition Facility (NIF) (NS1-2-2) Completed delivery and started operation of ASCI White system at 12.3 trillion operations per second (TeraOps). (NS1-2-3) Manufactured development pits to support the manufacture of a certifiable W88 pit. (NS1-2-4)	Implement the Program and Implementation Plans for the Scientific, Engineering, HEDP, ASC and Readiness campaigns. (NS1-2-1) Installed the NIF cluster 3 beam-path infrastructure in Laser Bay 2 and Implement management of core diagnostic and cryogenic projects under the NIF Director. (NS1-2-2) Complete 3-D prototype full-system coupled simulation and 3-D safety simulation of a complex abnormal explosive-initiation scenario. (NS1-2-3) Complete 30 TeraOPS *Q* computer system at LANL. (NS1-2-3) Complete implementation of manufacturing and quality infrastructure required to fabricate a certifiable pit in FY 2003. (NS1-2-4)	Implement and execute the deliverables and milestones contained in the Program and Implementation Plans for the Scientific, Engineering, and Readiness campaigns. (NS1-2-1) Implement the High Energy Density Physics Campaign (formerly ICF) Program and Implementation Plan. (NS1-2-2) Implement the Advanced Simulation and Computing Campaign Program and Implementation Plans including the completion of initial capability for 3-D high-fidelity-physics primary burn simulation. (NS1-2-3) Manufacture the first certifiable W88 pit. (NS1-2-4)

Program Strategic Performance Goals

NS 4-1: Attract and retain the best laboratory and production workforce.

Performance Indicators

Provide challenging and rewarding work in a safe and secure environment. (NS-4-1-1)

Meet targets for hiring and retaining critical personnel. (NS 4-1-2)

Performance Standards

Blue: Not Applicable

Green: All FY 2003 planned program milestones and deliverables are met; or, for any FY 2003 planned program milestone or deliverable not met, a corrective action plan or adjusted program plan is in place.

Yellow: Major FY 2003 planned program milestones or deliverables are not met, and corrective action plan or adjusted program plan is under development.

Red: Major FY 2003 planned program milestones or deliverables are not met, and corrective action plan or adjusted program plan is not in place and is not achievable within fiscal year or within Weapons Activities appropriation.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Target (Revised Final)	FY 2003 Proposed Target
No previous measures	Meet targets included in workforce site plans and contracts for hiring and retaining critical personnel. (NS 4-1-1)	Meet FY 2003 targets included in workforce site plans for hiring and retaining critical personnel. (NS 4-1-1) Minimize the number of vacant critical skill positions and reduce the average age of the critically skilled workforce through recruitment and retention of a new generation of nuclear weapons stewards. (NS 4-1-2)

Program Strategic Performance Goals

NS 4-2: Provide state-of-the-art facilities and infrastructure supported by advanced scientific and technical tools to meet operational and mission requirements.

Performance Indicators

Develop and construct programmatic facilities needed to support the campaigns. (NS 4-2-1)

Implement the respective Project Execution Plans for the state-of-the-art facilities supporting the Science, High Energy Density Physics, Advanced Simulation and Computing, and Readiness campaigns. (NS 4-2-2)

Performance Standards

Blue: Not Applicable

Green: All FY 2003 planned program milestones and deliverables are met; or, for any FY 2003 planned program milestone or deliverable not met, a corrective action plan or adjusted program plan is in place.

Yellow: Major FY 2003 planned program milestones or deliverables are not met, and corrective action plan or adjusted program plan is under development.

Red: Major FY 2003 planned program milestones or deliverables are not met, and corrective action plan or adjusted program plan is not in place and is not achievable within fiscal year or within Weapons Activities appropriation.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Target (Revised Final)	FY 2003 Proposed Target
Completed the milestones contained in the Project Execution Plans for projects in support of the campaigns, including: the National Ignition Facility, (NIF); and the projects directly supporting the Advanced Simulation and Computing (ASC) campaign. (NS 4-2-1) Initiated construction of the Tritium Extraction Facility (TEF). (NS 4-2-2)	Complete the milestones contained in the Project Execution Plans (PEP) for projects in support of the campaigns, including: The first axis of the Dual Axis Radiographic Hydrodynamic Test facility, which became operational for experimental use in FY 1999 and the second axis is currently 80% complete; adherence to PEP milestones for the projects directly supporting the HEDP, ASC, and Tritium campaigns. (NS 4-2-1) Generation of the first electron beam in the second axis and generation of the first electrons from the injector are planned. (NS 4-2-2) Completion and start of Operations for the Strategic Computing Complex. (NS 4-2-3)	Meet milestones contained in the PEP for projects in support of the campaigns including: projects directly supporting the ASC campaign; and continued construction activities for the TEF. (NS 4-2-1) Production of an electron beam the entire length of the second axis in the Dual Axis Radiographic Hydrodynamic Test facility. (NS 4-2-2) Continued construction activities for the NIF including completing commissioning of the Optical Assembly Building and installation of First Laser Bay Flashlamp. (NS 4-2-3)

Significant Accomplishments and Program Shifts

There is no direct funding for Technology Partnerships in Campaigns. However, NNSA will continue to utilize various technology partnerships within campaigns as a means to reach the goals and objectives of the Stockpile Stewardship Program. Funding for ongoing Technology Partnerships activities is budgeted in the budget elements which they support. There is no funding requested for the Materials Readiness campaign.

Significant accomplishments of the individual campaigns are described below and in the Detailed Justification section.

FY 2001 Accomplishments

- OBOE 8 subcritical experiment successfully fired.
- Four weapon geometry hydrotests were fired.
- Extended measurement of the high- pressure/high temperature phase diagram of plutonium and hydrogen.
- Performed measurements of fundamental plutonium materials properties in support of pit manufacturing and qualification.
- Performed first experiments on the first axis of DARHT.
- Completed advanced electronic archiving of prompt diagnostic data for NTS events.
- Proof-of-principle analysis technique for shock rise completed and published.
- Completed modernization of data analysis codes.
- Operated Z-Beamlet backlighter system at full energy and first point experiments were executed.

- Developed advanced firing system technology (weak link capacitors, optical triggers, etc.) for the W80.
- Matured LIGA actuator technologies and refined stronglink design based on results (LIGA, an acronym from the German words for lithography, electroforming and molding, is a microfabrication process involving x-ray lithography, electrodeposition, and replication).
- Successfully demonstrated prototypes of enabling technologies.
- Certification validated capability for gas transfer systems
- Completed and documented a technical assessment of engineering computational tools to support the qualification of the W76-1 in abnormal thermal environments and the mechanical response to hostile environments.
- Established materials database.
- Completed Omega experiments to provide validation and source scaling data.
- Completed reactor experiments to establish better understanding of aged fissile material in neutron environments.
- Completed qualification of MC4380 neutron generator and development of high energy, heavy-ion, radiation effects microscope.
- Fabricated a fully functional, 64-kilobit Static Random Access Memory in silicon-on-insulator technology. Unlike commercially available circuits, this circuit is hardened to survive hostile environments that may be encountered by our weapon systems.
- Provided 10 new diagnostics tools for new stockpile evaluation test capabilities at Pantex, Y-12, Savannah River, Kansas City, LLNL and LANL.
- Provided component aging and lifetime assessments to support the B61, W76 and W80 LEP refurbishments.
- Began fabrication of plutonium alloys in which the aging process is accelerated to allow direct measurements of effects of aging on plutonium properties.
- Completed design of full-scale bipolar cell for lithium production.
- Delivered optimized procedures for HMX synthesis at pilot-plant scale in support of life extension programs (LEPs).
- Completed secure, seamless weapons data communications among four sites.
- Completed infrastructure deployment in support of collaborative models-based manufacture at three sites.
- Completed conventional construction of the National Ignition Facility (NIF)
- Performed first integrated 2D calculations of the simultaneous effects of laser imprint and target nonuniformity on the baseline deuterium ablator NIF direct-drive target.

- Fielded first direct drive cryogenic implosion experiments on Omega.
- Completed Z-beamlet Laser.
- Completed delivery and started operation of ASCI White system at 12.3 trillion operations per second (TeraOPS).
- Continued operation of ASCI Red system at 3.15 TeraOPS, ASCI Blue Mountain System at 3.07 TeraOPS, and ASCI Blue Pacific System at 3.89 TeraOPS in support of numerous stockpile stewardship applications.
- Manufactured development pits to support the manufacture of a certifiable W88 pit.
- Initiated pre-conceptual activities for a Modern Pit Facility.
- Completed installation of all equipment required for war reserve manufacture.
- Continued modernization planning efforts and provided Other Project Costs for the Highly Enriched Uranium Materials Facility.
- Procured and initiated installation of critical production equipment in support of near-term life extension programs (LEPs).
- Provided facility safety basis, process hazards analysis, and container certification.
- Provided analytical and physical testing support for PBX 9501.
- Modified/upgraded and qualified neutron generator, active ceramic, and neutron generator explosive testers to support DSW work.
- Provide resources for the management of all enriched uranium scrap shipments and receipts.
- Provide planning and management to place Building 9206 in a well-characterized, stable and dormant condition.
- Awarded contract for the fabrication of tritium-producing rods (TPBARs).
- Started construction of the Tritium Extraction Facility (TEF).
- Tennessee Valley Authority (TVA) submitted requests for the Watts Bar and Sequoyah Reactors License Amendments to the Nuclear Regulatory Commission (NRC).

<u>FY 2002 Planned Accomplishments</u>

- Validate High Explosives burn model.
- Vito, Rocco, and Mario subcritical experiments.
- Piano/OBOE 7/Trumpet series subcritical experiments.
- Measure Pu equation of state (EOS) on JASPER up to 400 Gpa.
- Conduct Isentropic Compression Experiments on Z up to 200 GPa and 2000K.

- Develop LIGA structure with engineering material.
- Evaluate requirements for an Advanced Hydrotest Facility (AHF).
- Begin commissioning of DARHT II.
- Construct improved models for primary emission in 2-D.
- Complete initial series of LED AGEX for case dynamics.
- Complete initial series of scaled 3-D radiation flow experiments.
- Measure inelastic scattering cross sections for Uranium, Plutonium and Iridium using Germanium Array for Neutron-Induced Excitation (GEANIE) at Los Alamos Neutron Science Center.
- Design and test second LIGA test vehicle that includes LIGA-based actuators.
- Begin new-design microfiring set with rad-hard optical triggering and micro-technologies.
- Demonstrate photo-sensitive optical switch for the W80.
- Develop CAT-H elements for the W80 Block 1.
- Develop surety enhancements for a CAT-F application.
- Technology demonstration of advanced container options.
- Develop and test prototype advanced power sources.
- Deliver a validated capability to predict the off-axis crush response of honeycomb.
- Complete Gap Analysis for W80-3 for collaborations on W80 SLEP and DSW.
- Deliver instrumented NEP Flight Test Unit.
- Assess capability to predict combined abnormal environments insult to the Nuclear Explosive Package.
- Complete initial assessment of threat outputs and initial Blue Book system output re-evaluations.
- Complete initial LLNL hot source validation experiments.
- Complete validation of 2D cable SGEMP design code for flat flex cable, develop an improved radiation source on Saturn, and demonstrate Silicon-On-Insulator (SOI) subsystem radiation hardness.
- Achieve full characterization on radiation hardened digital SOI fabricated parts to support simulation guidelines and provide 0.35 micron radiation hardened digital SOI ASIC design to the IC fabrication facility.
- Assess vulnerability test results on aged Pu.
- Complete procurement and installation of 8mil resolution x-ray tomography system at Pantex.
- Conduct validation efforts on 3-D models of Canned Sub-Assembly (CSA) aging.
- Deliver and validate test procedures to predict performance of Arming Fusing & Firing shields for W76.

- Complete initial assessment of component lifetime for an expanded suite of B61components and update in B61 life assessment reports.
- Complete implementation of insensitive high-explosive booster performance and detonator safety into core surveillance.
- Demonstrate neutron imaging simulation of W80 CSA.
- Issue Engineering Authorization Business Practice.
- Complete initial W76 Acorn weld studies.
- Demonstrate new and improved dimensional inspection techniques.
- Installed the NIF cluster 3 beam-path infrastructure in Laser Bay 2.
- Implement management of core diagnostic and cryogenic projects reporting to the NIF Director.
- Execute approximately 50 cryogenic implosions on the Omega Laser.
- Extend deuterium equation-of-state data experiments on Z to higher pressures.
- Test advanced direct drive ignition target designs on the Nike Laser.
- Complete 3-D prototype full-system coupled simulation and 3-D safety simulation of a complex abnormal explosive-initiation scenario.
- Complete 30 TeraOPS *Q* computer system at LANL.
- Complete implementation of manufacturing and quality infrastructure required to fabricate a certifiable pit in FY 2003.
- Complete critical decision on mission need (CD-0) to initiate development of a conceptual design for a Modern Pit Facility.
- Initiate CDR for Utility Upgrade Project, Purification Prototype Facility and the Beryllium Manufacturing Facility.
- Continue procurement of key manufacturing equipment and continue installation of FY 2001 procured equipment supporting the LEPs.
- Implement Integrated Pit Inspection Station and Interactive Electronic Procedures. Deploy SecureNet, servers, additional classified workstations and software.
- Deploy synthesis and formulation processes for PBX 9501 with backup capacity.
- Deploy Commercial Off-the-Shelf process at KC.
- Complete design of detonator facility at LANL.
- Initiate procurement and installation of equipment to support LEPs.
- Expand high performance computing at KC.

- Complete a survey of national security materials and requirements.
- Complete gap analysis and identify a strategy or program elements for filling gaps.
- Begin fabrication of tritium-producing rods (TPBARs) at rate of 400 rods per month.
- Award contract for long-term transportation services for irradiated TPBARs.
- Place test articles in TVA's Watts Bar reactor for the "Thimble Tube Test".
- Award fixed price contract for Tritium Extraction Facility remainder of plant (ROP) (NS 1-2)

Funding Profile

(dollars in thousands)

Campaigns	FY 2001 Comparable Appropriation	FY 2002 Original Appropriation	FY 2002 Adjustments	FY 2002 Comparable Appropriation	FY 2003 Request
Primary Certification	45,396	52,500	-1,652 [a]	50,848	47,159
Dynamic Materials Properties	66,795	87,400	2,882 [b]	90,282	87,594
Advanced Radiography O&M	48,459	85,803	-3,460 [c]	82,343	52,925
97-D-102, Dual-Axis Radiographic Hydrotest Facility	35,154	0	0	0	0
Subtotal, Advanced Radiography	83,613	85,803	-3,460 c	82,343	52,925
Secondary Certification & Nuclear Systems Margins	41,720	44,000	-1,561 a	42,439	47,790
Subtotal, Science Campaigns	**237,524**	**269,703**	**-3,791**	**265,912**	**235,468**
Enhanced Surety	30,543	37,000	-4,803 a	32,197	37,713
Weapons Systems Engineering Certification	15,330	26,665	-939 a	25,726	27,007
Nuclear Survivability	15,097	23,694	-1,792 a	21,902	23,394
Enhanced Surveillance	103,148	82,333	-8,648 a	73,685	77,155
Advanced Design & Production Technologies	75,958	75,533	-7,101 a	68,432	74,141
Subtotal, Engineering Campaigns	**240,076**	**245,225**	**-23,283**	**221,942**	**239,410**

[a] Adjustment resulting from the General Reduction contained in P.L. 107-66.

[b] Adjustments reflect use of limited reprogramming authority from the Conference Report accompanying P.L. 107-66.

[c] Adjustment of $ -578,000 is part of the General Reduction from P.L. 107-66; and $ -2,882,000 reflects use of limited reprogramming authority from the Conference Report accompanying P.L. 107-66.

(dollars in thousands)

Campaigns	FY 2001 Comparable Appropriation	FY 2002 Original Appropriation	FY 2002 Adjustments	FY 2002 Comparable Appropriation	FY 2003 Request
High Energy Density Physics O&M . .	231,225	261,443	-1,070 [a]	260,373	237,748
96-D-111, National Ignition Facility . .	197,255	245,000	0	245,000	214,045
Subtotal, High Energy Density Physics	428,480	506,443	-1,070 [a]	505,373	451,793
Advanced Simulation and Computing O&M	676,732	675,000	-12,208 [a]	662,792	669,527
01-D-101, Distributed Information Systems Laboratory	2,295	8,400	0	8,400	13,305
00-D-103, Terascale Simulation Facility	4,889	22,000	0	22,000	35,030
00-D-105, Strategic Computing Complex	55,877	11,070	0	11,070	0
00-D-107, Joint Computational Engineering Laboratory	6,685	13,377	0	13,377	7,000
Subtotal, Advanced Simulation & Computing	746,478	729,847	-12,208 [a]	717,639	724,862
Pit Manufacturing and Certification . .	157,181	219,000	-24,539 [a]	194,461	194,484
Stockpile Readiness	31,087	47,169	-854 [a]	46,315	61,027
HE/Assembly Readiness	3,395	6,846	-124 [a]	6,722	12,093
Nonnuclear Readiness	2,939	18,187	-330 [a]	17,857	22,398
Materials Readiness	6,163	1,209	-21 [a]	1,188	0
Tritium Readiness O&M	75,519	42,350	-766 [a]	41,584	56,134
98-D-125, Tritium Extraction Facility	74,835	81,125	0	81,125	70,165
98-D-126, Accelerator Production of Tritium, VL	14,967	0	0	0	0
Subtotal, Tritium Readiness	165,321	123,475	-766 a	122,709	126,299
Subtotal, Readiness Campaigns . . .	**208,905**	**196,886**	**-2,095**	**194,791**	**221,817**
Total, Campaigns	**2,018,644**	**2,167,104**	**-66,986**	**2,100,118**	**2,067,834**

[a] Adjustment resulting from the General Reduction contained in P.L. 107-66.

Public Law Authorization:

Public Law 107-107, National Defense Authorization Act, FY 2002
Public Law 107-66, "Energy and Water Development Appropriations Act for FY 2002"

Funding by Site

Campaigns:	FY 2001	FY 2002	FY 2003	$ Change	% Change
	(dollars in thousands)				
Albuquerque Operations Office					
Albuquerque Operations Office	19,333	0	0	0	0.0%
Kansas City Plant	41,318	40,193	42,128	1,935	4.8%
Los Alamos National Laboratory	601,179	487,642	485,988	-1,654	-0.3%
Pantex Plant	19,633	16,424	21,740	5,316	32.4%
Sandia National Laboratories	324,857	304,426	324,876	20,450	6.7%
Total, Albuquerque Operations Office	1,006,320	848,685	874,732	26,047	3.1%
Chicago Operations Office					
Argonne National Laboratories	1,500	576	397	-179	-31.1%
Brookhaven National Laboratory	0	0	0	0	0.0%
Chicago Operations Office	12,077	2,000	1,987	-13	-0.7%
Total, Chicago Operations Office	13,577	2,576	2,384	-192	-7.5%
Headquarters	5,376	289,393	274,908	-14,485	-5.0%
Idaho National Engineering and Environmental Laboratory	85	250	0	-250	0.0%
National Energy Technology Laboratory	3,235	0	0	0	0.0%
Nevada Operations Office	49,088	56,612	41,107	-15,505	-27.4%
Oakland Operations Office					
General Atomics	9,785	7,558	8,695	1,137	15.0%
Lawrence Berkeley National Laboratory	5,615	0	0	0	0.0%
Lawrence Livermore National Laboratory	659,073	666,312	638,930	-27,382	-4.1%
Naval Research Laboratory	24,705	21,287	10,000	-11,287	-53.0%
Oakland Operations Office	5,481	6,994	7,442	448	6.4%
University of Rochester/Laboratory for Laser Energetics	33,150	34,693	36,400	1,707	4.9%
Total, Oakland Operations Office	737,809	736,844	701,467	-35,377	-4.8%

Campaigns:	FY 2001	FY 2002	FY 2003	$ Change	% Change
	(dollars in thousands)				
Oak Ridge Operations Office					
Oak Ridge Operations Office	340	0	0	0	0.0%
Oak Ridge National Laboratory	5,348	4,967	5,151	184	3.7%
Office of Science and Technology	150	149	149	0	0.0%
Y-12 National Security Complex	63,673	67,180	75,262	8,082	12.0%
Total, Oak Ridge Operations Office	69,511	72,296	80,562	8,266	11.4%
Richland Operations Office					
Pacific Northwest National Laboratory	42,665	3,548	0	-3,548	0
Savannah River Operations Office					
Savannah River Site	90,978	89,914	92,674	2,760	3.1%
Total, Campaigns	**2,018,644**	**2,100,118**	**2,067,834**	**-32,284**	**-1.5%**

Primary Certification

Mission Supporting Goals and Objectives

Primary Certification integrates the laboratory research and development efforts in materials science, engineering, and dynamic system behavior to develop certification tools and methodologies to certify the performance and safety of any rebuilt or aged primary to a specific yield.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Boost Physics	3,549	5,156	5,175	19	0.4%
Engineering Component Analysis	100	250	565	315	126.0%
Materials Science Integration and Analysis	13,581	12,605	12,124	-481	-3.8%
Integrated Hydro Test Assessment	875	1,855	2,233	378	20.4%
Subcritical Experiments	23,814	28,158	24,680	-3,478	-12.4%
Legacy Data Analysis and Archiving	3,477	2,824	2,382	-442	-15.7%
Total, Primary Certification	45,396	50,848	47,159	(3,689)	-7.3%

Performance Measures

Performance will be demonstrated by:

- Evaluating historical test data for archiving.
- Assessing the effect of engineering and manufacturing technologies on pits.
- Conducting experiments and testing validated computational models.
- Continuing development of an improved dynamic model.
- Obtaining equation of state (EOS) and other data from subcritical experiments.
- Evaluating thermochemically based high explosive EOS.
- Validating pit material EOS models in FY 2003.
- Conducting subcritical experiments: Piano, Trumpet 1, 2, and 3.

Past achievements in this campaign include:

- OBOE 6, 7 and 8 subcritical experiments fired successfully and yielded excellent results.
- Improvements were made to the radiographic scatter reducing collimator that allows flash x-ray radiography of thick weapon geometry objects.
- Weapon geometry hydros have been successfully fired.
- A new fiber optic diagnostic for measuring high explosive burn front velocity was developed.

Detailed Program Justification

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Boost Physics	3,549	5,156	5,175
Develop an improved thermonuclear boost model to support the campaign certification goal.			
Engineering Component Analysis	100	250	565
Assess the impact of new manufacturing technologies on remanufactured components; and develop a pit engineering evaluation of each stockpile weapon system.			
Materials Science Integration and Analysis	13,581	12,605	12,124
Validate improved materials properties models and use these models to improve computational predictions of primary performance.			
Integrated Hydro Test Assessment	875	1,855	2,233
Conduct integrated hydrodynamic experiments to validate computational models and to demonstrate a certification methodology for aged and remanufactured components.			
Subcritical Experiments	23,814	28,158	24,680
Conduct integrated subcritical experiments to measure the properties of remanufactured and aged pits.			
Legacy Data Analysis and Archiving	3,477	2,824	2,382
Analyze historical nuclear test data and develop an accessible archive of information relevant to the certification of primaries in the enduring stockpile.			
Total, Primary Certification	**45,396**	**50,848**	**47,159**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Primary Certification	
# Principal change is a decrease in funding for Nevada support of subcritical experiments in this activity. This is due to a programmatic decision to move appropriate funding of the Accordian subcritical experiment to DSW.	
Total Funding Change, Primary Certification	**-3,689**

Capital Operating Expenses & Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	256	264	272	8	3.00%
Total, Capital Operating Expenses	256	264	272	8	3.00%

[a] Since funds are appropriated for Operations and Maintenance, which includes operating expenses, capital equipment and general plant projects, we no longer budget separately for capital equipment and general plant projects. FY 2002 and FY 2003 funding shown reflects estimates based on actual FY2001 obligations.

Dynamic Materials Properties

Mission Supporting Goals and Objectives

The Dynamic Materials Properties campaign supports the development of physics-based, experimentally validated physical data and materials models of all stockpile materials, at the level of accuracy required by the certification and engineering campaigns. The campaign's objective is to develop experimentally validated predictive materials models and physical data of all materials required to assess the performance, safety, and reliability of stockpiled weapons.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Stockpile Materials Equation of State (EOS), Melt, and Phase Transitions	16,709	13,536	14,420	884	6.5%
Constitutive Properties of Metals: Strength, Spall, and Ejecta	23,450	32,195	32,785	590	1.8%
High Explosives (HE) Performance and Safety; Dynamic Loading of Foams and Organics	12,402	16,887	16,290	-597	-3.5%
Materials Processing, Properties and Performance	10,774	8,548	10,330	1,782	20.8%
University Partnerships	2,500	17,508	13,110	-4,398	-25.1%
Physical Data Computational Support	460	151	149	-2	-1.3%
Nanoscience	500	1,457	510	-947	-65.0%
Total, Dynamic Materials Properties	66,795	90,282	87,594	(2,688)	-3.0%

Performance Measures

Performance will be demonstrated by:

- Extending measurements of the high-pressure/high-temperature phase diagrams of both plutonium and hydrogen.
- Measuring the dynamic materials properties of plutonium at the Joint Actinides Shock Physics Experimental Research (JASPER) facility at the Nevada Test Site (NTS).
- Performing Isentropic Compression Experiments (ICE) on stockpile-relevant materials beyond 100 GPa.
- Measuring dynamic strength of materials, experimentally characterizing ejecta, and performing dynamic measurements of interfacial interactions in weapons materials.
- Development and assessment of techniques and methods for equation-of-state measurements of SNM on the Z machine.

- Establishing experimental techniques to benchmark grain-scale high explosives to validate fundamental physics-based materials models.
- Demonstration of a miniature LIGA structure with engineering-quality surface strength.
- Developing the Atlas pulsed-power facility to characterize material strength for Al, Ta, U and Be at high strains and strain-rates.
- Maintaining a robust user program for stockpile stewardship and basic research at the Los Alamos Neutron Science Center (LANSCE) facility.
- Creating a joint theoretical, simulation, and experimental materials science program to predict the processing/structure/properties relationships that control the performance of surfaces and interfaces for microsystems.
- Maintaining a competitive academic alliances program in technical areas of relevance to the Dynamic Materials Properties Campaign.

<u>Past achievements in this campaign include</u>:

- Measured sound speed in shocked deuterium (D_2) that are consistent with the "soft" Hugoniot measured on the NOVA laser facility.
- Performed a series of calibration shots on non-nuclear materials at the JASPER facility at NTS.
- Determined the pressure-temperature (p, T) dependence of the large volume collapse transitions in praseodymium up to 900 K at high pressures.
- Successfully obtained and analyzed data on ejecta and spall from several U1a subcritical experiments.
- Validated a new high explosive reactive flow model for LX-17.
- Combined LANSCE and x-ray spectrographic techniques with ultrasonic methods to determine the high pressure and temperature properties for a new molybdenum equation of state in preparation for plutonium experiments.
- Developed techniques to use magnetically driven Isentropic Compression Experiments (ICE) on the Z-accelerator to obtain high-pressure equation of state and strength data, by completing proof of principle measurements on aluminum up to 150 GPa.
- Measured shock EOS properties on deuterium to 70 GPa using flyer-plate techniques on the Z-accelerator.
- Evaluated wear and mechanical performance of electro-composite and nano-laminated LIGA structures.
- Determined constitutive properties of ceramic materials during sintering.
- Completed and released the formal solicitation for the Stewardship Science Academic Alliances Program.

Detailed Program Justification

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Stockpile Materials Equation of State (EOS), Melt, and Phase Transitions	16,709	13,536	14,420

Develop physics-based and experimentally-validated data and models for the thermodynamic properties (EOS, melt, phase diagram) of stockpile materials, with emphasis on plutonium and other relevant metals, and hydrogen.

Constitutive Properties of Metals: Strength, Spall, and Ejecta	23,450	32,195	32,785

Develop physics-based and experimentally validated data and multi-length-scale models for the mechanical constitutive properties and dynamic response of stockpile materials, with emphasis on plutonium and other metals.

High Explosives (HE) Performance and Safety; Dynamic Loading of Foams and Organics	12,402	16,887	16,290

Develop physics-based and experimentally validated data and models for high explosives, organics and foams as they specifically affect performance and safety.

Materials Processing, Properties and Performance	10,774	8,548	10,330

Develop a quantitative understanding of how process variables determine the microstructure and composition of materials that ultimately control their critical performance properties.

University Partnerships	2,500	17,508	13,110

Establish academic alliances through a competitively funded program in materials science and other research areas of relevance to stockpile stewardship. DOE/NNSA realizes the importance of increasing the level of effort in university partnerships to maintain the intellectual vitality of the NNSA/DP laboratories complex.

Physical Data Computational Support	460	151	149

Provide physical data computational user support.

Nanoscience	500	1,457	510

Develop scientific understanding of novel classes of nanoscale materials structures, properties, and processing techniques, in addition to developing new characterization and synthesis tools for nanostructured materials.

Total, Dynamic Materials Properties	**66,795**	**90,282**	**87,594**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Dynamic Materials Properties	
# Decrement will lead to termination of all DP-supported activities within the DP/BES Nanoscience Network	-947
# Decrement will result in funding university partnerships at a slower pace than originally planned	-4,398
# Increase supports more extensive and comprehensive experimental measurements of the fundamental materials properties of plutonium, including equation of state, phase diagram, constitutive properties, and materials response under high-pressure, high-temperature, and dynamic loading conditions. In particular, increase supports the shock physics plutonium materials program at the JASPER gas gun facility at NTS. Increase also supports improved experimental characterization of other stockpile materials.	2,657
Total Funding Change, Dynamic Materials Properties	**-2,688**

Capital Operating Expenses & Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	2,552	2,629	2,707	79	3.00%
Total, Capital Operating Expenses	2,552	2,629	2,707	79	3.00%

[a] Since funds are appropriated for Operations and Maintenance, which includes operating expenses, capital equipment and general plant projects, we no longer budget separately for capital equipment and general plant projects. FY 2002 and FY 2003 funding shown reflects estimates based on actual FY2001 obligations.

Advanced Radiography

Mission Supporting Goals and Objectives

Advanced Radiography supports research and development technologies for multi-view, time-gated images of imploding surrogate primaries, with sufficient spatial resolution to resolve uncertainties in primary performance. This includes programmatic efforts to commission the second axis of DARHT and research to optimize the performance of DARHT first and second axis. Further activities for special materials acquisition, diagnostics optimization, and confinement vessel optimization are supported in order to make best use of existing radiographic facilities. The long term goal is to develop technologies for an advanced radiography facility through experimental work in proton radiography and through the studies of requirements and possible architectures for an advanced radiography facility.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
DARHT Optimization	12,910	22,350	22,100	(250)	-1.1%
Simulation and Analysis	3,434	5,100	4,500	(600)	-11.8%
Provide Required Materials	4,569	10,976	10,983	7	0.1%
Advanced Radiography Requirements and Technology Development	25,909	41,917	15,342	(26,575)	-63.4%
Vessel Development and Certification	1,637	2,000	0	(2,000)	-100.0%
Construction	35,154	0	0	0	0.0%
Total, Advanced Radiography..............	83,613	82,343	52,925	-29,418	-35.7%

Performance Measures

Performance will be demonstrated by:

- Achieving optimum/minimum spot size on a DARHT I target.
- Completing design of a multi-pulse target for DARHT II.
- Executing the commissioning plan for DARHT II.
- Completing evaluation of requirements for an advanced radiography facility.
- Experimental proton radiography activities.
- Identifying preferred long-term material sources and developing supporting technologies for recovery and extraction.
- Developing technologies for multi-axis confinement systems.

Past achievements in this campaign include:

- Radiographed burning high explosives with protons at LANSCE, demonstrating features of proton radiography including time dependence and obtaining direct data on a stockpile performance issue.

- Demonstrated several capabilities key to DARHT optimization at the ETA-II accelerator, including:
  - First solid-state kicker pulser with 2 kA electron beam, marking the first time that solid-state technology has been used with a relativistic electron beam as a load.
  - Production of submillimeter x-ray spot size on a Tantalum x-ray converter target.
  - First double pulse target experiments and demonstration of backstreaming ion suppression.
- Performed benchmarking calculations on the effect of background gas on electron beam stability using the DARHT first axis.
- Developed, procured, and fabricated the diagnostics that will be used to measure long-pulse beam parameters during commissioning of the DARHT second axis injector.
- Performed validation of the DARHT second axis accelerator cell design, vacuum integrity, beam loss effects, and diagnostic utility using the THOR machine.
- Completed several high-precision experiments at the Duke Free-Election Laser facility to measure total photon absorption cross sections at various energies for the materials copper and tungsten, providing very precise cross sections in support of capability to perform highly accurate simulations.
- Development of a deterministic model for calculating proton radiographs incorporating multiple Coulomb scattering, energy loss, magnetic beam-line mapping, and scattering angle cuts.
- Combined PIC (electromagnetic) and MCNP (transport) computer codes in static form to simulate e-beam/target interactions, bremsstrahlung X-ray production, and transport through an object onto a detector.
- Implemented inverse reconstruction accounting for object tilt and applied to analyze X-ray and proton radiographs with tilt up to 45 degrees.
- Completed initial modeling effort on material loss/supply rate estimates.
- Completed draft pre-conceptual design report for Advanced Hydrotest Facility (AHF) project.
- Completed 4 key trade studies on synchotron design, beam transport systems, power supplies, and site configuration to develop options for lower project cost for the Advanced Hydrotest Facility project.
- Design and development of a half-scale windowless, aluminum-composite containment vessel in support of multi-axis radiography systems.

Detailed Program Justification

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
DARHT Optimization	12,910	22,350	22,100

Commission DARHT II and optimize experimental use of DARHT. Tasks comprising this effort encompass: reduction of first axis x-ray spot size to explore a wider variety of hydrodynamic phenomena that requires extremely high resolution; and optimizing the second axis detectors and the x-ray source to enhance quality of dynamic images.

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Simulation and Analysis	3,434	5,100	4,500

Develop and apply comprehensive radiographic simulation and analysis tools, including accurate simulation capability for x-ray and proton transport, efficient and accurate techniques for characterizing radiographic data, and forward and inverse modeling capabilities to analyze radiographs.

Provide Required Materials	4,569	10,976	10,983

Develop and implement a plan for materials, including development of enhanced recovery techniques and processing capabilities at LANL and development of separation capabilities at LLNL.

Advanced Radiography Requirements and Technology Development	25,909	41,917	15,342

This element supports research in proton radiography at LANSCE and the AGS at Brookhaven and other technology development for multi-axis, multi-time radiography. Advanced x-ray technologies are pursued for compact down-hole radiography sources for diagnosing materials properties in subcritical experiments. A switchyard kicker is being developed for LANSCE to improve beam availability for proton radiogrophy research. Funding was added in the FY 2002 Appropriations Act to continue research, development and conceptual design for an advanced hydrodynamic test facility (AHF), including further development and evaluation of proton radiography. All continuing work on requirements or development studies for an AHF are deferred in FY 2003.

Vessel Development and Certification	1,637	2,000	0

Begin development and certification of experimental vessels suitable for use in multi-axis radiography, including exploration of composite vessel technologies. While this technology is a critical component for an Advanced Hydro Facility, all work on vessels and confinement systems for an AHF are deferred in FY 2003.

Construction	35,154	0	0

97-D-102, Dual-Axis Radiographic Hydrotest Facility, LANL. Final funding for DARHT was appropriated in FY 2001, with additional funding of $6.1 million provided in FY 2001 in the Cerro Grande Fire appropriation account to mitigate the impacts of the fire on this project.

Total, Advanced Radiography	**83,613**	**82,343**	**52,925**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Advanced Radiography	
# Reduce the level of effort of experiments on proton radiography at LANSCE and defer all continuing work on requirements or development studies for an Advanced Hydrodynamics Facility (AHF).	-26,575
# Defer further development work on vessels and confinement systems for an Advanced Hydrodynamics Facility.	-2,000
# Adjustment to DARHT II commissioning effort and long term R&D effort for radiography simulation and analysis	-843
Total Funding Change, Advanced Radiography	**-29,418**

Capital Operating Expenses & Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	2,545	2,621	2,700	79	3.00%
Total, Capital Operating Expenses	2,545	2,621	2,700	79	3.00%

Major Items of Equipment (TEC $2 million or greater)

	Total Estimated Cost	Prior Year Approp-riations	FY 2001	FY 2002	FY 2003	Acceptance Date
Switchyard Kicker	3,827	0	1,216	2,068	544	FY 2004

The Switchyard Kicker is a pulsed electromagnetic deflecting device which will provide the capability for rapid switching of the LANSCE accelerator high energy beam between two beamlines. This will enable real time beam sharing between the proton radiography facility in line C and other operations, most notably those at the Manuel Lujan Neutron Scattering Center. This device will allow both facilities to operate independently, therefore increasing the productivity at both locations.

[a] Since funds are appropriated for Operations and Maintenance, which includes operating expenses, capital equipment and general plant projects, we no longer budget separately for capital equipment and general plant projects. FY 2002 and FY 2003 funding shown reflects estimates based on actual FY2001 obligations.

Secondary Certification and Nuclear System Margins

Mission Supporting Goals and Objectives

The goal of this campaign is to develop modern secondary assessment through identification and resolution of uncertainties in the understanding and prediction of secondary physics and development of models, tools, and analysis to support warhead certification now and in the future. Modern secondary assessment is based on reexamination of past nuclear test data, the use of low-energy-density and high-energy-density aboveground experiments (AGEX), all coupled to modern design codes and sub-grid model development. In addition to developing new secondary assessment tools, this campaign will also serve to help develop the future "expert judgment" for the new stewards. Among the key tools to be developed are computational baseline models using both existing simulation tools and new simulation codes incorporating more first principle physics models that, through detailed verification and validation, will become the assessment and certification tools for the future. This effort will rely heavily on the use of AGEX facilities and require the development of new experimental diagnostics, measurement techniques, and targets.

The FY 2003 budget directs resources toward selected activities, such as case dynamics, important for near term stockpile deliverables. Consistent with NNSA priorities, this budget will result in delays of the high-energy-density-physics experimental program on major facilities such as NIF (under construction at Lawrence Livermore National Laboratory).

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Radiation Source	8,056	3,651	3,950	299	8.2%
Initial Radiation Case Dynamics	5,970	9,120	14,380	5,260	57.7%
Radiation Flow	13,315	17,630	15,860	-1,770	-10.0%
Secondary Performance	12,584	10,422	11,900	1,478	14.2%
University Grants/Other Support	1,795	1,616	1,700	84	5.2%
Total, Secondary Certification and Nuclear Systems Margins	41,720	42,439	47,790	5,351	12.6%

Performance Measures

Performance will be demonstrated as follows:

- Perform planned baselining calculations
- Perform proton radiography experiments investigating case dynamics
- Determine basic mechanistic data and experimentally determined model parameters for strength, damage, failure, shock/strain, etc.

- Implement an improved two-dimensional, low-energy density dynamics model
- Perform radiation-flow experiments on the Z accelerator facility at Sandia National Laboratories
- Demonstrate/develop opacity, pulse shaping, and other Z capabilities
- Test models for dynamic hohlraums on Z
- Develop National Ignition Facility (NIF) experimental support technology (diagnostics, targets, etc.) for weapons physics experiments consistent with available funding
- Develop and field calibrated diagnostic for Omega hydrodynamic tests
- Measure neutron cross-sections for unstable radiochemical isotopes using DANCE (Device for Advanced Neutron Capture Experiments) at LANSCE at Los Alamos National Laboratory (LANL)
- Implement an improved two-dimensional energy balance model
- Demonstrate the initial two-dimensional simulation required for Lawrence Livermore National Laboratory (LLNL) 2005 campaign milestone

<u>Past achievements in this campaign are as follows</u>:

- Completed advanced electronic archiving of prompt diagnostic data for nuclear tests
- Completed and published proof-of-principle analysis technique for shock rise
- Completed modernization of data analysis codes, published PINEX (an underground nuclear test diagnostic) Handbook, several radio-chemical reports, and Recording Practices Handbook
- Operated the Z-Beamlet backlighter at full energy and executed the first point projection experiments
- Completed an ultra-high vacuum chamber for thin-film organic deposition, assembly of a miniature two-stage gas gun, and a short-pulse laser-driven mass spectrometer for application to high explosive, metals, and case dynamics (HERCULES program)
- Resolved of the shock-front rise in high explosive systems and metals for the first time, via short- pulse laser probe on HERCULES
- Determined, with high precision, the (n,2n) cross section of plutonium at LANSCE resolving a long standing problem in radio-chemical data interpretation
- Completed the initial material sensitivity analysis (cross-sections, opacity, equations-of-state)
- Completed a two-dimensional analysis of past underground test and low-energy-density AGEX data
- Completed two-dimensional re-evaluations of primary-yield for several relevant nuclear tests
- Completed an initial series of high-energy-density experiments to examine relevant hydrodynamics
- Improved a two-dimensional low-energy-density dynamics model
- Completed a series of radiation-flow experiments in complicated two- and three-dimensional geometries to verify the radiation transport algorithms incorporated in three-dimensional ASC codes
- Completed initial experiments studying complex interplay of coupled radiation-driven hydrodynamics and radiation energy flow of importance to the stockpile life extension program
- Completed initial implementation of improved two-dimensional, sub-grid energy balance model
- Completed a initial series of low-energy-density AGEX examining high-explosive-induced dynamics
- Completed two-dimensional re-analysis using modern computational tools and physical databases of past underground test
- Identified issues important to two-dimensional simulations necessary to meet LLNL 2005 goals
- Completed initial shock/strain experiments on steel and uranium
- Began work on the uranium authorization basis and containment system at LANSCE for proton radiography experiments

- Measured the first neutron capture cross sections at DANCE (Device for Advanced Neutron Capture Experiments) forerunner at LANSCE
- Measured the radiation spectrum at peak power for dynamic hohlraums on Z
- Measured the time-dependence of radiation spectrum for dynamic hohlraums on Z
- Fielded deuterium-filled targets on Z in preparation for integrated implosion experiments
- Completed x-ray imaging system for point projection radiography on Z

Detailed Program Justification

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Radiation Source	8,056	3,651	3,950

Develop a validated, predictive computational capability for primary radiation emission, and complete a modern re-evaluation of primary outputs.

Initial Radiation Case Dynamics	5,970	9,120	14,380

Determine the effects of high explosive-induced case dynamics and experimentally determine distribution for full-size systems.

Radiation Flow	13,315	17,630	15,860

Determine other effects of energy flow, including a validated predictive model capability for energy flow associated with primary explosion through to secondary explosion, and develop advanced energy-flow diagnostics for use on NIF and other AGEX facilities.

Secondary Performance	12,584	10,422	11,900

Determine performance of nominal, aged, and rebuilt secondaries, including development of predictive capabilities validated on underground test measurements, implementation of advanced computational techniques, and development of advanced diagnostics for use on NIF and other AGEX facilities.

University Grants/Other Support	1,795	1,616	1,700

Headquarters supported activities include university grants in high-energy-density science and support of critical technical needs.

Total, Secondary Certification	**41,720**	**42,439**	**47,790**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Secondary Certification and Nuclear Systems Margins	
# Retain FY 2002 level of effort in re-analysis of nuclear tests supporting weapons system baseline development	299
# Pursue development of a thorough understanding of case dynamics physics, which is key to weapons system performance modeling, including ongoing annual assessment, weapons system life extensions, and modern baseline development	5,260
# Decrease experimental support technology development for high-energy-density-physics experiments for major facilities such as NIF, under construction at Lawrence Livermore National Laboratory	-292
# Increase funds supporting the High Energy Density Physics Grants program	84
Total Funding Change, Secondary Certification and Nuclear Systems Margins	**5,351**

Capital Operating Expenses & Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	3,028	3,119	3,212	94	3.00%
Total, Capital Operating Expenses	3,028	3,119	3,212	94	3.00%

[a] Since funds are appropriated for Operations and Maintenance, which includes operating expenses, capital equipment and general plant projects, we no longer budget separately for capital equipment and general plant projects. FY 2002 and FY 2003 funding shown reflects estimates based on actual FY2001 obligations.

Enhanced Surety

Mission Supporting Goals and Objectives

Enhanced Surety provides validated technology for inclusion in the stockpile refurbishment program to assure that modern nuclear safety standards are fully met and to provide a new level of use-denial performance. The Campaign will pursue a multi-technology approach to develop options for possible selection by weapon system designers during scheduled stockpile refurbishments. This multi-technology development will also open the design space and result in synergistic improvements in other weapon components. The campaign's objective is to demonstrate enhanced use-denial and advanced initiation options for the entire stockpile.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Advanced Initiation	17,154	17,049	20,377	3,328	19.5%
Enhanced Use Denial	13,389	15,148	17,336	2,188	14.4%
Total, Enhanced Surety	30,543	32,197	37,713	5,516	17.1%

Performance Measures

Performance will be demonstrated by:

Developing Full Scale Engineering Development-ready technologies for improved surety options for the stockpile with initial emphasis on the W76 and W80 systems that:

- technology demonstration of advanced container options
- deliver advanced use denial technologies for the W80
- continue development of use denial technologies for the B61, W78, and W76 and W80 block 2's
- continue development of a micro-firing system advanced strong link for the W76 and W80, block 2
- continue development of microsystems-based surety options.

Detailed Program Justification

(dollars in thousands)

	FY 2001	FY 2002	FY 2003
Advanced Initiation	17,154	17,049	20,377

Develop and demonstrate advanced initiation options, to include new concepts in strong-links, micro-firing systems, and direct optical initiation that would enable stockpile systems to fully meet modern nuclear safety standards. During FY 2003, advanced firing system technology will be completed for the W76-like configurations.

(dollars in thousands)	FY 2001	FY 2002	FY 2003
Enhanced Use Denial	13,389	15,148	17,336

Develop and demonstrate enhanced use denial options, internal and external to the warhead that would provide a higher assessed level of use denial performance. During FY 2003, use denial options will be developed for the W76 and W80 Block One configurations.

	FY 2001	FY 2002	FY 2003
Total, Enhanced Surety	**17,154**	**17,049**	**20,377**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Enhanced Surety	
# Level of activity increases in advanced concepts development and certification-related testing. Emphasis will begin to shift to support technologies suitable for the next generation of enhanced surety options. The next weapons scheduled top undergo a stockpile life extension are the B61, W78 and W88 in addition to the W76 and W80 Block 2 options	5,516
Total Funding Change, Enhanced Surety	**5,516**

Capital Operating Expenses & Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	456	470	484	14	3.00%
Total, Capital Operating Expenses	456	470	484	14	3.00%

[a] Since funds are appropriated for Operations and Maintenance, which includes operating expenses, capital equipment and general plant projects, we no longer budget separately for capital equipment and general plant projects. FY 2002 and FY 2003 funding shown reflects estimates based on actual FY2001 obligations.

Weapons Systems Engineering Certification

Mission Supporting Goals and Objectives

Weapons Systems Engineering Certification establishes science-based engineering certification methods in weapons systems within a limited non-nuclear test program. Activities include conducting experiments and providing data necessary to validate computational models. The campaign's objective is to establish the capability to predict engineering margins by integrating numerical simulations with experimental data.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Define Methodology	300	800	815	15	1.9%
Model Validation Experiments	15,030	24,926	26,192	1,266	5.1%
Total, Weapons Systems Engineering Certification	15,330	25,726	27,007	1,281	5.0%

Performance Measures

Performance will be demonstrated by:

- Complete and document assessment of the computational tools needed to support the qualifications of the new radar for the B61.
- Complete and document assessment of the computational tools needed to support primary qualifications of the W76 flight test environment.
- Integrate with DSW A&C STS Margins effort - methodology and terms for single event margins.
- Deliver a validated capability to predict the fire-induced response of confined foam. This capability is critical to supporting the qualification of the W76-1 Arming Fusing & Firing in abnormal thermal environments.
- Complete W76 pre-flight test predictions.
- Deliver flight test data and comparisons with predictions.
- Deliver validation data for shock and vibration.

Past achievements in this campaign include:

- Held workshop that identified four key attributes of the engineering certification process based on recent Directed Stockpile Work (DSW) case studies with the three weapons laboratories.
- Generated a draft NNSA policy and a Nuclear Weapons Complex Technical Business Practice on engineering certification.
- Completed and documented a technical assessment of engineering computational tools to support the qualification of the W76-1 in abnormal thermal environments and the mechanical response to hostile environments.

- Released a beta version of a material database necessary for advanced simulation tools.
- Demonstrated an in-flight data gathering capability (High Explosive Radio Telemetry) necessary for understanding structural load transmission to the physics package.
- Initiated experimental tasks necessary for model validation data of the physics package (polymer characterization, assembly characterization, and stochastic structural dynamic activities.)
- Validated capability for manufacturing Gas transfer systems.

Detailed Program Justification

(dollars in thousands)

	FY 2001	FY 2002	FY 2003
Define Methodology	300	800	815

Emphasis is placed in this program element on working with DSW and the Advanced Simulation and Computing (ASC) Campaign. The purpose is to assess future DSW needs related to the ASC development plans. This part of the process is intended to identify gaps relative to the physics that needs to be incorporated into the numerical tools and/or diagnostic development to support the validation and development of mathematical models that underpin the fidelity of the simulation tools. In addition, it is the intent of this activity to work closely with DSW to establish the necessary protocols that enable the maximum use of modeling and simulation tools to support the qualification process. This major technical element consists of on-going and continuous planning efforts to integrate the outputs from this campaign with ASC and ultimately DSW priorities. Specifics include the following:

- Complete and document assessment of the computational tools needed to support the qualifications of the new radar for the B61.
- Complete and document assessment of the computational tools needed to support primary qualifications of the W76 flight test environment.
- Integrate with DSW A&C STS Margins effort - methodology and terms for single event margins.

	FY 2001	FY 2002	FY 2003
	(dollars in thousands)		
Model Validation Experiments	15,030	24,926	26,192

The validation program conducts the following five types of validation experiments: (1) environment characterization experiments; (2) interfacial transport/phenomena experiments; (3) materials characterization experiments; (4) benchmark experiments; and (5) accreditation experiments.

Validation experiments are a special class of experiments in that they are specifically designed for direct comparison with the computational models. Making meaningful comparison between the computational and experimental results requires careful characterization and control of the experimental features or parameters used as inputs into the computational model.

The FY 2003 work scope includes multiyear activities in all five areas of validation experiments consistent with supporting priorities for the W80-2, 3 and W76-1 refurbishment activities in the DSW program. Specifics include the following:

- Deliver a validated capability to predict the fire-induced response of confined foam. This capability is critical to supporting the qualification of the W76-1 Arming Fusing & Firing in abnormal thermal environments.
- Complete W76 pre-flight test predictions.
- Deliver flight test data and comparisons with predictions.
- Deliver validation data for shock and vibration.

	FY 2001	FY 2002	FY 2003
Total, Weapons Systems Engineering	**15,330**	**25,726**	**27,007**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Weapons Systems Engineering Certification	
# Increase provides support of the NWC-approved refurbishments for the W76 FPU of FY07 and the W80 FPU of FY06. The increased funding will enable development of a complete suite of models for the W76 to predict the mechanical energy transmission through manufactured joints.	1,281
Total Funding Change, Weapons Systems Engineering	**1,281**

Capital Operating Expenses & Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	80	82	85	2	3.00%
Total, Capital Operating Expenses	80	82	85	2	3.00%

[a] Since funds are appropriated for Operations and Maintenance, which includes operating expenses, capital equipment and general plant projects, we no longer budget separately for capital equipment and general plant projects. FY 2002 and FY 2003 funding shown reflects estimates based on actual FY2001 obligations.

Nuclear Survivability

Mission Supporting Goals and Objectives

This campaign supports the nuclear survivability of the enduring stockpile, its certification and life extension, without underground tests, through radiation hardening, modeling and validation, and aboveground testing. The campaign will develop validated computational tools to reevaluate threat nuclear weapon radiation environments and system radiation responses, develop radiation-hardened technologies, and improve radiation sources and diagnostics. The initial applications of nuclear survivability certification technologies will support neutron generator qualifications and the W76 life extension program. The campaign also supports nuclear weapon output and lethality modeling, tool development and validation.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Modernization of Weapon Outputs	1,677	2,176	2,184	8	0.4%
Nuclear Survivability of Nuclear Components	0	0	400	400	N/A
Nuclear Survivability of Nonnuclear Components	7,730	10,329	10,896	567	5.5%
Hardening of Microelectronics and Microsystems	5,690	9,397	9,914	517	5.5%
Total, Nuclear Survivability	15,097	21,902	23,394	1,492	6.8%

Performance Measures

<u>Performance will be demonstrated by</u>:

- Analyzing DSW pit tests on the W76 and W88, and using the results to improve equations of state, material properties, and analytical methods in support of an FY07 milestone, and completing metallic jet validation experiments.
- Developing upgraded diagnostics for combined neutron/gamma environments and developing a validated code to characterize neutron and gamma hostile, fratricide, and test environments.
- Achieving QC-1 certification for 0.35 micron radiation hardened, digital SOI CMOS and providing 0.35 micron, flight test quality, radiation-hardened digital ASICs to the W76-1 project.

<u>Past achievements in this campaign include</u>:

- Developed the body-under-source field effect transistor (BUSFET), a radiation-hardened silicon-on-insulator (SOI) device structure applicable to both strategic and satellite use.
- Completed OMEGA experiments to provide validation and source scaling data.
- Completed nuclear survivability qualification tools for and supported qualification of the MC4380

neutron generator.

- Developed a high-energy, heavy-ion, radiation effects microscope. Obtained first-pass success in fabricating a 1Mbit radiation hardened static random access memory (SRAM) in the 0.35 micron BUSFET SOI technology.
- Supported reconstitution of the Annular Core Research Reactor (ACRR) for National Nuclear Security Administration nuclear survivability qualification testing.
- Fabricated a single event tested radiation-hardened 64K static random access memory (SRAM) prototypes in 0.35-micron technology at the Microelectronics Development Laboratory, achieving total-dose hardness greater than 1 Mrad(Si), dose rate survivability greater than 10^{10} rad(Si)/s, and a single event threshold greater than 45 MeV-cm^2/g.
- Assessed options and developed plan for providing fast burst reactor facility that adequately simulates exo-atmospheric environments (SPR III/IIIM).
- Developed and characterized improved soft x-ray sources on Z.
- Restored Saturn facility source to full operational capability.

Detailed Program Justification

(dollars in thousands)	FY 2001	FY 2002	FY 2003
Modernization of Weapon Outputs	1,677	2,176	2,184
Develop and validate modern output tools and re-assess nuclear weapons outputs as needed.			
Nuclear Survivability of Nuclear Components	0	0	400
Develop and validate modeling and experimental nuclear survivability assessment tools for nuclear components.			
Nuclear Survivability of Nonnuclear Components	7,730	10,329	10,896
Develop and validate modeling and experimental nuclear survivability assessment tools for nonnuclear components.			
Hardening of Microelectronics and Microsystems	5,690	9,397	9,914
Develop technologies and infrastructure for nuclear survivability of microelectronics, microsystems, and other nonnuclear components.			
Total, Nuclear Survivability	**15,097**	**21,902**	**23,394**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Nuclear Survivability	
# Increase accelerates development of radiation hardened microelectronics for the W76-1 to meet the FPU date, sustains development and validation of system level modeling tools required to qualify the W76-1 to the nuclear survivability requirements, provides required capital equipment, and initiates activities to collect, analyze and archive pit response data generated under Directed Stockpile Work . . .	1,492
Total Funding Change, Nuclear Survivability	**1,492**

Enhanced Surveillance

Mission Supporting Goals and Objectives

Enhanced Surveillance provides validated component lifetime assessments to support refurbishment decisions and annual assessment of the stockpile, and have predictive tools in place to identify aging defects prior to any impact to safety, reliability, or performance.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Pits	29,169	22,654	21,956	-698	-3.1%
Canned Subassemblies	20,620	12,679	13,338	659	5.2%
High Explosives/Energetics	8,900	8,065	8,037	-28	-0.3%
Nonnuclear Components	11,854	10,169	10,744	575	5.7%
Nonnuclear Materials	12,300	11,500	9,140	-2,360	-20.5%
Systems	20,305	8,618	13,940	5,322	61.8%
Total, Enhanced Surveillance	103,148	73,685	77,155	3,470	4.7%

Performance Measures

Performance will be demonstrated by:

- Provide aging analysis and life time assessment data annually for annual assessment of the stockpile
- Provide lifetime assessment reports annually to enable recommendations about refurbishment of the weapon components
- Deliver component life time requirements to support decisions on scope and timing of new facility construction .
- Develop and validate updated models for aging of components and materials
- Develop and deploy diagnostics for early detection of stockpile defects.

Past achievements in this campaign include:

- Demonstrated that high explosive aging does not degrade safety during impacts in accident conditions.
- Developed and delivered several new high explosive tests into the surveillance program (high explosive divergence and detonator booster performance tests).
- Identified self-irradiation (caused by plutonium nuclear decay) as a cause for pit aging and began testing old pit materials.
- Began fabrication of plutonium alloys in which the aging process is accelerated to allow direct measurements of effects of aging on plutonium properties.
- Fielded a suite of experimental diagnostic tools to measure physical properties of new and aged

plutonium samples.

- Utilized new miniaturized instrumentation to characterize key features during missile flight tests while preserving system fidelity to the greatest extent possible.
- Continued and improved development of new diagnostics techniques and began the integration of new diagnostics into the ongoing weapon surveillance program.
- Developed the technical basis for age-driven component refurbishment decisions in support of the W76 and W80 6.2/6.2A studies.

Detailed Program Justification

(dollars in thousands)	FY 2001	FY 2002	FY 2003
Pits	29,169	22,654	21,956

Perform pit aging experiments and modeling to determine whether pit lifetimes equal or exceed 60 years, which would enable substantial deferral or downsizing of a potential new pit manufacturing facility, and develop and implement new, nondestructive examination tools for early detection of potential flaws.

Canned Subassemblies	20,620	12,679	13,338

Perform canned subassemblies (CSAs)/aging experiments and modeling to determine when these major components as well as cases need to be replaced and will develop and implement new, nondestructive examination tools for early detection of potential changes in behavior.

High Explosives/Energetics	8,900	8,065	8,037

Perform high explosives/energetics aging experiments and modeling to determine when the full range of conventional and insensitive high explosives must be replaced.

Nonnuclear Components	11,854	10,169	10,744

Inform weapons planning and system refurbishment decisions with validated performance predictions for high-risk, nonnuclear components and identify possible micro-systems failure mechanism and develop a model-based certification process.

Nonnuclear Materials	12,300	11,500	9,140

Predict changes in critical nonnuclear material properties for both existing and replacement materials. These materials will be selected based on the highest risk for producing unacceptable degradation in weapon system performance.

Systems	20,305	8,618	13,940

Provide new system-level diagnostics for laboratory and flight testing that enhance the ability to detect, assess and predict problems in the stockpile.

Total, Enhanced Surveillance	**103,148**	**73,685**	**77,155**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Enhanced Surveillance	
# **Pits**- The decrease results from reduced emphasis on primary component lifetime assessment at KCP.	-698
# **Canned Subassemblies**- The change includes an increase associated with the development of non-destructive evaluation tools at LLNL and a decrease in lifetime assessments at LANL.	659
# **High Explosives/Energetics**- The decrease is associated with a reduction in HE lifetime assessment at PX which is partially offset by an increase in lifetime assessment work at LLNL.	-28
# **Nonnuclear Components**- The increase is in the area of component lifetime assessments which provide age-aware information for use in new component design and manufacturing process development supporting the weapons refurbishments.	575
# **Nonnuclear Materials**-The decrease is associated with reduced activities in material lifetimes work at SNL.	-2,360
# **Systems**- The increase supports the development and deployment of modernized system-level testers to replace aging and unreliable testers at the Weapons Evaluation Test Laboratory.	5,322
Total Funding Change, Enhanced Surveillance	**3,470**

Capital Operating Expenses & Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
General Plant Projects	300	309	318	9	3.00%
Capital Equipment	10,991	11,321	11,660	340	3.00%
Total, Capital Operating Expenses	11,291	11,630	11,979	349	3.00%

[a] Since funds are appropriated for Operations and Maintenance, which includes operating expenses, capital equipment and general plant projects, we no longer budget separately for capital equipment and general plant projects. FY 2002 and FY 2003 funding shown reflects estimates based on actual FY2001 obligations.

Advanced Design and Production Technologies

Mission Supporting Goals and Objectives

Advanced Design and Production Technologies integrates and systematically develops new technologies and enhanced capabilities to deliver qualified refurbishment products upon demand. This will be accomplished by developing multiple, fast turnaround engineering options through virtual prototypes and implementing modern product data management and collaboration tools. The campaigns' objective is to provide the capability to deliver qualified stockpile life extension refurbishment products upon demand at one-half cost, one-half the current time and with one-tenth the defects. The success of the ADAPT campaign will contribute to achieving the 36 months weapon refurbishment readiness objective within the Nuclear Weapons Complex.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Process Development Program	34,987	37,659	41,211	3,552	9.4%
Enterprise Integration Program	20,200	13,993	14,805	812	5.8%
Integrated Product and Process Design (IPPD)/Agile Manufacturing	18,907	16,780	18,125	1,345	8.0%
Robotics and Intelligent Machines (RIM)	1,864	0	0	0	0.0%
Total, Advanced Design and Production Technologies	75,958	68,432	74,141	5,709	8.3%

Performance Measures

Performance will be demonstrated by:

- Deploying access to the Program Control Document (PCD) System at all sites.
- Certifying Public Key Infrastructure (PKI) architecture, allowing W80 LEP work over SecureNet.
- Enabling limited certified WEB browser access to sites.
- Implementing Model-Based Design and Manufacturing Tools in support of the Life Extension Program.
- Developing processes for sharing design definition with analysis codes.
- Completing technical support of Inert Metallography deployment.
- Continuing development of enclosure technology for the Special Materials Complex.
- Providing recommendations for alternate casting methods.
- Demonstrating large-scale pilot plant production of TATB.
- Deployment of eddy current and acoustic capabilities to the Integrated Pit Inspection Station for pit requalification in support of the W76 LEP.
- Deploy secure IP-based video conferencing technology.
- Establish Pu electronic properties for monitoring metal changes in processing.
- Conduct density evaluations from the Coordinate Measuring Machine inspection data.
- Conduct detonator powder process development in support the LEPs.

Detailed Program Justification

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Process Development Program	34,987	37,659	41,211

Focuses on continuous and innovative improvement of individual manufacturing procedures and incorporating advanced systems into plant operations. Process Development is essential to maintain and improve production capabilities and introduce new technologies into the weapons complex while satisfying increased environmental constraints, improved product reliability needs, improved manufacturing efficiency and changes in available materials and processes. FY 2003 activities include: development of enclosure technology for the Special Materials Complex that does not impact design of the Y-12 Plant facility; demonstrating capability to produce one button per day in the Saltless Direct Oxide Reduction development facility; installation and testing of a microwave casting prototype at Y-12; optimizing Large Scale Pilot Plant production of TATB at Pantex; fabrication and test of W76 replacement functional prototypes of radar and firesets at Kansas City Plant; complete initial inertial weld studies for W80 Acorn and complete W76 Acorn weld and assembly characterization at Kansas City Plant; and supporting activities associated with moving the W76 and W80 neutron generators and their subsystems to the Process Prove-In stage at Sandia.

Enterprise Integration Program	20,200	13,993	14,805

Develops, demonstrates and deploys emerging information networking technology to provide high speed, seamless connectivity, provide limited enterprise systems needed for secure, distributed access to and management of product information, ensure that modern electronic business practices needed to allow new approaches to product realization are in place, and provide common planning and scheduling tools. FY 2003 activities include: completion of a Nuclear Weapons Complex (Nuclear Weapons Complex) wide “Certificate Authority” Infrastructure; deployment system to allow uploading of surveillance reports to the Product Data Management system; deployment of Interactive Electronic Procedures for assembly/disassembly of a War-Reserve weapon system; complete deployment of Integrated Programmatic Scheduling System (IPSS) as a distributed application across the SecureNet with standard security architecture; and begin development of “intelligent” agents to enable improvements to Nuclear Weapons Complex business processes.

Integrated Product and Process Design (IPPD)/Agile Manufacturing	18,907	16,780	18,125

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003

Develops, validates, and deploys modern hardware and software tools to institute a flexible system to design and produce optimized products, establishes an advanced system that provides rapid, flexible processes for product qualification and acceptance, and implements a highly automated Computer Aided Design (CAD)-to-part capability that provides fabrication of complex parts in small lots. FY 2003 activities include: increased use of model-based design and manufacturing systems tools for non-War Reserve (WR) parts and use of model-based design and manufacturing tools in the B61 Life Extension Program (LEP). Specifically, activities will be accelerated to begin deployment of an improved capability to use models based approaches for manufacturing, inspection & measurement, and process planning and acceptance at all Nuclear Weapons Complex sites by FY 2004.

Robotics and Intelligent Machines (RIM)	1,864	0	0

Develops systems composed of machines, sensors, computers and software capable of executing various tasks with minimal human intervention. These systems have wide ranging applications for solving many operational challenges including weapons manufacturing and dismantlement, accelerating cleanup, and reducing the amount of exposure humans experience from nuclear materials.

Total, Advanced Design and Production Technologies	**75,958**	**68,432**	**74,141**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Advanced Design and Production Technologies (ADAPT)	
# The increase in Process Development is primarily driven by the restoration of campaign funding at LANL which will support the development of nonnuclear materials processes, beryllium primary metal processes, neutron tube target loading processes, and tritium/reservoir processes. It also supports various activities at other sites which are required to support the B61, W80, and W76 LEPs. Process Development is directly involved in readying the production processes that will be required for production of replacement and new parts for all three refurbishments .	3,552

# The increase in Enterprise Integration is also primarily driven by the restoration of campaign funding at LANL which will be used to complete an online Product Realization Technical Business Practice (TBP) for complex-wide applications. Overall, this major technical element will provide connectivity and access to limited data and scheduling/planning systems to make these efforts more efficient and less costly	812
# The increase in Integrated Product & Process Design/Agile Manufacturing is also primarily driven by the restoration of campaign funding at LANL which will be used to develop engineering Validation and Verification (V&V) of B61, W76, and W88 stockpile models for models-based LEP applications. LANL will also complete Pro/E standardization/automation and systems integration for models-based engineering applications. Overall, the major technical element will deploy the tools, systems and procedures necessary to use models-based engineering and manufacturing approaches for all three refurbishments..	1,345
Total Funding Change, Advanced Design and Production Technologies (ADAPT) . .	**5,709**

Capital Operating Expenses & Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	3,197	3,293	3,392	99	3.00%
Total, Capital Operating Expenses	3,197	3,293	3,392	99	3.00%

[a] Since funds are appropriated for Operations and Maintenance, which includes operating expenses, capital equipment and general plant projects, we no longer budget separately for capital equipment and general plant projects. FY 2002 and FY 2003 funding shown reflects estimates based on actual FY2001 obligations.

High Energy Density Physics

Mission Supporting Goals and Objectives

The High Energy Density Physics (HEDP) Campaign (previously Inertial Confinement Fusion Ignition and High Yield) addresses high-energy-density physics issues required to maintain a safe, secure, and reliable nuclear stockpile. Specific campaign objectives include the demonstration of laboratory ignition, enhancement of HEDP experimental capabilities, design, fielding and analysis of HEDP experiments needed to support development and validation of ASCI codes, and assessment of options for high-yield fusion. The HEDP Program uses a complementary suite of laser and pulsed power facilities to accomplish its mission. The central HEDP facilities include the National Ignition Facility (NIF) under construction at Lawrence Livermore National Laboratory (LLNL), the Omega laser at the University of Rochester Laboratory for Laser Energetics (UR/LLE), and the Z accelerator facility at Sandia National Laboratories (SNL).

The FY 2003 budget maintains the NIF project schedule. However, within overall NNSA budget priorities, reductions have been made in program funded activities in NIF diagnostics, cryogenics and other areas that will delay the NIF experimental program, including some ignition related work. The High-Average-Power Laser Program (HAPL), an activity of high technical quality relevant to inertial fusion energy, stockpile stewardship, and directed-energy weapons programs, is eliminated due to the need to fund higher priority activities. Additionally, while NNSA endorses the importance of petawatt lasers for the HEDP Program, no funds are available to continue the FY 2002 petawatt initiative due to the need to fund higher priority activities. Lastly, funding is not provided for the University of Nevada-Reno program.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Ignition	42,147	44,718	43,957	-761	-1.7%
Support of Stockpile Program	24,254	19,014	22,593	3,579	18.8%
Experimental Support Technologies	28,275	41,526	34,370	-7,156	-17.2%
High Yield Assessment	5,648	5,470	5,470	0	0.0%
University Grants/Other Support	3,740	5,933	3,156	-2,777	-46.8%
Inertial Fusion Technology	24,765	23,977	0	-23,977	0.0%
Operations of Facilities	36,555	46,035	51,476	5,441	11.8%
NIF Demonstration Program	60,013	72,300	75,732	3,432	4.7%
NIF Other Project Costs (OPC)	5,828	1,400	994	-406	-29.0%
Construction	197,255	245,000	214,045	-30,955	-12.6%
Total, High Energy Density Physics	428,480	505,373	451,793	-53,580	-10.6%

Performance Measures

Performance will be demonstrated as follows:

NIF Construction Project:

- Make NIF Optics Assembly Building operational
- Install NIF First Flashlamp canister in Laser Bay 2
- Install NIF Target Positioner (TARPOS) in target bay

HEDP Program:

- Acquire data to validate radiation transport models
- Develop sources required to validate model used to test system generated EMP effects using Z
- Demonstrate multiframe backlighting capability on Z using Z-Beamlet
- Demonstrate planned spot size and 3 shot/day operation on Z-Beamlet
- Achieve planned temperature balance between upper and lower hohlraums on Z
- Demonstrate imaging x-rays from the imploded core of a capsule on Z
- Demonstrate Z capsule implosions with a moderate convergence ratio
- Operate NIF, Omega, Z, and the target fabrication facilities for HEDP and other users
- Study "near ignition" conditions using beryllium capsules
- Complete prototype testing of nuclear burn history and neutron imaging diagnostics
- Extend meso-scale laser plasma interaction modeling and related experiments to NIF plasmas
- Utilize hydrodynamic implosion experiments to provide specific data for ASCI modeling validation
- Utilize radiation transport experiments on both Z and Omega for validation of specific aspects of ASCI transport and radiation hydrodynamics modeling
- Complete first phase of measurements providing data on aging issues
- Incorporate results of the Omega laser plasma instability experiments (backscatter and Thompson scattering) into improved nonlinear saturation models in a plasma physics code
- Perform multi-cone, gas-filled hohlraum symmetry experiments at Omega
- Demonstrate diagnostic techniques for timing the shocks in NIF ignition capsules
- Complete initial specifications of first NIF hohlraums and capsules
- Extend polymer NIF capsule production techniques to larger scales
- Fill and demonstrate infrared cryogenic layering of NIF ignition capsules in the deuterium test system
- Acquire data to validate hydrodynamic models used to predict the performance of weapon primaries
- Develop sources and diagnostic techniques for equation of state and phase-transition experiments
- Test a high-resolution, compact diagnostic system on Omega that will be for general use on NIF
- Perform cryogenic directly-driven layered implosions on Omega
- Construct NIF diagnostics and prepare for NIF experiments on a schedule consistent with funding
- Support basic science through the HEDP Grants and the National Laser User Facility(NLUF) Program
- Conduct experimental tests on the Nike Laser of advanced NIF direct-drive ignition target designs
- Conduct EOS experiments on the Nike Laser in coordination with the national laboratories

<u>Past achievements in this campaign are as follows</u>:

<u>NIF Construction Project</u>

- Completed the NIF Conventional facilities construction
- Positioned the NIF Target chamber
- Installed the NIF Cluster 3 beam path infrastructure
- Prepared the NIF Laser Bay 2 ready for Line Replaceable Unit installation

<u>HEDP Program:</u>

- Performed first integrated two-dimensional calculations of the effects of laser imprint and target nonuniformity on the baseline NIF direct-drive target
- Obtained high-resolution measurements of Richmyer-Meshkoff instability growth using x-ray backlighting on Nike
- Completed Z-Beamlet laser (ZBL)
- Obtained backlit images of a capsule using ZBL
- Obtained isentropic compression data for aluminum on Z
- Obtained accurate liquid deuterium data with the new "cold" magnetically-driven flyer plate method
- Completed initial designs of high-yield targets for z-pinch-driven and dynamic hohlraums
- Characterized sources and developed diagnostics for Z weapons physics radiation transport experiments
- Obtained and analyzed the first experimental data for shock propagation and x-ray burn-through for two ignition capsule ablator materials
- Demonstrated improved accuracies in temperature balance between upper and lower hohlraums on Z
- Demonstrated higher fluence x-ray capability on Z necessary for materials experiments for neutron generator hardening studies
- Developed and presented pulsed-power options and specifications for a refurbishment of Z
- Demonstrated concept of explosive closure containment
- Performed intensity scaling experiments for the Stimulated Raman Scatter (SRS) laser plasma instability, observing the onset for SRS
- Completed advanced design studies for beryllium ignition capsules
- Demonstrated polishing capabilities for NIF ignition capsule materials in planar geometry
- Demonstrated micromachining capabilities for production of beryllium NIF ignition capsules
- Demonstrated the fluorescence spectroscopy diagnostic on Omega
- Demonstrated higher temperature drives on Z using dynamic hohlraums
- Diagnosed hydrodynamic instabilities in a compressible convergent geometry
- Constructed, calibrated, and utilized a low-bandwidth burn history diagnostic
- Layered and fielded the first direct-drive cryogenic experiments on Omega
- Reduced the non-uniformity of illumination on target on Omega
- Conducted a major review and submitted a detailed report on the role of high-energy-density-physics and the NIF in Stockpile Stewardship, in response to Congressional requirement to evaluate full-scale NIF versus possible alternatives

- Tested the capability for verifying the fuel filling and layering process for NIF ignition targets
- Ensured a direct-drive target illumination capability is not precluded on NIF
- Defined baseline deployment sequence for the NIF
- Began construction of NIF core diagnostics
- Completed design and progressed on construction of scientific prototype of NIF cryogenic system
- Instituted and filled the position of NIF Director at LLNL

Detailed Program Justification

(dollars in thousands)

	FY 2001	FY 2002	FY 2003
Ignition	42,147	44,718	43,957

Conduct calculations and experimental activities aimed at risk reduction and development of the physics basis for indirect drive and direct drive ignition.

Support of Stockpile Program	24,254	19,014	22,593

Execute high-energy-density-physics experiments on HEDP facilities in support of the current scope of the Stockpile Stewardship Program.

Experimental Support Technologies	28,275	41,526	34,370

Support experimental technology including the development of NIF core and advanced diagnostics and calibration systems; definition, prototyping, design, fabrication, testing, and deployment of the NIF cryogenic system and target filling system; development of pulsed power technology; development of petawatt-laser capabilities; and providing the required target support for all HEDP laboratories. These activities supported within this element of the campaign are necessary to maximize the utility of HEDP facilities, including NIF.

High Yield Assessment	5,648	5,470	5,470

Conduct the necessary experimental program in support of assessment of pulsed-power for high yield.

University Grants/Other Support	3,740	5,933	3,156

Support university grants in high-energy-density science, National Laser User Facility activities, national ignition program coordination, and critical technical needs of the campaign. Within the FY 2002 funding, $2.447 million will complete the petawatt laser effort at the University of Nevada-Reno and approximately $3 million supports university grants and user programs on the HEDP facilities as directed in the FY 2002 Appropriations Act.

Inertial Fusion Technology	24,765	23,977	0

Develop the technology options for inertial fusion and stockpile stewardship use of high-average power lasers.

	FY 2001	FY 2002	FY 2003
	(dollars in thousands)		
Operations of Facilities	36,555	46,035	51,476

Operate HEDP facilities, including Omega and Z, in a safe, secure manner.

	FY 2001	FY 2002	FY 2003
NIF Demonstration Program	60,013	72,300	75,732

Supports the activities associated with completing the NIF to the point where full operations commence, and includes costs for the integration, planning, assembly, installation, and activation for the NIF.

	FY 2001	FY 2002	FY 2003
NIF Other Project Costs (OPC)	5,828	1,400	994

Complete NEPA documentation, including environmental impact statement and environmental monitoring and permits, and complete assurances, safety analysis and integration.

	FY 2001	FY 2002	FY 2003
Construction	197,255	245,000	214,045

96-D-111, National Ignition Facility, LLNL. Funding decreases in FY 2003, consistent with the baseline submitted to Congress in September 2000 and the baseline change approved by the Deputy Administrator for Defense Programs in March 2001, which allowed the NIF Project to maintain schedule and cost despite receiving less funding in the FY 2001 appropriation than assumed in the baseline that was submitted in September 2000.

	FY 2001	FY 2002	FY 2003
Total, High Energy Density Physics	**428,480**	**505,373**	**451,793**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
High Energy Density Physics	
# Decreases the level of effort in the indirect-drive ignition experiments program in order to field critical weapons physics experiments on Omega and Z. This decrease is consistent with the slowed experimental program on NIF.	-761
# Increase in weapons physics experiments on Omega and Z to support ASCI code validation and development of weapons modeling to improve the predictive capability required for assessment and certification	3,579

		FY 2003 vs. FY 2002 ($000)
#	Decrease in experimental support technology funding defers construction of NIF diagnostics and cyrogenics, delaying the NIF target physics experimental program, including some ignition related work. Additionally, no funds are available to continue the FY 2002 petawatt initiative due to the need to fund higher priority activities.	-7,156
#	Supports HEDP Grants Program and funding for the NLUF at the UR/LLE Omega facility. Funding is not provided for University of Nevada-Reno program.	-2,777
#	The High-Average-Power Laser Program, an activity of high technical quality relevant to inertial fusion energy, stockpile stewardship, and directed-energy weapons programs, is eliminated due to the need to fund higher priority activities	-23,977
#	Maintain Omega and Z operations at current levels. Increase fraction of Z operations supported by the HEDP campaign	5,441
#	Increase provides full support for the NIF Demonstration Program, consistent with the NIF baseline, March 2001	3,432
#	Decrease in the National Ignition Facility (NIF) Other Project Costs, consistent with the current NIF project schedule, cost and scope certified by the Secretary of Energy in September 2000 and the revised Project baseline approved by the Deputy Administrator for Defense Programs in March 2001	-406
#	Decrease in the National Ignition Facility (NIF) line item supports the current NIF project schedule, cost, and scope certified by the Secretary of Energy in September, 2000 and the revised Project baseline approved by the Deputy Administrator for Defense Programs in March 2001	-30,955
Total Funding Change, High Energy Density Physics		**-53,580**

Capital Operating Expenses & Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	6,967	7,176	7,391	215	3.00%
Total, Capital Operating Expenses	6,967	7,176	7,391	215	3.00%

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior Year Approp-riations	FY 2001	FY 2002	FY 2003	Unapprop-riated Balance
96-D-111, National Ignition Facility, LLNL	2,094,897	898,458	197,255	245,000	214,045	540,139
Total, High Energy Density Physics			**197,255**	**245,000**	**214,045**	**540,139**

[a] Since funds are appropriated for Operations and Maintenance, which includes operating expenses, capital equipment and general plant projects, we no longer budget separately for capital equipment and general plant projects. FY 2002 and FY 2003 funding shown reflects estimates based on actual FY2001 obligations.

96-D-111, National Ignition Facility (NIF), Lawrence Livermore National Laboratory, Livermore, California

(Changes from the FY 2002 Congressional Budget are denoted with a vertical line [|] in the left margin)

Significant Changes

None.

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)	Other Related Costs ($000)	Total Project-Related Costs ($000)
	A-E Work Initiated	A-E Work Complete d	Physical Construction Start	Physical Construction Complete				
FY 1996 Budget Request (*Preliminary Estimate*)	1Q 1996	1Q 1998	3Q 1997	3Q 2002	842,600	1,073,600	N/A	N/A
FY 1998 Budget Request (*Title I Baseline*)	1Q 1996	1Q 1998	3Q 1997	3Q 2003	1,045,700	1,198,900	N/A	N/A
FY 2000 Budget Request	1Q 1996	2Q 1998	3Q 1997	3Q 2003	1,045,700	1,198,900	N/A	N/A
FY 2001 Budget Request	1Q 1996	2Q 1998	3Q 1997	3Q 2003	1,045,700	1,198,900	833,100	2,032,000
FY 2001 Amended Budget Request	1Q 1996	2Q 1998	3Q 1997	4Q 2008	2,094,897	2,248,097	1,200,000	3,448,097
FY 2002 Budget Request	1Q 1996	2Q 1998	3Q 1997	4Q 2008	2,094,897	2,248,097	1,200,000	3,448,097
FY 2003 Budget Request (*Current Baseline Estimate*) . .	1Q 1996	2Q 1998	3Q 1997	4Q 2008	2,094,897	2,248,097	1,200,000	3,448,097

2. Financial Schedule

(TEC Funding)

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
1996	37,400	37,400	33,990
1997	131,900	131,900	74,294
1998	197,800	197,800	165,389
1999	284,200	284,200	251,476
2000	247,158 [a]	247,158	252,766
2001	197,255 [b]	197,255	254,725
2002	245,000	245,000	277,331
2003	214,045	214,045	205,437
2004	150,000	150,000	164,142
2005	130,000	130,000	126,452
2006	130,000	130,000	135,312
2007	120,000	120,000	129,089
2008	10,139	10,139	24,494

3. Project Description, Justification and Scope

The Project provides for the design, procurement, construction, assembly, and acceptance testing of the National Ignition Facility. The NIF is an experimental inertial confinement fusion facility intended to achieve controlled thermonuclear fusion in the laboratory by imploding a small capsule containing a mixture of the hydrogen isotopes, deuterium and tritium. The NIF is being constructed at the Lawrence Livermore National Laboratory (LLNL), Livermore, California as determined by the Record of Decision made on December 19, 1996, as a part of the Stockpile Stewardship and Management Programmatic Environmental Impact Statement (SSM PEIS).

| The High Energy Density Physics (HEDP) Program carries out the HEDP experiments required for success of
| the Stockpile Stewardship Program (SSP). The demonstration of fusion ignition in the laboratory is an
| important component of the HEDP Program. Technical capabilities provided by the ICF program also contribute to other DOE missions including nuclear weapons effects testing and the development of inertial

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[a] Original appropriation was $248,100,000. This was reduced by $942,000 for the FY 2000 rescission enacted by P.L. 106-113.

[b] The FY 2001 amended budget request of $209,100,000 was reduced by Congress to $199,100,000. The appropriation of $199,100,000 was reduced by $1,410,000 due to the Safeguards and Security (S&S) amendment, and by $435,000 for a rescission enacted by Section 1403 of the FY 2001 Consolidated Appropriations Act.

fusion power. As a key element of the Stockpile Stewardship Program, the NIF is designed to achieve propagating fusion burn and modest (1-10) energy gain within 2-3 years of full operation and to conduct high energy density experiments, both through fusion ignition and through direct application of the high laser power. This mission was identified in the NIF Justification of Mission Need, which was endorsed by the Secretary of Energy. Identification of target ignition as the next important step in ICF development for both defense and non-defense applications is consistent with the earlier (1990) recommendation of DOE's Fusion Policy Advisory Committee, and the National Academy of Sciences Inertial Fusion Review Group. In 1995, the DOE's Inertial Confinement Fusion Advisory Committee affirmed the program's readiness for an ignition experiment. A review by the JASONs in 1996 affirmed the value of the NIF for stockpile stewardship.

The NIF project supports the DOE mandate to maintain nuclear weapons science expertise required for stewardship of the stockpile. After the United States announcement of a moratorium on underground nuclear tests in 1992, the Department established the Stockpile Stewardship program to ensure the preservation of the core intellectual and technical competencies in nuclear weapons. The NIF is one of the most vital facilities in that program. The NIF will provide the capability to conduct laboratory experiments to address the high energy density and fusion aspects that are important to both primaries and secondaries in stockpile weapons.

At present, the Nation's computational capabilities and scientific knowledge are inadequate to ascertain all of the performance and safety impacts from changes in the nuclear warhead physics packages due to aging, remanufacturing, or engineering and design alterations. Such changes are inevitable if the warheads in the stockpile are retained well into this century, as expected. In the past, the impacts of such changes were evaluated through nuclear weapon tests. Without underground tests, we will require better, more accurate computational capabilities to assure the reliability and safety of the nuclear weapons stockpile for the indefinite future.

To achieve the required level of confidence in our predictive capability, it is essential that we have access to near-weapons conditions in laboratory experiments. The importance of nuclear weapons to our national security requires such confidence. For detonation of weapon primaries, that access is provided in part by hydrodynamic testing. For secondaries and for some aspects of primary performance, the NIF will be a principal laboratory experimental physics facility.

The most significant potential commercial application of ICF in the long term is the generation of electric power. Consistent with the recommendations of the Fusion Policy Advisory Committee, the NIF will provide a unique capability to address critical elements of the inertial fusion energy program by exploring moderate gain (1 - 10) target designs, establishing requirements for driver energy and target illumination for high gain targets, and developing materials and technologies useful for civilian inertial fusion power reactors.

The ignition of an inertial fusion capsule in the laboratory will produce extremely high temperatures and densities in matter. Thus, the NIF will also become a unique and valuable laboratory for experiments relevant to a number of areas of basic science and technology (e.g., stellar phenonena).

The NIF is an experimental fusion facility consisting of a laser and target area, and associated assembly and refurbishment capability. The laser will be capable of providing an output pulse with an energy of 1.8

megajoules (MJ) and an output pulse power of 500 terawatts (TW) at a wavelength of 0.35 micrometers (:m) and with specified symmetry, beam balance and pulse shape. The NIF design is an experimental facility housing a multibeam line, neodymium (Nd) glass laser capable of generating and delivering the pulses to a target chamber. In the target chamber, a positioner will center a target containing fusion fuel, a deuterium-tritium mixture, for each experiment.

The NIF experimental facility, titled the Laser and Target Area Building, will provide an optically stable and clean environment. This Target Area Building will be shielded for radiation confinement around the target chamber and will be designed as a radiological, low-hazard facility capable of withstanding the natural phenomena specified for the LLNL site. The baseline facility is for one target chamber, but the design shall not preclude future upgrade for additional target chambers.

The NIF project consists of conventional and special facilities.

- Site and Conventional Facilities include the land improvements (e.g., grading, roads) and utilities (electricity, heating gas, water), as well as the laser building, which has an approximately 20,300 square meters footprint and 38,000 square meters in total area. It is a reinforced concrete and structural steel building that provides the vibration-free, shielded, and clean space for the installation of the laser, target area, and integrated control system. The laser building consists of two laser bays, each 31 meters (m) by 135 m long, and a central target area--a heavily shielded (1.8 m thick concrete) cylinder 32 m in diameter and 32 m high. The laser building includes security systems, radioactive confinement and shielding, control rooms, supporting utilities, fire protection, monitoring, and decontamination and waste handling areas. Optics assembly and refurbishment capability is provided for at LLNL by incorporation of an optics assembly area attached to the laser building and minor modifications of other existing site facilities.

  Special facilities include the Laser System, Target Area, Integrated Computer Control System, and Optics.

  < The laser system is designed to generate and deliver high power optical pulses to the target chamber. The system consists of 192 laser beams configured to illuminate the target surface with a specified symmetry, uniformity, and temporal pulse shape. The laser pulse originates in the pulse generation system. This precisely formatted low energy pulse is amplified in the main amplifier. To minimize intensity fluctuation, each beam is passed through a pinhole in a spatial filter on each of the four passes through the amplifier and through a transport spatial filter. The beam transport directs each high power laser beam to an array of ports distributed around the target chamber where the frequency of the laser light is tripled to 0.35 :m, spatially modulated and focused on the target. Systems are provided for automatic control of alignment and the measurement of the power and energy of the beam. Structural support and auxiliary systems provide the stable platform and utilities required.

  < The target area includes a 10 m diameter, low activation (i.e., activated from radiation) aluminum vacuum chamber located in the Target Area of the laser building. Within this

chamber, the target will be precisely located. The chamber and building structure provide confinement of radioactivity (e.g., x-rays, neutrons, tritium, and activation products). Diagnostics will be arranged around the chamber to demonstrate subsystem performance for project acceptance tests. Structural, utility and other support systems necessary for safe operation and maintenance will also be provided in the Target Area. The target chamber, the target diagnostics, and staging areas will be capable of conducting experiments with cryogenic targets. The Experimental Plan indicates that cryogenic target experiments for ignition will be needed 2-3 years after completion of the project. Therefore, the targets and this cryogenic capability will be supplied by the experiments. The NIF project will make mechanical and electrical provisions necessary to position and align the cryogenic targets within the chamber. The baseline is for indirectly driven targets. An option for future modifications to permit directly driven targets is included in the design.

- The integrated computer control system includes the computer systems (note: no individual computer will cost over $100,000) required to control the laser and target systems. The system will provide the hardware and software necessary to support initial NIF acceptance and operations checkout. Also included is an integrated timing system for experimental control of laser and diagnostic operations, safety interlocks, and personnel access control.

- Thousands of optical components will be required for the 192 beamlet NIF. These components include laser glass, lenses, mirrors, polarizers, deuterated potassium dihydrogen phosphate crystals, potassium dihydrogen phosphate crystals, pulse generation optics, debris shields and windows, and the required optics coatings. Optics includes quality control equipment to receive, inspect, characterize, and refurbish the optical elements.

Project Milestones:

Major milestones and critical decision points have not changed:

Milestones	Date
Approval of Mission Need (CD1)	Jan 1993
Title I Initiated	Jan 1996
NEPA Record of Decision	Dec 1996
Approval to Initiate Construction (CD3)	Mar 1997
Start Special Equipment Installation	Nov 1998
1st light	Jun 2004
12 bundle	Jun 2007
24 bundles	Sep 2008
Project Complete (CD4)	Sep 2008

Project milestones for FY 2002 include:

< Target Chamber positioned 2Q

< Beampath Infrastructure System (BIS) turnover to commissioning - Control Room 3Q

< BIS ready for transporter automation start - Laser Bay 2 3Q

< BIS ready for Power Conditioning System Installation Contractor - Capacitor Bay 3 4Q

Project milestones for FY 2003 include:

< Laser Bay 2, Cluster 3 Beampath installed 1Q

< First Laser Bay 2 Flashlamp installed 2Q

< Optics Assembly Building operational 3Q

< Target Positioner (TARPOS) installed in Target Bay 3Q

4. Details of Cost Estimate

	(dollars in thousands)	
	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design Drawings and Specifications)	213,150	203,150
Design Management Costs (1.8% of TEC)	38,400	38,400
Project Management Costs (1.9% of TEC)	39,414	39,414
Total Design Costs (13.4% of TEC)	290,964	280,964
Construction Phase		
Improvements to Land	1,800	1,800
Buildings	179,000	173,400
Special Equipment	1,237,828	1,219,828
Utilities	500	500
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	122,566	120,677
Construction Management (0.9% of TEC)	18,000	18,000
Project Management (2.7% of TEC)	55,594	55,594
Total Construction Costs (75.9% of TEC)	1,615,288	1,589,799
Contingencies		
Design Phase (1.4% of TEC; 3.7% of remaining TEC BA)	30,065	40,065
Construction Phase (7.6% of TEC; 19.6% of remaining TEC BA)	158,580	184,069
Total Contingencies (9.0% of TEC; 23.3% of remaining TEC BA)	188,645	224,134
Total, Line Item Costs (TEC)	2,094,897	2,094,897

The cost estimate assumes a project organization and cost distribution consistent with the management requirements appropriate for a DOE Major System as outlined in the NIF Project Execution Plan. Actual cost distribution will be in conformance with accounting guidelines in place at the time of project execution.

5. Method of Performance

The NIF Project Office (consisting of LLNL, Los Alamos National Laboratory (LANL), Sandia National Laboratory (SNL), and University of Rochester Laboratory for Laser Energetics (UR/LLE) and supported by competitively selected contracts with Architect/Engineering firms, an integration management and installation contractor, equipment and material vendors, and construction firms) will prepare the design, procure equipment and materials, and perform conventional construction, safety, system analysis, and acceptance tests. DOE/NNSA will maintain oversight and coordination through the National Nuclear Security Administration Office of the NIF Project. All activities are integrated through the guiding principles and five core functions of the DOE Order on Integrated Safety Management Systems (ISMS) (DOE P450.4). DOE conducted the site selection and the NEPA determination in the SSMPEIS. LLNL was selected as the construction site in the ROD made on December 19, 1996.

5.1 NIF Execution

5.1.1 Conceptual and Advanced Conceptual Design

The conceptual design was completed in May 1994 by the staff of the participating laboratories. Keller and Gannon contractors provided designs of the conventional facilities and equipment.

Design requirements were developed through the Work Smart Standards (WSS) Process approved by the Director of the Oakland Operations Office. New requirements have been defined since the original WSS was placed in Contract 48 in 1997. A gap analysis will be performed, and if changes are required a revision will be prepared.

The Conceptual Design Report was subjected to an Independent Cost Estimate (ICE) review by Foster Wheeler USA under contract to the DOE. The advanced conceptual design phase further developed the design, and is the phase in which all the criteria documents that govern Title I Design were reviewed and updated.

5.1.2 Title I Design

In fiscal year 1996, Title I Design began with the contract award for the Architect/Engineers (Parsons and AC Martin) and a Construction Management firm (Sverdrup) for the design and the constructiblity reviews of the (1) NIF Laser and Target Area Building and (2) Optics Assembly Building. Title I Design included developing advanced design details to finalize the building and the equipment arrangements and the service and utility requirements, reviewing project cost estimates and integrated schedule, preparing procurement plans, conducting design reviews, completing the PSAR and NEPA documentation, and planning for and conducting the constructibility reviews.

Title I Design was completed in November 1996 and was followed by an ICE review.

5.1.3 Title II Design

The participants in Title II (final design) include LLNL, LANL, SNL, Parsons, AC Martin, and Jacobs/Sverdrup (constructibility reviews). The Title II Design provides construction subcontract packages and equipment procurement packages, construction cost estimate and schedule, Acceptance Test Procedures, and the acceptability criteria for tested components (e.g., pumps, power conditioning, special equipment), and environmental permits for construction (e.g., *Storm Water Pollution Prevention Plan*).

5.1.4 Title III Design

The Title III engineering participants include LLNL, Parsons, AC Martin, and Jacobs/Sverdrup. Title III engineering represents the engineering necessary to support the construction and equipment installation, including inspection and field engineering. The main activities are to perform the engineering necessary to resolve issues that may arise during construction (e.g., fit problems, interferences). Title III engineering will result in the final as-built drawings that represent the NIF configuration.

5.1.5 Construction and Equipment Procurement, Installation, and Acceptance

Based on the March 7, 1997, Critical Decision 3, construction began with site preparation and excavation of the Laser Target Area Building (LTAB) forming the initial critical-path activities. The NIF Construction Safety program was approved and sets forth the safety requirements at the construction site for all LLNL and non-LLNL (including contractor) personnel. There was sufficient Title II Design completed to support bid of the major construction and equipment procurements. The conventional facilities are designed as construction subcontract bid packages and competitively bid as firm fixed price procurements. The initial critical-path construction activities include both the Laser and Target Area Building and the Optics Assembly Building (where large optics assembly and staging will take place). In addition, the site support infrastructure needed to support construction of conventional facility, beampath infrastructure installation, and line replaceable equipment and optics staging are being put in place. At the same time, procurements on the critical path (e.g., target chamber) began following the established *NIF Acquisition Plan*.

The next major critical path activity is the assembly and installation of the Beampath Infrastructure Systems. These are the structural and utility systems required to support the line replaceable units. The management and installation of the Beampath Infrastructure System is being contracted to an Integration Management and Installation Contractor. This was done to fully involve industry in the construction of NIF as directed in the Secretary of Energy's 6-Point Plan and recommended by the Secretary of Energy Advisory Board interim report in January 2000. During the period of Beampath Infrastructure System installation, line replaceable unit and optics procurements continue.

The line replaceable unit equipment will be delivered, staged, and installed as phased beneficial occupancy of the Laser and Target Area Building is achieved. This is a complex period in which priority conflicts may occur because construction, equipment installation, and acceptance testing will be occurring. The Product Line Managers, Area Integration Managers, and Integration Management and Installation Contractor will manage and integrate the activities to avoid potential interferences affecting the schedule. The construction, equipment installation, and acceptance testing will be supported by Title III inspection and field engineering, which will include resolving construction and installation issues and preparing the final as-built drawings.

5.1.6 Operational Testing and Commissioning

After installation, the facility and equipment will be commissioned prior to the phased turnover to the operations organization. The transfer points employ the Management Pre-Start Review process in which an independent team evaluates the readiness (e.g., training and qualification of operators, Commissioning Test Procedures results, and as-built drawings) and recommends turnover by the NIF Project Manager. The NIF Project Manager approves the transfer of responsibility for ISMS Work Authorization.

The integrated system activation will begin with the commissioning of the first bundle. Management Pre-Start Reviews (MPRs) will be used by the Project Manager to control each system turnover. In specific cases, such as first light, first experiment, and ignition readiness, the DOE/NNSA Field Office will oversee and concur in the MPR. A sequence of MPRs are scheduled to ensure a disciplined and controlled turnover of NIF systems from construction to activation. MPRs will be conducted by LLNL prior to the start of first experiments and NIF 192-beam operation, and the results will be validated by the National Nuclear Security Administration Office of the NIF Readiness Assessment. The first experiment and 192-beam Readiness Assessment requires that the FSAR be completed and approved (including the documented operating/maintenance procedures, operating staff training, and as-built design documentation). The 192-beam Readiness Assessment results are a key input for Critical Decision 4 (Project closeout) by the Acquisition Executive.

5.1.7 Project Completion

The complete set of NIF criteria is contained in the *NIF Functional Requirements and Primary Criteria*. These are the criteria that NIF is required to meet when fully operational. However, early test operation of NIF by the Program through a series of turnovers controlled by Management Pre-Start Reviews will be achieved by a phased transition to Program operations for user tests before Project completion. This enables the Program to begin experimental operations in support of Stockpile Stewardship and other programmatic missions at the earliest possible date, as NIF performance capability is building up toward the eventual goals set out in the *NIF Functional Requirements and Primary Criteria* and *Project Completion Criteria*.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 2001	FY 2002	FY 2003	Outyears	Total
Project Cost						
Facility Costs						
Design	268,043	35,128	8,872	7,300	1,686	321,029
Construction	509,872	219,597	268,459	198,137	577,803	1,773,868
Total, Line item TEC	777,915	254,725	277,331	205,437	579,489	2,094,897
Other Project Costs						
R&D necessary to complete construction [a]	100,045	2,297	2,053	0	0	104,395
Conceptual design costs [b]	12,300	0	0	0	0	12,300
NEPA documentation costs [c]	5,005	509	641	950	3,400	10,505
Other project-related costs [d]	21,005	456	694	1,400	2,445	26,000
Total, Other Project Costs	138,355	3,262	3,388	2,350	5,845	153,200
Total Project Cost (TPC)	916,270	257,987	280,719	207,787	585,334	2,248,097
Other Related Operations and Maintenance Costs - NIF Demonstration Program	402,771	73,860	70,740	75,000	577,629	1,200,000
TOTAL Project and Related Costs	1,319,041	331,847	351,459	282,787	1,162,963	3,448,097
Budget Authority (BA) requirements [e]						
TEC (capital funding)	898,458	197,255	245,000	214,045	540,139	2,094,897
OPC (O&M funding)	144,978	5,828	1,400	994	0	153,200

[a] Costs include optics vendor facilitization and optics quality assurance.

[b] Includes original conceptual design report completed in FY 1994 and the conceptual design activities for the optical assembly and refurbishment capability and site infrastructure.

[c] Includes preparation of the NIF portion of the Stockpile Stewardship and Management Programmatic Environmental Impact Statement, NIF Supplemental Environmental Impact Statement and environmental monitoring and permits; OSHA implementation.

[d] Includes engineering studies (including advanced conceptual design) of project options; assurances, safety analysis, and integration; start-up planning, management, training and staffing; procedure preparation; startup; and Operational Readiness Review.

[e] Long-lead procurements and contracts require BA in advance of costs.

(dollars in thousands)

	Prior Years	FY 2001	FY 2002	FY 2003	Outyears	Total
NIF Demonstration Program (O&M funding) [f] . . .	419,331	59,737	72,300	75,732	572,900	1,200,000
Total, BA requirements	1,462,767	262,820	318,700	290,771	1,113,039	3,448,097

7. Related Annual Funding Requirements

	Current Estimate	Previous Estimate
Annual facility operating costs [b]	35,916	35,962
Annual facility maintenance/repair costs [c]	63,868	62,122
Programmatic operating expenses directly related to the facility [d]	0	0
Capital equipment not related to construction but related to the programmatic effort in the facility	212	208
GPP or other construction related to the programmatic effort in the facility	212	208
Utility costs [e]	13,657	9,929
Other costs [f]	1,740	1,704

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[a] Funding previously requested and appropriated in the Inertial Confinement Fusion Program and, beginning in FY 2001, under the High Energy Density Physics Campaign (previously Inertial Confinement Fusion Ignition and High Yield). The outyear funding profile is $96,300,000 in FY 2004; $113,700,000 in FY 2005; $117,260,000 for FY 2006; $120,957,000 in FY 2007; and $124,683,000 in FY 2008. This is the funding required to maintain the Project baseline.

[b] Includes all NIF support personnel who are not in facility maintenance as described in note b (198 personnel). This is based on the latest facility use projection of 746 shots in FY 2011; previous estimate was based on an average of shots over the life of the facility.

[c] Includes refurbishment of laser and target systems, building maintenance, and component procurement based on 746 shots in FY 2011 (204 personnel); previous estimate was based on an average number of shots over the life of the facility.

[d] For these costs, refer to the National Stockpile Stewardship Program; previous estimate included the LLNL ICF Program-related costs.

[e] Estimate of electricity costs has increased based on currently projected rates.

[f] Facility usage estimate of industrial gases (argon, synthetic air).

	Current Estimate	Previous Estimate
Total related annual funding (estimate based on operating life of FY 2009 through FY 2038)	115,605 [g]	110,133 [h]

[a] In FY 2003 dollars.

[b] In FY 2002 dollars.

Advanced Simulation and Computing

Program Mission Supporting Goals and Objectives

The Advanced Simulation and Computing campaign creates simulation capabilities, based on advanced weapon codes and high-performance computing, that incorporate high-fidelity scientific models validated against experimental results, past tests, and theory. The Advanced Simulation and Computing (ASCI) campaign evolved from the merging of the Advanced Strategic Computing Initiative and Stockpile Computing programs. For historical reasons, the use of the acronym "ASCI" has continued following the programmatic merger. The ASCI goal is to provide the means to assess and certify the safety, performance, and reliability of nuclear weapons.

The ASCI FY 2005 objective is to provide validated three dimensional (3-D), high-fidelity physics, full-system simulation codes required for engineering, safety, and performance analyses of the stockpile, and to develop computing resources with sufficient power (speed, memory, and storage capacity) to support the stockpile analyses. ASCI FY 2003 milestones seek to continue the progress toward this objective. In order to develop and validate the ASCI simulations and provide useful tools for stockpile work, the ASCI campaign is tightly integrated with Directed Stockpile Work (DSW), as well as the science/experimental and weapon campaigns.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Advanced Applications Development	143,912	147,552	150,875	3,323	2.3%
Materials Physics and Modeling	65,608	67,962	69,658	1,696	2.5%
Verification and Validation	38,598	40,391	41,413	1,022	2.5%
Ongoing Computing	93,153	97,322	109,370	12,048	12.4%
Advanced Architectures	3,358	5,600	5,032	-568	-10.1%
Physical Infrastructure and Platforms	95,899	98,543	105,759	7,216	7.3%
PathForward	21,485	11,321	10,000	-1,321	-11.7%
Distance and Distributed Computing	42,290	28,791	17,054	-11,737	-40.8%
Problem Solving Environment (PSE)	39,587	41,489	42,122	633	1.5%
Visual Interactive Environment for Weapon Simulation (VIEWS)	70,220	65,006	63,278	-1,728	-2.7%
University Partnerships	55,923	48,500	46,606	-1,894	-3.9%
ASCI Special Projects	6,699	10,315	8,360	-1,955	-19.0%
Construction	69,746	54,847	55,335	488	0.9%
Total, Advanced Simulation and Computing	746,478	717,639	724,862	7,223	1.0%

Performance Measures

FY 2003 performance will be evaluated using the following Level 1 milestones:

- The campaign, using ASCI developed codes, will make a two-dimensional high-fidelity-physics calculation of the explosion of a primary system. The simulation will produce relevant information, including the primary yield, that can be compared to a nuclear test.
- The campaign, also using ASCI developed codes, will demonstrate the three-dimensional coupled mechanical response of a weapons system in hostile (nuclear) environments.
- The campaign will develop and deploy complex-wide infrastructure that integrates critical ASCI computing resources into a flexible and adaptable distributed computing environment.

Expected achievements during FY 2002 include the following:

- Three-dimensional prototype full-system coupled simulation.
- Three-dimensional safety simulation of a complex abnormal explosive-initiation scenario
- STS abnormal environment prototype simulation
- Delivery of initial macro-scale reactive flow model for high-explosive detonation derived from grain-scale dynamics
- 30-teraOPS system (*Q*)

Past achievements:

- Delivered three-dimensional prototype computer codes to simulate the primary and secondary behavior of nuclear weapons. These codes are being deployed to designers at the nuclear weapons for design of components and system-level certification activities for performance, safety and reliability of the stockpile.
- Delivered three-dimensional prototype computer codes to simulate weapon component and system response to normal and hostile Stockpile-to-Target Sequence (STS) environments. These codes will play a major role in the remanufacture of the W76-1 AF&F.
- Delivered an initial model validation methodology on current state of ASCI models and codes for early-time primary behavior. This methodology will serve as the foundation for future verification and validation of all ASCI codes for stockpile work.
- Provided high-end simulation capabilities supporting numerous stockpile applications, such as:
  - Resolved a nuclear underground test anomaly by application of a 3D ASCI code which required four months on the ASCI Blue Mountain computer, but would have required 80 years on a Cray-class computer.
  - Simulated an underground nuclear test measurement for the first time which required one day on the ASCI Blue Mountain computer, but would have required 2-3 years on a Cray-class computer.
- Provided the required computational infrastructure that enables application code developers and analysts to utilize the four existing multi-teraOPS platforms, ASCI Red, Blue Mountain, Blue Pacific and White.
- Enabled platform vendors such as IBM and Compaq to become viable bidders/winners of ASCI systems.

- Deployment of Data and Visualization Corridors, supporting analysis and visualization at all three national labs.
- Implementation of a high-speed wide area network between the tri-labs and the ASCI White platform.
- Implementation of high-speed transfer capability that accommodates very large files in a secure environment.

Detailed Program Justification

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Advanced Applications Development	143,912	147,552	150,875

Continue the development of enhanced 3-D computer codes that provide unprecedented levels of physics and geometric fidelity in weapons simulations. Running these codes in support of the Stockpile Stewardship Program will require the utilization of the 30 teraOPS platform planned for full operation in 2003. Applications will focus on the 3-D codes capable of simulating the high fidelity physics for primary performance and the coupled response of re-entry vehicle systems to abnormal STS environments.

Materials Physics and Modeling	65,608	67,962	69,658

Continue to incorporate the improved models for the behavior of materials that are used in the stockpile weapons into Advanced Simulation and Computing (ASCI) application codes as those materials are subjected to stockpile-to-target sequence environments, hostile nuclear environments, and aging.

Verification and Validation	38,598	40,391	41,413

Continue developing and implementing methodologies for assessing the accuracy and fidelity of the ASCI weapons simulations by testing code predictions against theory, archival UGT data, and AGEX data, enhancing the analysis of simulated uncertainty. Continue to increase the quality of the developed computer codes by implementing improved modern software engineering practices and improved designer acceptance and quality simulation results.

Ongoing Computing	93,153	97,322	109,370

Support ongoing computer center operations and evolution of existing simulation capability necessary for maintaining the core computational infrastructure and enabling technologies.

Advanced Architectures	3,358	5,600	5,032

Address the long term platform risk issues of cost, power, and size by study of alternative architectures that have the potential to make future ASCI platforms more cost effective.

Physical Infrastructure and Platforms	95,899	98,543	105,759

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003

Continue acquisition of computer platforms including full deployment of the 30 teraOPS supercomputer in late FY 2002/early FY 2003 at LANL and delivery of the 20 teraOPS system in FY 2004 at SNL. Initiate efforts to place contract in FY 2003 for the next teraOPS capability system at LLNL for delivery in FY 2005.

PathForward	21,485	11,321	10,000

Support PathForward activities with industrial partnerships to continue developing key interconnect, parallel, file system, visualization, and software technologies necessary to accelerate the development of balanced, multi-teraOPS computer systems.

Distance and Distributed Computing	42,290	28,791	17,054

Continue deployment of an enterprise-wide integrated computing architecture capable of supporting application milepost development, and Directed Stockpile Work at remote sites.

Problem Solving Environment (PSE)	39,587	41,489	42,122

Support projects in the areas of: ASCI Software Development Environment - a common software environment for scalable simulation development across ASCI platforms; Data Transfer and Storage – for end-to-end, high performance archival storage, high-speed interconnects, and scalable I/O infrastructures for stockpile stewardship simulations; Computer Systems Infrastructure – for operating systems, security infrastructure, and platform system management; and PSE Management and Integration – for tri-lab planning and coordination to achieve an integrated, balanced, and scalable computational environment.

Visual Interactive Environment for Weapon Simulation (VIEWS)	70,220	65,006	63,278

Delivers leading-edge visualization and data management software and hardware to provide the "see and understand" capabilities needed to view, manipulate and analyze terascale data. In FY 2003, VIEWS will focus on delivery of high-end graphics to offices, enabled by emerging technologies such as improved LCD monitors, video delivery over gigabit ethernet, PC-cluster-based scalable rendering, and most important, software to exploit such technologies.

University Partnerships	55,923	48,500	46,606

Continue activities aimed at training, recruiting, and collaborating with top researchers in key disciplines for Stockpile Stewardship, including the continued operation of Computer Science Institutes at each of the NNSA Labs, Graduate Fellowships, and University Alliances. Addressing Chiles Commission issues is a major focus of these activities.

ASCI Special Projects	6,699	10,315	8,360

Includes support for Super Computing (SC03) research exhibit projects and the One Program/Three Lab integration strategy for collaborations across the three labs for program collaboration meetings, program planning, topical investigations, and/or meetings, outreach and crosscuts.

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Construction	69,746	54,847	55,335
01-D-101, Distributed Information Systems Laboratory, (DISL) at Sandia National Laboratories in California	2,295	8,400	13,305
00-D-103, Terascale Simulation Facility (TSF) at Lawrence Livermore National Laboratory in California	4,889	22,000	35,030
00-D-105, Strategic Computing Complex (SCC) at Los Alamos National Laboratory New Mexico	55,877	11,070	0
00-D-107, Joint Computational Engineering Laboratory (JCEL) at Sandia National Laboratories in New Mexico	6,685	13,377	7,000
Total, Advanced Simulation and Computing	**746,478**	**717,639**	**724,862**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Advanced Simulation and Computing	
# Reduction in development of computer network capabilities supporting the entire weapons complex, (DisCom -$11,737). Reduction in collaborative research efforts with US supercomputing companies, (PathForward -$1,321 and Advanced Architectures -$568). Reduction in cooperative research with academic institutions, (University Partnerships -$1,894). Slow procurement of computer equipment that enables weapons designers to see and understand the results of their large simulations, (VIEWS -$1,728), and reduced Special Projects (-$1,955).	-19,203
# Higher computing maintenance costs associated with all currently operating ASCI platforms including Red, Blue Pacific, Blue Mountain and White, . Increases related to maintenance are the result of the machines aging, end of existing support contracts and power rate changes, (Ongoing Computing, +$12,048). The remaining increase is the result of planned workload levels for the ASCI program elements and strategies, (Physical Infrastructure and Platforms, +$7,216; Advanced Applications, +$3,323; Materials Physics and Modeling, +$1,696; Verification and Validation, +$1,022; Problem Solving Environments, +$633;)	25,938

	FY 2003 vs. FY 2002 ($000)
# Net change supports construction profiles for the Strategic Computing Complex (SCC) (-$11,070), Terascale Simulation Facility (TSF)(+$13,030), the Joint Computational Engineering Laboratory (JCEL)(-$6,377), and the Distributed Information Systems Laboratory (DISL) (+$4,905).	488
Total Funding Change, Advanced Simulation and Computing	**7,223**

Capital Operating Expenses & Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
General Plant Projects	1,459	1,503	1,548	45	3.00%
Capital Equipment	133,994	138,014	142,154	4,140	3.00%
Total, Capital Operating Expenses	135,453	139,517	143,702	4,185	3.00%

Construction Projects

(dollars in thousands)

	Total Estimated Cost	Prior Year Approp-riations	FY 2001	FY 2002	FY 2003	Unapprop-riated Balance
01-D-101, Distributed Information Systems Laboratory, SNL/CA	36,300	0	2,295	8,400	13,305	12,300
00-D-107, Joint Computational Engineering Laboratory, SNL	28,855	1,793	6,685	13,377	7,000	0
00-D-105, Strategic Computing Complex, LANL	98,849	31,902	55,877	11,070	0	0
00-D-103, Terascale Simulation Facility, LLNL	92,117	1,970	4,889	22,000	35,030	28,228
Total, Advanced Simulation & Computing			**69,746**	**54,847**	**55,335**	**40,528**

[a] Since funds are appropriated for Operations and Maintenance, which includes operating expenses, capital equipment and general plant projects, we no longer budget separately for capital equipment and general plant projects. FY 2002 and FY 2003 funding shown reflects estimates based on actual FY2001 obligations.

01-D-101, Distributed Information Systems Laboratory (DISL) Sandia National Laboratories, Livermore, California

(Changes from FY 2002 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

| # The TEC/TPC shown in previous project data sheets were based on the "Preliminary Baseline" estimates as defined in the Department of Energy Order 413.3 "Program and Project Management for the Acquisition of Capital Assets." The Fiscal Year 2003 figures "Current Baseline Estimates" are based on the Performance Baselines estimates as defined in the above Order, pending approval of the Acquisition Executive.

| # The TEC increase of $800,000 results from the deferral of $12,300,000 into FY 2004, and Other Project Costs decreased $940,000 to reflect elimination of program management costs from the project costs.

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 2001 Budget Request *(Preliminary Estimate)*	2Q 2001	2Q 2002	3Q 2002	1Q 2004	35,500	38,100
FY 2002 Budget Request	1Q 2001	1Q 2002	TBD	TBD	35,500	38,148
FY 2003 Budget Request *(Current Baseline Estimate)*	1Q 2001	1Q 2002	3Q 2002	1Q 2004	36,300	38,008

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
2001	2,295 [a]	2,295	1,919
2002	8,400	8,400	3,340
2003	13,305	13,305	17,870
2004	12,300	12,300	12,622
2005	0	0	549

[a] Original appropriation was $2,300,000. This was reduced by $5,000 for a rescission enacted by Section 1403 of the FY 2001 Consolidated Appropriations Act. There is no change to the TEC due to a corresponding increase to the FY 2003 appropriation amount.

3. Project Description, Justification and Scope

The Distributed Information Systems Laboratory (DISL) is a proposed new facility at Sandia National Laboratories to develop and implement distributed information systems for National Nuclear Security Administration (NNSA). It consolidates at one accessible location all activities focused on incorporating those systems to support NNSA's Stockpile Stewardship Program (SSP). Research at DISL will concentrate on secure networking, high performance distributed and distance computing, and visualization and collaboration technologies that do not exist today, yet need development to help create design and manufacturing productivity environments for the future Nuclear Weapons Complex (NWC). The major objective of DISL is to bring together these technologies to develop a distributed information systems architecture that will link the NWC of the future.

Description:

The proposed facility requires approximately 70,400 gross square feet (gsf) of space to house 130 employees and visiting researchers. Space will be provided for laboratories, technology deployment facilities, individual workspaces, collaborative areas, management and administrative areas, and public and support areas. Laboratory and other specialized space will be used for research and development of distributed computing and visualization, networking, information security, and collaborative environments technologies, and for deployment and use of those technologies by weapon project teams. Individual workspaces, located in a number of separate suites within the facility, will house Sandia technical staff and visiting researchers and will accommodate multiple computer workstations with monitors and peripheral equipment. Collaborative areas include conference and meeting rooms and informal common areas throughout the facility. Management and administration space and typical building support space, such as storage and break/vending areas, will also be included. The facility will be interconnected with a large amount of fiber-optics communications to accommodate the work there.

The laboratories, conference rooms, and individual workspace suites will have access controls and be acoustically constructed to enable simultaneous occupancy by different need-to-know workgroups in adjacent areas within the facility. Some laboratories, technology deployment facilities, and project team areas will be built as secure vault-type rooms. Most DISL space will be classified, with a portion located in the unclassified area for collaborations and shared research with academia and private industry. The entire facility is designed to meet Top Secret Restricted Data (TSRD) requirements if needed in the future.

DISL will be situated in the central part of Sandia's California (SNL/CA) site, near existing development, parking, and utilities, and easily accessible to visiting working partners. Improvements to land include site work such as new curbs and gutters at existing streets, walkways, planters, minor paving, and landscaping and irrigation surrounding the facility. Utilities work includes extensions of existing nearby water, storm and sanitary sewer, and electrical power and communications systems to the building.

Standard equipment will include new furniture and video conferencing equipment. Specialized equipment (Major Computer Items) necessary to create the communications network, visualization, and collaborative environments infrastructure in DISL includes visualization and computational equipment such as multi-processor and multimedia servers, high performance storage systems, and display systems; communications equipment such as switches, routers, network analyzers, racks and connectors; computational, display, and videoconferencing equipment for collaborative environments; and analyst workstations and associated equipment for project teams.

Justification:

The NNSA is responsible for the management of the NWC. Changes in the military-political landscape, including the cessation of underground testing and a significantly smaller nuclear weapons manufacturing complex, require NNSA to find new ways of ensuring a safe, reliable, and secure nuclear weapon stockpile while meeting unchanged certification requirements. NNSA's Directed Stockpile Work (DSW) Plan defines the stockpile refurbishment decisions and schedule necessary to maintain this deterrent. To meet NNSA mission goals and DSW requirements, NNSA has developed a Stockpile Stewardship Program (SSP) that plans to use technology to monitor, remanufacture, and test, through simulation, weapons in the current and future stockpiles. The NWC of the future will be linked by a distributed information architecture which will be developed, in large part, at DISL

Examples of NNSA efforts that support the Stockpile Stewardship Program include:

- The Advanced Simulation and Computing (ASC) Campaign, (formerly the Accelerated Strategic Computing Initiative (ASCI)), which will create the leading-edge computational modeling and simulation capabilities to help weapons designers shift from test-based methods to computation-based methods for stockpile certification.
- The Distance Computing and Distributed Computing ($DisCom^2$) Program, within the ASC Campaign, which will accelerate the ability of NNSA labs and plants to apply vital high-end and distributed resources (from desktops to TeraOps [1 TeraOp = 10^{12} floating-point operations per second]) across thousands of miles to meet the urgent and expansive design, analysis, and engineering needs of stockpile stewardship.
- The Advanced Design and Production Technologies (ADAPT) Initiative's Enterprise Integration strategy, which will:
  - Create seamless, secure, and connected communications.
  - Create products and process information systems which allow rapid access to weapons information.
  - Encourage streamlined business and engineering practices which are more responsive and productive.

With these and other Programs, NNSA envisions a highly distributed, yet totally integrated, system of facilities within the NWC that support information networking and provide cost-effective information integration, access, and preservation.

Safe, effective, and efficient product realization, weapon surveillance, and material disposition are the core issues involved in the SSP. Research toward successful resolution of these issues necessitates distributed/distance computing capabilities, and will depend on information-based resources that are accessible across the NWC. For these systems to be developed, SSP will need the technical skills of the best scientists and engineers working in academia, industry, and government agencies, in addition to those currently working for the national laboratories. It is important that NNSA laboratories (Sandia National Laboratories, Lawrence Livermore National Laboratory and Los Alamos National Laboratory) encourage partnerships with industry and academia when conducting this research. Partnerships leverage professional skills and costs associated with research, thereby improving the research process and the resultant product.

To realize the mission objectives outlined above, NNSA must have the ability to access information from across the NWC, fully integrate the design and re-manufacture of nuclear weapons (and components) so as to reduce the redesign time for nuclear weapons by half, and have a means to incorporate emerging information systems technology from the private sector and academia as rapidly as possible. The proposed DISL at SNL will provide the means to accomplish these goals. The DISL will provide technologies that will allow seamless, secure, reliable access to scientific and engineering and business information by the many geographically dispersed elements of the NWC, including laboratories, production facilities, and DOE offices.

Research and development in DISL will focus on developments that will greatly enhance the integration of design and manufacturing tasks. DISL will house weapon systems engineers together with computer scientists to foster the interchange necessary to ensure the development of a design-to-analysis-to-manufacturing enterprise, allowing researchers, weapons designers, analysts, product realization specialists and others to systematically reduce the time and cost required to design new nuclear weapons or redesign and refurbish existing ones. The long-term objective of DISL is to bring together prototype technologies to develop a distributed information systems infrastructure that will be incorporated into NNSA's virtual enterprise for the SSP.

The DISL will serve as a technology deployment center/user facility to accelerate the introduction of advanced information systems technology into the NWC. NNSA laboratories can neither create a virtual enterprise nor sustain a vibrant high-performance computing market on their own, and so must work closely with industry and academia to develop critical new information technology. Extensive collaboration with industry and academia is a major strategy of ADAPT, ASC, and DisCom^2, and, therefore, is a cornerstone of DISL. In addition, the existence of DISL will create opportunities for the NNSA laboratories to influence the course of technology development in the private sector and maximize benefits to their related core programs.

Existing facilities within the NWC cannot satisfy the need for the development of integrated information systems required to support SSP and its programs. While many of the elements needed to support NNSA's distributed information systems requirements exist at SNL/CA, the necessary facilities are absent—either they do not have laboratory areas with appropriate infrastructure (air conditioning and communications) and size to support required technologies, or they must remain completely classified. DISL must have space for classified activities, but must also facilitate unclassified exchanges. Thus NNSA proposes to create DISL as a single facility—one that consolidates activities and equipment; is sized appropriately; provides space for visiting personnel from the private sector, academia, and other laboratories; and possesses a suitable technological infrastructure, to ensure that NNSA can meet its critical mission responsibilities related to SSP.

The President has mandated that the nuclear weapon stockpile be safe, secure, and reliable. All US weapons require periodic refurbishment and remanufacture, because they contain components that have limited lifetimes. NNSA's DSW planning schedule lays out the schedule of weapon system alterations, modifications, and improvements to be completed in the coming decades. A major step in the refurbishment and remanufacture of a weapon is Full-Scale Engineering Development (FSED), the step during which weapon designers and systems engineers develop engineering designs, qualify them, and implement them at the production plants. After a weapon has been redesigned through FSED, it goes into production in the weapon plants. A key milestone is the date when the first production unit (FPU) assembly is completed. The DSW Planning Schedule calls for refurbishment in the near-term on the W80 (FPU in FY2006), in the mid-term on the B83 ALT353 (FPU in FY2007), and in the longer-term on the W76-1 (FPU in the FY2007-2008 time frame).

To meet the DSW planning schedule, significant reductions in FSED time for weapon systems will be required within a decade. For example, FSED of weapon arming, fuzing and firing subsystems need to be reduced to three years from the six required in the past. With present technology, this cannot be done. DISL, planned to be operational in FY2004, will provide by FY 2006 the technology to enable this reduction in schedule, and is therefore an essential part of NNSA's plan to meet the DSW milestones. In the specific case of the W76-1, DISL-provided technology will enable the FSED to be completed in the 2006-2007 time frame, thus enabling FPU to occur on schedule.

There is no facility available that is adequate in its current state to support the distributed information systems research and development activities required to meet NNSA programmatic goals.

Project Milestones:

FY 2003: Construction ongoing through FY 2003

4. Details of Cost Estimate

(dollars in thousands)

	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design Drawings and Specifications)	1,683	1,620
Design Management Costs (0.1% of TEC)	396	295
Contracted Professional Management Services (0.4 % of TEC)	160	172
Project Management Costs (0.5% of TEC)	195	199
Total Design Costs (6.3% of TEC)	2,434	2,286
Construction Phase		
Improvements to Land		
Buildings	16,727	15,568
Utilities		
Standard Equipment	1,574	1,530
Major Computer Items [a]	8,630	9,531
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	1,033	619
Construction Management (4.3% of TEC)	643	934
Project Management (2.1% of TEC)	774	423
Total Construction Costs (80.9% of TEC)	29,381	28,605
Contingencies		
Design Phase (0.1% of TEC)	37	325
Construction Phase (12.2% of TEC)	4,448	4,284
Total Contingencies (12.3% of TEC)	4,485	4,609
Total Line Item Costs (TEC)	36,300	35,500

5. Method of Performance

Design will be performed by an architect-engineer under a fixed-price contract. Construction and procurement will be accomplished by fixed-price contracts awarded on the basis of competitive bidding and best value strategies.

[a] Reflects BCP-01 transfer of $1.1M from Major Computer Items to other Construction Phase WBS elements to provide additional cooling and fire suppression equipment to the network research lab in DISL.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 2001	FY 2002	FY 2003	Outyears	Total
Project Cost						
Facility Costs						
Design	0	1,919	552	0	0	2,471
Construction	0	0	2,788	17,870	13,171	33,829
Total, Line item TEC	0	1,919	3,340	17,870	13,171	36,300
Total Facility Costs (Federal and Non-Federal)	0	1,919	3,340	17,870	13,171	36,300
Other Project Costs						
Conceptual design costs	637	0	0	0	0	637
Other project-related costs [a]	570	56	0	11	434	1,071
Total, Other Project Costs	1,207	56	0	11	434	1,708
Total Project Cost (TPC)	1,207	1,975	3,340	17,881	13,605	38,008

7. Related Annual Funding Requirements

(FY 2004 dollars in thousands)

	Current Estimate	Previous Estimate
Annual facility operating costs [a]	290	290
Annual facility maintenance/repair costs [a]	80	80
Programmatic operating expenses directly related to the facility [b]	30,000	30,000
Capital equipment not related to construction but related to the programmatic effort in the facility [c]	2,500	2,500
Utility costs	310	310
Total related annual funding (operating from FY 2004 through FY 2034)	33,180	33,180

[a] Includes funding to complete: Project Execution Plan, TSRD Study, Value Engineering Study, Bridging Document, Internal Non-Advocate Review, External Independent Review, Design Criteria, AE Selection and Award, Construction Project Data Sheet, Validation, Readiness Assessment, Start-up, Move-in, Project Close-out, and Final Cost Report.

[a] Average annual facility operating costs for materials and labor, including systems operations and custodial services, beginning when the facility is operational in the 3rd Quarter of FY 2004. An average total of 4.3 staff years per year will be required to operate the facility. The new facility will be built at the location where a previous facility existed; however, the new facility does not replace the old one.

[a] Average annual facility maintenance and repair costs for materials and labor, beginning when operational in the 3rd Qtr. of FY 2004. An average total of 0.4 staff years per year will be required to maintain and repair the facility.

[b] Annual programmatic operating expenses based on representative current operating expenses of 130 people. The majority of this funding is expected to come from the DOE-NNSA Office of Advanced Simulation and Computing. Lesser amounts are expected from other DOE-NNSA Offices for activities that support their mission needs for engineering information management.

[c] Because information technology evolves with a cycle of 1 to 2 years, DISL activities will require this annual capital equipment outlay.

00-D-103, Terascale Simulation Facility, Lawrence Livermore National Laboratory, Livermore, California

(Changes from FY 2002 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

| # This datasheet reflects a completed Title I design which accommodates requirements with a slight reduction in the square footage due to innovative design for electrical equipment layout. This datasheet also reflects a preliminary baseline estimate. The performance baseline for cost, schedule and scope will be established following completion of design and Critical Decision 2. The TEC/TPC, funding profile and schedule milestone dates reflected in this data sheet are preliminary, and the Current Baseline Estimate reflects later construction start and completion dates and a resultant $3,217,000 increase in TEC. The TEC/TPC, outyear funding profile, and schedule have not been validated and may be modified after completion of a thorough review and validation.

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 2000 Budget Request (*Preliminary Estimate*)	2Q 2000	2Q 2001	4Q 2000	4Q 2004	83,500	86,200
| FY 2001 Budget Request	3Q 2000	3Q 2001	4Q 2001	2Q 2006	89,000	92,200
| FY 2002 Budget Request	1Q 2001	1Q 2002	2Q 2002	2Q 2006	88,900	92,100
| FY 2003 Budget Request (*Current Baseline Estimate*)	1Q 2001	1Q 2002	3Q 2002	4Q 2006	92,117	95,317

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
2000	1,970 [a]	1,970	200
2001	4,889 [b] [c]	4,889	4,642
2002	22,000	22,000	23,642
2003	35,030	35,030	33,963
2004	25,000	25,000	25,085
2005	3,228	3,228	3,065
2006	0	0	1,520

3. Project Description, Justification and Scope

Description

The project provides for the design, engineering and construction of the Terascale Simulation Facility (TSF - Building 453) which will be capable of housing the 100 TeraOps-class computers required to meet the Accelerated Strategic Computing Initiative (ASCI). The building will encompass approximately 253,000 square feet. The building will contain a multi-story office tower with an adjacent computer center. The Terascale Simulation Facility (TSF) proposed here is designed from inception to enable the very large-scale weapons simulations essential to ensuring the safety and reliability of America's nuclear stockpile. The timeline for construction is driven by requirements coming from the ASCI within the Stockpile Stewardship Program (SSP). The TSF will manage the computers, the networks and the data and visualization capabilities necessary to store and understand the data generated by the most powerful computing systems in the world.

Justification

The Advanced Simulation and Computing (ASC) Campaign (previously the Accelerated Strategic Computing Initiative) has as its mission the acceleration of simulation to meet the demands of the nation's nuclear defense mission. The challenge is to maintain confidence in the nuclear stockpile without nuclear testing. Along with sub-critical experiments, one of the primary tools employed will be 3-D scientific weapons calculations of unprecedented computational scope. As has been emphasized

[a] Original appropriation of $8,000,000 was reduced by $30,000 for the FY 2000 rescission enacted by P.L. 106-113 and the remaining value of $7,970,000 was reduced by $6,000,000 as a result of a reprogramming action to fund Stockpile-related workload issues at LANL.

[b] Appropriation of $5,000,000 was reduced by $100,000 by the Safeguards and Security (S&S) amendment.

[c] Revised appropriation was $4,900,000. This was reduced by $11,000 for a rescission enacted by Section 1403 of the FY 2001 Consolidated Appropriations Act. There is no change to the TEC due to a corresponding increase to the FY 2005 appropriation amount.

in the ASC Program Plan, it is the rapid aging of both the stockpile and the designers with test experience that is at the heart of the issue and the reason for acceleration. The most critical period is between 2003 and 2010. By 2003, the number of designers with test experience will be reduced by about 50 percent from their numbers in 1990. By 2010, the percentage will be further reduced to about 15 percent. By 2003, most of the weapons in the stockpile will be in transition from their designed field life to beyond field life design. By 2010, about half will be in the beyond-field-life design stage. Therefore some validated mechanism or capability must be available soon to certify the safety and reliability of this aging stockpile. A major element of this capability will be the ASC applications codes and the associated terascale simulation environment. The ASC campaign intends by the middle of the decade, to reach a threshold state simulation capability in which the first functional "full system calculation" generation of codes requiring a 100+ TeraOps computer will be used to certify the stockpile. The remaining designers and analysts with test experience will be an indispensable part of this process, because they will validate the models and early simulation results.

The ASCI applications codes and the weapons analysts who make use of these applications require a supporting simulation infrastructure of major proportions, which includes:

1. Terascale computing platforms (ASCI Platforms)
2. A supporting numerical environment consisting of data management, data visualization and data delivery systems (Visual Interactive Environment for Weapons Simulation)
3. Sophisticated computer science and numerical methods research and development teams (ASCI Problem Solving Environment (PSE) and Alliances)
4. A first rate operations, user services and systems team
5. Data and visualization corridor capability including data assessment theaters, high performance desktop visualization systems and other innovative technologies.

To house, organize and manage these simulation systems and services requires a new facility with sufficient electrical power, mechanical support, networking infrastructure and space for computers and staff. The proposed TSF at LLNL will meet these requirements.

Scope

The TSF project will construct a building (Building 453) of approximately 253,000 square feet located adjacent to an existing (but far less capable) computer facility, Building 451, on the LLNL main site. The building will contain a multi-story office tower with an adjacent computer center. The computer center will house computer machine rooms totaling approximately 47,500 square feet. The computer machine rooms will be clear span (without impediments) and of an aspect ratio designed to minimize the maximum distance between computing nodes and switch racks. The ceiling height will be sufficiently high to assure proper forced air circulation. A raised access floor will be provided in order to allow adequate room for air circulation, cabling, electrical, plumbing, and fire/leak detection equipment.

The first computer structure will be available for occupancy in FY 2004. The building will be initially built with enough power and cooling to support two terascale systems, the first to be installed in FY 2004. As a risk reduction strategy, the building will be further designed so that power and mechanical resources can be easily added in the event that systems sited in the future will require higher levels of power. However, it is expected that by the middle of the decade the rate of growth of the peak capability of installed computers will relax. Therefore, the building should have enough power and cooling to accept any system procured after that time.

The TSF will include meeting rooms, offices, and a data and visualization capability. Scientists will be able to utilize innovative visualization technologies, including an Assessment Theater. The theater will be used both for prototyping advanced visualization concepts and for ongoing data analysis and data assimilation by weapons scientists. In short, the theater represents the area where physical and computer scientists working together will visualize and make accessible to the human eye and mind the huge data sets generated by the computers. This will allow workers to understand and assess the status of the immensely complex weapons systems being simulated.

The office space will accommodate staff and scientists who require access both to classified and unclassified workstations. Vendors, operational and problem solving environment staff must have immediate access to computer systems, since the simulation environment will require very active support. A key principle underlying all TSF planning is tight coupling between Stockpile Stewardship Program elements and the platforms. Thus, the TSF will also house the nucleus of the classified and unclassified (LabNet) networks. To assure the efficient operation of remote Assessment Theaters high speed networking hubs will connect the computers seamlessly to key weapons scientists and analysts at the highest performance available.

Project Milestones

|	FY 2002:	Complete Title II Design	1Q
|	FY 2002:	Start Construction	3Q
|	FY 2003:	Construction	Ongoing

4. Details of Cost Estimate

	(dollars in thousands) Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design Drawings and Specifications – $4,600)	5,450	5,450
Design Management Costs (0.8% of TEC)	703	650
Project Management Costs (0.7% of TEC)	610	600
Total Design Costs (7.3% of TEC)	6,763	6,700
Construction Phase		
Improvements to Land	1,510	2,550
Buildings	51,670	45,100
Utilities	9,280	10,300
Standard Equipment	0	1,450
Inspection, Design and Project Liasion, Testing, Checkout and Acceptance	4,100	3,900
Construction Management (5.8% of TEC)	5,320	3,950
Project Management (3.4% of TEC)	3,150	2,950
Total Construction Costs (81.5% of TEC)	75,030	70,200
Contingencies		
Design Phase (0.2% of TEC)	179	600
Construction Phase (11.0% of TEC) [a]	10,145	11,400
Total Contingencies (11.2% of TEC)	10,324	12,000
Total, Line Item Costs (TEC) [b]	92,117	88,900

5. Method of Performance

Design shall be performed under a negotiated Best Value architect/engineer contract. Construction and procurement shall be accomplished by fixed-price contracts based on competitive bidding and Best Value award.

[a] Appropriation of $5,000,000 was reduced by $100,000 by the Safeguards and Security (S&S) amendment. The comparable S&S amount for FY 2000 for this project was $39,000; the comparable appropriation amount was $1,931,000.

[b] Escalation rates taken from the FY 2001 DOE escalation multiplier tables dated January, 1999.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 2001	FY 2002	FY 2003	Outyears	Total
Project Cost						
Facility Costs						
Design	200	4,642	2,022	78	0	6,942
Construction	0	0	21,620	33,885	29,670	85,175
Total, Line item TEC	200	4,642	23,642	33,963	29,670	92,117
Total Facility Costs (Federal and Non-Federal)	200	4,642	23,642	33,963	29,670	92,117
Other Project Costs						
Conceptual design costs	1,300	0	0	0	0	1,300
NEPA documentation costs	150	0	0	0	0	150
Other project-related costs [a]	930	0	0	0	820	1,750
Total, Other Project Costs	2,380	0	0	0	820	3,200
Total Project Cost (TPC)	2,580	4,642	23,642	33,963	30,490	95,317

7. Related Annual Funding Requirements

(FY 2006 dollars in thousands)

	Current Estimate	Previous Estimate
Annual facility operating costs [b]	1,500	1,500
Programmatic operating expenses directly related to the facility [c]	56,200	56,200
Utility costs [d]	8,500	8,500
Total related annual funding (operating from FY 2006 through FY 2025)	66,200	66,200

[a] Including tasks such as Project Execution Plan, Pre-Title I Development, Design Criteria, Safeguards and Security Analysis, Architect/Engineer Selection, Value Engineering Study, Independent Cost Estimate, Energy Conservation Report, Fire Hazards Assessment, Site Surveys, Soil Reports, Permits, Administrative Support, Operations and Maintenance Support, ES&H Monitoring, Operations Testing, Energy Management Control System Support, Readiness Assessment. Also reflected here is the FY 2001 Appropriation reduction of $100,000 for the Safeguards and Security (S&S) amendment.

[b] Facility operating costs are approximately $ 1,500,000 per year (which also includes facility maintenance and repair costs), when facility is operational in 4th Qtr. FY 2006. Costs are based on the LLNL internal indirect rate Laboratory Facility Charge (LFC) for facility operating costs.

[c] The annual operating expenses for the Terascale Simulation Facility are estimated at $ 56,200,000 based on representative current operating expenses of 300 personnel. The majority of this funding is expected to come from DOE/DP for activities in support of the Nuclear Weapons Stockpile Stewardship Program.

[d] Costs are based on LLNL utility recharge rates.

00-D-107, Joint Computational Engineering Laboratory, Sandia National Laboratories, Albuquerque, New Mexico

(Changes from FY 2002 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

This datasheet reflects a preliminary baseline estimate and an increase to the total gross square footage to reflect the current design. The increase in size is attributable to meeting Functional and Operational requirements greater than those envisioned in the Conceptual Design Review. At this point in time, Title I design estimates and the Independent Cost Review do not indicate any increase in the TEC. The performance baseline for cost, schedule and scope will be established following Critical Decision 2.

The TPC for this project changed to reflect Occupant Move-In costs as Other Project Costs rather than part of the TEC as identified in the Independent Cost Review prior to CD-2.

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 2001 Budget Request *(Preliminary Estimate)*	2Q 2000	2Q 2001	3Q 2001	4Q 2003	28,870	30,303
FY 2002 Budget Request	1Q 2001	1Q 2002	TBD	TBD	28,855	30,428
FY 2003 Budget Request *(Current Budget Estimate)*	1Q 2001	2Q 2002	3Q 2002	4Q 2003	28,855	30,845

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
2000	1,793 [a]	1,793	0
2001	6,685 [b]	6,685	768
2002	13,377	13,377	6,757
2003	7,000	7,000	16,530
2004	0	0	4,800

[a] Original FY 2000 appropriation was $1,800,000. This was reduced by $7,000 for the FY 2000 rescission enacted by P.L. 106-113.

[b] Original FY 2001 appropriation was $6,700,000. This was reduced by $15,000 for a rescission enacted by Section 1403 of the FY 2001 Consolidated Appropriations Act.

3. Project Description, Justification and Scope

Description:

The Joint Computational Engineering Laboratory (JCEL) will be a new, state-of-the-art facility at Sandia National Laboratories for research, development, and application of leading-edge, high-end computational and communications technologies. JCEL will provide office space and laboratories for 175 people in a building with a total of approximately 64,900 gross square feet, that includes a 4,100 square foot Central Utilities Building. JCEL will be the center of Sandia's computational modeling, analysis, and design community, and will be constructed in close proximity to Sandia's existing computer and communications building, presently occupied by part of this community.

Justification:

The primary mission of JCEL is to ensure the rapid development and application of high performance computing, modeling, analysis, design, and simulation, which forms the foundation of DOE's Science-Based Stockpile Stewardship (SBSS) vision and, more specifically, supports the Advanced Simulation and Computing (ASC) campaign, formerly the Accelerated Strategic Computing Initiative (ASCI). The goal of ASC is to accelerate the development of simulation capabilities that are needed to ensure the confidence of the stockpile.

JCEL will primarily focus on computational simulation and virtual-prototyping. JCEL focuses on modeling and simulation to support model- and simulation-based life cycle engineering and to serve as a testbed for and a prototype of the "virtual enterprise." In essence, JCEL's mission is to develop advanced Stockpile Stewardship Program (SSP) tools. In JCEL, design alternatives will be explored using iterative simulations of virtual prototypes. Surety and reliability assessments will be model-based and incorporate fundamental understanding of critical component response to the full range and all credible combinations of environmental inputs by DoD. Tools developed within JCEL will ultimately support manufacturing efforts elsewhere within Sandia and the NWC by enabling product design alternatives to be modeled, analyzed, evaluated, and modified as necessary by engineers—all through the use of simulation.

As required by the ASM, JCEL is critical to Sandia's mission role to serve as integrator of the Nuclear Weapons Complex (NWC) into a "virtual enterprise." JCEL will lead the way with campus-wide distributed technologies, "data everywhere/people-anywhere" data management and data interpretation technologies, and the computational plants to enable it. JCEL will serve as a major integration node—connecting people to people, people to machines, and machines to machines, allowing access, integration, and preservation of information across the entire Sandia, NM site. JCEL will serve as a prototype of the "virtual enterprise," which will serve as a model for how to integrate the many heterogeneous nodes of the existing NWC into a virtual business enterprise for affordable and effective stockpile stewardship.

JCEL will utilize key expertise to create strategic simulations and advanced collaborative environments. Increased interaction, collaboration, and teamwork are essential for shifting more rapidly to science-based methods and for effective stewardship of the nuclear stockpile. JCEL will provide classified at the TSRD level to facilitate collaboration between the users of high-end simulation technology and the developers, while maintaining strict security of classified weapon information. JCEL will also include space designed to encourage interaction and collaboration among the scientists and engineers occupying the building and will provide work space tailored for multidisciplinary, high-performance teams who will develop computer codes and analyze nuclear weapons.

JCEL will provide labs for developing, prototyping and using Virtual Environment Technology, where designers, analysts, and experimenters can interact with each other as if they were in the same room. Moreover, JCEL will use, as well as develop, this leading-edge technology. It will prototype and demonstrate a science and engineering workplace of the 21st century.

The communications networks will enable JCEL's occupants to use the supercomputers in the DOE complex. To display the extensive results of complicated, three-dimensional simulations of nuclear weapons, the JCEL project will also provide computer equipment for virtual reality and advanced visualization techniques, graphics workstations and printers, and video equipment.

To achieve its goals, the JCEL project will provide:

- A main facility of approximately 60,800 gross square feet located in Technical Area I of Sandia National Laboratories on Kirtland Air Force Base in Albuquerque, New Mexico.
- Laboratory space, office space, management and administrative space, and interaction and meeting space.
- A facility which will meet Top-Secret Restricted-Data (TSRD) security requirements.
- Classified communications within the facility and between the facility and the rest of Sandia and DOE complex.
- Computer equipment for displaying and printing the results from complex, three-dimensional computer simulations of nuclear weapons.
- Classified computer workstations for use by leading engineers and scientists from the NWC.
- Video equipment for video conferencing, displaying, and editing video images produced by computer simulations.
- Central Utility Building of approximately 4,100 gross square feet that will provide the heating and cooling generation for the main facility.

Benefits

- Reduced program costs through use of high-fidelity computer simulations developed through JCEL programs to reduce the scope of costly test programs.
- Faster response on stockpile stewardship issues that will arise.
- Rapid interchange of appropriate technology.
- Accelerated National Nuclear Security Administration technology development.
- Cost savings in the development of Sandia research foundation technology base.

Scope:

Plan, design, and construct a new, three-story building to accommodate a total of about 175 people, which will provide classified (at the TSRD level) space in close proximity to the Sandia Central Computing Facility in building 880. The project will provide computer equipment to: display three-dimensional simulations; support engineers and scientists and provide video conferencing capability. Computer equipment includes: Visualization Laboratory display facilities ($3,145,000); and Advanced Conference Room Equipment ($425,000). In addition, the project will move existing furniture and install some new furniture. Site landscaping, parking, pedestrian access improvements, signage, and fencing improvements will be provided.

Project Milestones:

Physical Construction Start	3rd Qtr. FY 2002
Physical Construction Complete	4th Qtr. FY 2003

4. Details of Cost Estimate

	(dollars in thousands)	
	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design Drawings and Specifications)	1,715	1,132
Design Management Costs (1.6% of TEC)	471	509
Project Management Costs (0.3% of TEC)	90	332
Total Design Costs (7.9% of TEC)	2,276	1,973
Construction Phase		
Improvements to Land [a]	1,030	953
Buildings [a]	14,453	11,918
Utilities [a]	176	392
Communication/Voice Networking Equipment	2,740	3,435
Standard Computer/Visualization Equipment	3,786	3,786
Furniture and Office Equipment	318	318
Government Furnished - Contractor Installed Equipment	79	0
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	1,250	1,250
Project Moves [b]	0	305
Construction Management (1.0% of TEC)	294	294
Project Management (1.0% of TEC)	276	276
Total Construction Costs (84.5% of TEC)	24,402	22,927
Contingencies		
Design Phase (1.6% of TEC)	37	325
Construction Phase (8.8% of TEC)	2,140	3,630
Total Contingencies (7.6% of TEC)	2,177	3,955
Total, Line Item Costs (TEC)	28,855	28,855

5. Method of Performance

Architectural and engineering design and inspection will be performed by Sandia Facilities Departments and/or under a competitive-bid fixed-price contract based on capability and capacity to perform the work. Construction will be performed under a competitive-bid fixed-price contract or multiple competitive-bid fixed-price contracts and best value strategies.

[a] Costs based on latest Title I design cost estimate dated 10/9/01.

[b] Project moves were part of the TEC, but the ICR Final Report notes that these costs should be OPC.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 2001	FY 2002	FY 2003	Outyears	Total
Project Cost						
Facility Costs						
Design	0	768	1,508	0	0	2,276
Construction	0	0	5,249	16,530	4,800	26,579
Total, Line item TEC	0	768	6,757	16,530	4,800	28,855
Total Facility Costs (Federal and Non-Federal)	0	768	6,757	16,530	4,800	28,855
Other Project Costs						
Conceptual design costs [a]	989	0	0	0	0	989
Other project-related costs [b]	457	74	55	55	360	1,001
Total, Other Project Costs	1,446	74	55	55	360	1,990
Total Project Cost (TPC)	1,446	842	6,812	16,585	5,160	30,845

7. Related Annual Funding Requirements

(FY 2003 dollars in thousands)

	Current Estimate	Previous Estimate
Annual facility operating costs [c]	267	259
Annual facility maintenance/repair costs [d]	122	118

[a] Includes NEPA documentation costs.

[b] Including tasks such as Project Execution Plan, Pre-Title I Development, Design Criteria, Safeguards and Security Analysis, Architect/Engineer Selection, Value Engineering Study, Independent Cost Estimate, Fire Hazards Assessment, Permits, Administrative Support, Operations and Maintenance Support, ES&H Monitoring, Operations Testing, Energy Management Control System Support, Readiness Assessment, Facility Security Requirements, and External Independent Review.

[c] When all facilities are operational in the 2th Quarter of FY 2004, average $267,000 for labor and materials per year. An average of 3.4 staff years will be required to operate the facility.

[d] A total of 1.0 staff years per year are required to maintain the facility.

	(FY 2003 dollars in thousands)	
	Current Estimate	Previous Estimate
Programmatic operating expenses directly related to the facility [e]	52,530	51,000
Utility costs	202	196
Total related annual funding (operating from FY 2003 through FY 2032)	53,121	51,573

[e] Annual programmatic operating expenses are estimated at $52,530,000, based on representative current operating expenses of 175 people. The majority of this funding is expected to come from DOE/DP for activities in support of the Nuclear Weapons Stockpile Stewardship Program. Lesser amounts are expected from other sources for activities which are mutually beneficial to the funding source and DOE/DP. By bringing these activities together in one building, we expect the effectiveness of this work to be increased by at least 10% and probably much more. This would correspond to a savings of at least $5 million per year of DOE/DP operating funds.

Pit Manufacturing and Certification

Mission Supporting Goals and Objectives

In the near term, the Pit Manufacturing and Certification Campaign will focus mainly on W88 pit manufacturing and certification and planning for a Modern Pit Facility. However, in addition to meeting the W88 surveillance requirements, the NNSA is committed "to reestablishing and maintaining sufficient levels of production to support requirements for the safety, reliability, and performance of United States nuclear weapons" as delineated in the January 26, 1996, START II Treaty Ratification Text.

The abrupt closure of the Rocky Flats Plant in 1989 stopped production of W88 pits before sufficient pits were produced to meet the stockpile surveillance requirements for the projected 20-year design life of the W88 warhead. There is only one W88 surveillance pit remaining for destructive evaluation for the surveillance program. The NNSA is working closely with the Navy's Strategic Systems Program Office to ensure that military requirements are met.

In the absence of nuclear testing, the fabrication and certification of pits that meet quality requirements for the nuclear weapon stockpile war reserve remains a major challenge. The W88 Pit Manufacturing and Certification Integrated Project Plan, March 2001, has identified approximately 18,000 activities and 350 individual work packages to complete the pit production and certification task reflecting the magnitude of this major challenge.

The early years of the pit project are dominated by manufacturing process development for the W88 pit. During this period, certification tests are focused on examining fundamental plutonium properties and developing an approach to certification without nuclear testing. Following successful completion of process development pits and establishment of the requisite quality assurance infrastructure, the first certifiable pit will be fabricated and followed by the fabrication of qualification and production pits. During the ensuing qualification period, certifiable pits will be manufactured at LANL for use in experiments to demonstrate equivalence with Rocky Flats produced pits. A minimum set of certification experiments to determine product equivalency have been identified.

The goals of the campaign are to:

- Manufacture a certifiable W88 pit by the end of FY 2003;
- Establish a limited (10 pit/year) production capability for W88 pits by 2007 to meet the programmatic needs of the DoD;
- Establish the certification requirements and plan and implement the activities required to certify a W88 pit built at LANL without underground nuclear testing by FY 2009, with a goal of achieving an earlier date of FY 2007;
- Reestablish the capability to manufacture all pit types within the stockpile; and
- Plan the design and construction of a Modern Pit Facility to support long term pit manufacturing.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
W88 Pit Manufacturing	95,371	103,500	112,484	8,984	8.7%
W88 Pit Certification	51,800	84,961	78,000	-6,961	-8.2%
Pit Manufacturing Capability	8,010	2,000	2,000	0	0.0%
Modern Pit Facility	2,000	4,000	2,000	-2,000	-50.0%
Total, Pit Manufacturing and Certification	157,181	194,461	194,484	23	0.0%

Performance Measures

Performance will be demonstrated by:

- Manufacturing two development pits in FY 2002.
- Completing implementation of manufacturing and quality infrastructure in FY 2002.
- Providing documentation required to support a critical decision to initiate development of a conceptual design for a Modern Pit Facility in FY 2002.
- Conducting two ingegrated physics tests and pit engineering tests in FY.2002
- Completing a conceptual design report for a Modern Pit Facility and continue technology development for facility design and continue NEPA activities in FY 2004.
- Establishing production controls and quality infrastructure in FY 2003 to support the manufacture of the first certifiable pit in FY 2003.
- Establishing and implementing a peer process that includes at least one technical data exchange with LLNL in FY 2003.
- Manufacturing of a development pit and the first certifiable pit in FY 2003.
- Demonstrating progress on activities required to certify a W88 pit by FY 2009, with a goal of achieving an earlier date of 2007.
- Establishing limited (10 pits/year) W88 manufacturing capacity in FY 2007.
- Completing the reestablishment of key manufacturing technologies associated with the W87 and B61-7 pits as demonstrated through manufacture of development pits by FY 2007.
- Conducting two integrated physics tests and pit engineering tests in FY 2003.
- Continuing activities to support DynEx test in FY 2005 with a goal of accelerating the certification baseline.

There are a number of facilities and activities that must be supported to ensure success for this campaign, but are appropriately requested in other budget elements in FY 2003. Other budget elements supporting this campaign include, the Dynamic Materials campaign to support measurements of fundamental materials properties of plutonium; RTBF, Materials Recycle and Recovery to support related materials requirements; and RTBF, Operations of Facilities for a number of facilities at LANL that are critical to the success of the Pit Manufacturing and Certification Campaign.

Because of the need to prioritize NNSA work to meet all customer requirements, this budget request does not reflect the level of risk contingency funding contained in the September 28, 2001, "W88 Pit Manufacturing and Certification Report Fiscal Year 2001" report to the Congress. The budget request will, however, provide funding for W88 pit manufacturing and certification work to continue with a goal of meeting stated milestones.

Detailed Program Justification

FY 2002 Items of Congressional Interest: The FY 2002 House Energy and Water Development Appropriations Full Committee Report directed the National Nuclear Security Administration to submit a comprehensive report on the status of the W88 Pit Manufacturing and Certification program on a quarterly basis beginning October 1, 2001. The first quarter report will be provided to the Congress in February 2002. The NNSA submitted the FY 2001 final report to Congress in September 2001.

(dollars in thousands)

	FY 2001	FY 2002	FY 2003
W88 Pit Manufacturing	95,371	103,500	112,484

Development pits will be manufactured while manufacturing processes are defined and qualified. As a part of reestablishing the capability to manufacture war reserve pits, the production controls and quality infrastructure necessary to meet quality requirements and consistency of product will be established. Once completed, the first Qualification Pit will be manufactured as a "certifiable" pit. Further Qualification Pits will be manufactured to support engineering and physics testing for certification of the manufactured pits.

	FY 2001	FY 2002	FY 2003
W88 Pit Certification	51,800	84,961	78,000

To confirm nuclear performance of the W88 pit without underground nuclear testing, the W88 Pit Manufacturing and Certification Integrated Project Plan (W88 PMCIPP), March 2001, identifies the required engineering tests, physics experiments, dynamic experiments and integral experiments. A thorough peer review of the plan and activities required for W88 pit certification and manufacturing will be performed.

Engineering tests will be identified and scheduled for use in evaluating: the intrinsic radiation signature. plutonium hydriding structural response to environments delineated in the Stockpile-to-Target-Sequence including deployment and flight thermal and mechanical environments, pressure effects, and long-term material compatibility Physics laboratory experiments will be planned and scheduled to confirm that Los Alamos National Laboratory plutonium fabrication techniques produce equivalent compositions, microstructures and mechanical properties when compared to Rocky Flats manufactured material. Data from these material property experiments will be used to confirm consistent production results; to improve physics models used in ASC simulation codes; and to help predict and compare military performance. Integral tests will include explosively driven experiments to extrapolate material performance models in more realistic weapons environments, provide data to compare Rocky Flats material properties to LANL material properties, and to assist in development of advanced diagnostic techniques for more complex follow-on experiments. Additional integral dynamic tests will use actual geometry experiments to quantify performance differences that may

	FY 2001	FY 2002	FY 2003
	(dollars in thousands)		

result from differences in manufacturing between Rocky Flats and LANL. These experiments will also be the principal basis for computational ties to the prior nuclear test database.

Pit Manufacturing Capability	8,010	2,000	2,000

Pit manufacturing and certification activities not specifically supporting the W88 are conducted in the third element of the restructured campaign. These activities include identifying and scheduling the reestablishment of key manufacturing technologies for the W87 and B61-7 pits which, together with the W88, span technical variations of pits within the stockpile. This activity also provides technology development spinoff for the Modern Pit Facility.

Modern Pit Facility	2,000	4,000	2,000

The limited manufacturing capacity being established to support the W88 requirements is insufficient to meet manufacturing requirements for the long term support of the stockpile. In addition, the capability to manufacture pits is essential to replace pits that are destructively evaluated as part of surveillance activities or to replace pits that have exhibited unacceptable aging effects. Planning for a modern pit facility with the capability to meet requirements is essential to establish a viable readiness posture. The conceptual design scheduled to begin in early FY 2002, subsequent to a critical decision validating the mission need, will be postponed. The FY 2003 budget request would allow for continued planning activities.

Total, Pit Manufacturing and Certification	**157,181**	**194,461**	**194,484**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Pit Manufacturing & Certification	
# **W88 Pit Manufacturing**: The increase reflects the completion of the implementation of production controls and quality infrastructure and subsequent manufacture of the first W88 "certifiable" pit in FY 2003; and the installation of additional equipment to enhance manufacturing reliability and capacity for manufacture of parts and pits to meet certification testing requirements required to certify the manufactured W88 pits for entry into the stockpile.	8,984
# **W88 Pit Certification**: This change reflects a reduced level of effort for planned development and execution of integral physics experiments and continuing engineering experiments required to certify the LANL manufactured W88 pits.	-6,961

	FY 2003 vs. FY 2002 ($000)
# **Modern Pit Facility**: Detailed design of a Modern Pit Facility will be deferred until FY 2004 with FY 2003 funding used to continue manufacturing concepts.	2,000
Total Funding Change, Pit Manufacturing and Certification	**23**

Capital Operating Expenses & Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	13,855	14,271	14,699	428	3.00%
Total, Capital Operating Expenses	13,855	14,271	14,699	428	3.00%

[a] Since funds are appropriated for Operations and Maintenance, which includes operating expenses, capital equipment and general plant projects, we no longer budget separately for capital equipment and general plant projects. FY 2002 and FY 2003 funding shown reflects estimates based on actual FY2001 obligations.

Stockpile Readiness Campaign

Mission Supporting Goals and Objectives

The Y-12 National Security Complex is embarking on a course to replace or restore production capability and modernize aging facilities. These efforts will result in the revitalization of Y-12's ability to meets its mission requirements in a more efficient and cost effective manner and provide capability for the future needs of the Nuclear Weapons Complex. At present, critical manufacturing capabilities required for weapons refurbishments planned for FY 2004, FY 2007, and beyond do not exist at Y-12. It is imperative that we revitalize Y-12's ability to meet these mission requirements.

To more accurately reflect the entire scope of the Secondary Readiness Campaign (SRC), we are proposing to change the name to the Stockpile Readiness Campaign. A 90 Day Study was conducted on the Secondary Readiness Campaign. This Study concluded that the scope of the campaign is much broader than the current title suggests. The scope, as identified in the Program Plan, supports many aspects of today's stockpile. Consequently, the campaign name is being change to "Stockpile Readiness Campaign" which is more indicative of its scope.

The campaign, initiated in FY 2001, is the primary vehicle for this revitalization and is tasked with providing virtually all new processing, machining and inspection equipment required for the planned Life Extension Programs. As much of Y-12's current capability is based on 20 to 40 year old technology, SRC is charged with improving our basic manufacturing capability and deploying much needed technology developed by the Advanced Design and Production Technologies Campaign (ADAPT) and other technology Campaigns.

Finally, SRC is responsible for Y-12's Modernization Program. This program encompasses the planning and management tasks that integrate activities across Directed Stockpile Work (DSW), Campaigns, and Readiness Technical Base and Facilities (RTBF) to provide the needed facilities and infrastructure required for long-term mission accomplishment. complete solutions to restoration of Y-12's production capability and readiness posture.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Evaluate Material Requirements & Specifications	0	500	2,800	2,300	460.0%
Evaluate Designs for Improved Manufacturability	2,300	2,250	5,200	2,950	131.1%
Establish Near-Term Process Capability . . .	8,600	20,505	16,745	-3,760	-18.3%
Modernize Manufacturing Facilities and Infrastructure	17,887	19,860	33,410	13,550	68.2%
Implement Science & Model Based Manufacturing Information Systems	2,300	3,200	2,872	-328	-10.3%

(dollars in thousands)

Total, Stockpile Readiness	31,087	46,315	61,027	14,712	31.8%

Performance Measures

Performance will be demonstrated by:

- Completing deployment of new inspection capability for weapons manufacturing tooling.
- Completing installation of critical production equipment and facilities in support of test and production hardware for near-term life extension programs (LEPs).
- Identify requirements and establish capabilities for special materials required to recertify/remake parts in support of near-term LEPs
- Finalize design criteria in support of the subprojects making up the Special Materials Capability Project**.**

Detailed Program Justification

(dollars in thousands)

	FY 2001	FY 2002	FY 2003
Evaluate Material Requirements and Specifications	0	500	2,800

This activity supports material inventory and storage optimization, analytical tools for critical materials, and preparation for major materials technology deployments such as advanced oxide reduction technology to eliminate the hazards associated with hydrogen fluoride and provide a smaller, more efficient process footprint. The technologies to support several of these tasks are currently being developed under the ADAPT Campaign and will be implemented by SRC

Evaluate Designs for Improved Manufacturability	2,300	2,250	5,200

Final component designs for future LEPs are unknown at this time. This activity consists of tasks that would substantially improve Y-12's ability to manufacture and certify components in a more efficient manner, while reducing cycle time, waste streams, and purchased materials. The objectives of these efforts is to reduce manufacturing and certification times, allow quicker and more secure access to certification data, streamline the collection of critical information from unique technical evaluations, and rapidly transfer the most promising ADAPT technology to a production-ready state.

Establish Near-Term Process Capability	8,600	20,505	16,745

This activity is focused on restoring capability that does not currently exist but is required for maintenance of the enduring stockpile. These investments will be leveraged to achieve improvements in manufacturability and business processes while achieving near-term process capability. Specific activities will include machine tool acquisition and selected upgrades, inspection machine acquisitions, new welding capability, upgrading rolling mill and casting operations, upgrading the mechanical property laboratory, and certification of parts that will be reused.

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Modernize Manufacturing Facilities	17,887	19,860	33,410

Modernization is the binding element in Y-12's efforts to revitalize the plant's long-term readiness posture. Strategic planning and site planning efforts are providing the vision and direction for technology development, capability replacement, infrastructure reduction, and capital projects to ensure logic and consistency in determining location, priority, process layout, and execution strategy.
During FY 2003, the modernization component of Stockpile Readiness will continue to refine Y-12 modernization planning efforts (long-range facility plans, 10-year site plan, and master site plans). In addition, Modernization will continue to focus on the design, planning, and acquisition activities for the line item projects underway and initiation of planning for several new line item projects.

Several of these projects are aimed at essential infrastructure replacement/improvement necessary to meet mission requirements as well as footprint reduction, and process consolidation required to gain efficiency and reduce overall mission execution costs. Principle tasks to be planned under Modernization include: Highly Enriched Uranium Materials Facility (HEUMF), Purification Prototype Facility, Purification Production Facility, Ceramic Prototype and Manufacturing Projects, Ceramic Machining Bridging Projects, Utilities Upgrade Project, Enriched Uranium Manufacturing Facility (EUMF), Depleted Uranium Operations Consolidation, Quality Evaluation Consolidation, Emergency Operations Center/Plant Shift Superintendent (EOC/PSS) portion of the Tech Admin Complex, Advanced Design and Development Center, and Safeguards & Security Upgrades.

Implement Science & Model Based Manufacturing Information Systems	2,300	3,200	2,872

This element addresses five thrust areas: model-based product realization, science-based and intelligent manufacturing systems, information systems, facilities and infrastructure, and workforce development. These areas will be integrated to deploy a science- and model-based approach to manufacturing. This approach will ensure that the manufacturing processes are well understood and documented; optimized for maximum safety, efficiency, quality, and security; and deliver superior product in less time and with reduced costs.

Total, Stockpile Readiness	**31,087**	**46,315**	**61,027**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Stockpile Readiness	
# Increase reflects new modernization project starts and continued support of existing projects. Increase also reflects the continuation of equipment procurements and installation in preparation for near-term LEPs and work on materials and technology implementation. In FY 2003, this effort encompasses the next two planned LEPs. Increase also reflects new modernization projects starts and continued support of existing projects . . .	14,712
Total Funding Change, Stockpile Readiness . . .	**14,712**

Capital Operating Expenses & Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
General Plant Projects . . .	7,480	7,704	7,936	231	3.00%
Capital Equipment . . .	0	0	0	0	N/A
Total, Capital Operating Expenses . . .	7,480	7,704	7,936	231	3.00%

[a] Since funds are appropriated for Operations and Maintenance, which includes operating expenses, capital equipment and general plant projects, we no longer budget separately for capital equipment and general plant projects. FY 2002 and FY 2003 funding shown reflects estimates based on actual FY2001 obligations.

High Explosives Manufacturing and Weapons Assembly/Disassembly Readiness

Mission Supporting Goals and Objectives

This campaign established the plan for ensuring that the capability to requalify nuclear assembly components, manufacture and assemble high explosive components, both main charge and small energetic, and to assemble, disassemble, and perform surveillance on nuclear weapons is adequate to meet the needs of the nation's nuclear weapon stockpile, consistent with national goals and policies. The goal of this campaign is to ensure that the high explosives, component requalification, and assembly/disassembly operations through the Nuclear Weapons Complex are fully ready to support mission requirements.

The objective of the campaign is to determine the current state of readiness of the associated manufacturing technologies, capacities, facilities and personnel, identify where existing or potential shortfalls exist in each of these areas given production scenarios over the foreseeable future. In addition, this campaign will establish and manage a program of activities to correct those shortfalls to ensure these capabilities will be available to support production readiness. Specifically, the campaign addresses the gaps that exist in these operations in support of the B61-7/11, W80 and W76 LEPs, and 36-month readiness.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
High Explosives Manufacturing	1,896	1,364	6,253	4,889	358.4%
Product Requalification	400	1,913	2,170	257	13.4%
Enterprise Integration	0	0	770	770	??
Productivity Improvement	1,099	2,300	2,030	(270)	-11.7%
Collaborative Manufacturing	0	1,145	870	(275)	0.0%
Total, High Explosives Manufacturing and Weapons Assembly/Disassembly Readiness	3,395	6,722	12,093	5,371	79.9%

Performance Measures

<u>Performance will be demonstrated by</u>:

<u>FY 2002</u>

- Synthesize HMX explosive in 100-liter reactor
- Deploy synthesis and formulation processes for PBX 9501 with backup capacity
- Implement Integrated Pit Inspection Station (IPIS)

- Deployment of SecureNet, servers, additional classified workstations and software
- Implement Interactive Electronic Procedures (IEPs) to support DSW
- Complete installation of classified fiber optic loop for Zone 12 South

FY 2003

- Reestablish formulation capability and increase capacity for various explosives by moving from Building 12-019 to 11-050
- Implement Digital Radiography and Computed Tomography for pit characterization
- Implement model-based scheduling for the B61
- Continue Implementation of IEPs to support DSW
- Complete installation of fiber loop to Zones 11 and 12 North

Detailed Program Justification

	FY 2001	FY 2002	FY 2003
High Explosives Manufacturing	1,896	1,364	6,253

Includes activities that will establish the capability and capacity for synthesis, formulation, pressing, machining, and analytical and performance testing of all NNSA explosives to meet rebuilds, Joint Test Assemblies (JTAs), and Life Extension Programs (LEPs) requirements. These explosive materials also support activities such as development work (at Pantex Plant and the Design Labs), component rework, component replacement, and component aging studies.

Product Requalification	400	1,913	2,170

Includes activities that will deploy capability enhancements and new technologies. Typically these technologies are developed under the Advanced Design and Production Technologies (ADAPT), Enhanced Surveillance Program (ESP) and other NNSA programs, and are the ones that are required to support the requalification processes for pits, CSAs, case parts, metal structural parts, and other components that make up the nuclear assembly. The technologies required for pits and CSAs are top priorities. These technologies will focus on digital radiography, dimensional inspection, gas sampling and replacement, cleaning, tube replacement, surface characterization, and leak testing and other technologies identified be the Design Agencies for product requalification. Many of the technologies for requalification of pits and CSAs will also be applicable to the requalification of other weapon components.

Enterprise Integration	0	0	770

Includes activities that will implement the program and data management tools required to support the Nuclear Weapons Complex integration strategy that will ensure work is fully integrated, executed consistently and efficiently, and in a cost effective manner

Productivity Improvement	1,099	2,300	2,030

	FY 2001	FY 2002	FY 2003

Includes activities and costs that will implement facility, process, and procedure improvements that supports overall productivity improvements. This will be accomplished by enhancing existing capabilities, enabling efficient operations with new technologies, elimination of activities that are inefficient or have no added value, elimination of obsolete structures that are inefficient and costly to maintain, consolidation of operations into newer facilities with new and enhanced capabilities, and replacement of others with upgraded, modern facilities.

Collaborative Manufacturing	0	1,145	870

Includes activities and costs that will implement integrated, tool-oriented, computing and communication systems that support collaborative manufacturing among the design laboratories and production plants. Collaborative Manufacturing is the creation of a dynamic, integrated product development and realization process, one with the necessary agility and deftness to respond to the demands of nuclear weapons complex.

Total, High Explosives Manufacturing and Weapons Assembly/Disassembly Readiness	**3,395**	**6,722**	**12,093**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
HE/Assembly Readiness	
# **High Explosives Manufacturing** - Increase will address deliverables defined by the B61, W76, and W80 Life Extension Programs. Scale up activities for HE synthesis have been increased	4,889
# **Product Requalification** - Increase will address deliverables defined by the B61, W76, and W80 Life Extension Programs. Deployment of characterization capabilities for component requalification has been increased	257
# **Enterprise Integration** - Increase will address deliverables defined by the B61, W76, and W80 Life Extension Programs. Implementation of management control systems to support integration strategy will be continued	770
# **Productivity Improvement** - Increase will address deliverables defined by the B61, W76, and W80 Life Extension Programs. IEPs and models-based approaches for product definition and special tooling have been increased	-270

	FY 2003 vs. FY 2002 ($000)
# **Collaborative Manufacturing**- Increase will address deliverables defined by the B61, W76, and W80 Life Extension Programs. Increase will improve SecureNet access at the Pantex Plant to allow immediate review of the most current drawings	-275
Total Funding Change, HE/Assembly Readiness	**5,371**

Capital Operating Expenses & Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	1,671	1,721	1,773	52	3.00%
Total, Capital Operating Expenses	1,671	1,721	1,773	52	3.00%

[a] Since funds are appropriated for Operations and Maintenance, which includes operating expenses, capital equipment and general plant projects, we no longer budget separately for capital equipment and general plant projects. FY 2002 and FY 2003 funding shown reflects estimates based on actual FY2001 obligations.

Nonnuclear Readiness

Mission Supporting Goals and Objectives

The Nonnuclear Readiness Campaign (NNRC) will identify, acquire, and sustain future technical capabilities and production capacities to produce nonnuclear products for the nation's nuclear weapons stockpile. Nonnuclear production readiness identifies required new levels of performance, defines gaps between current conditions and new levels of performance, and addresses vulnerabilities that might impede existing production operations. The Nonnuclear Readiness Campaign will ensure present and long-term manufacturing capabilities to supply critical nonnuclear weapon components and subassemblies and will position the Nuclear Weapons Complex to meet anticipated and emergency stockpile requirements with faster response times. There are four Major Technical Elements associated with this campaign: Optimize Supply Chain, Enhance Processes for New Weapon Designs, Modernize Current Manufacturing Capabilities, and Implement Rapid Manufacturing Methods. This campaign addresses production readiness needs for detonators, neutron tube targets, other nonnuclear components, and in the future, some surveillance activities. This program is complementary to additional work being performed by the RTBF and other DSW Programs.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Optimize Supply Chain	0	2,245	5,522	3,277	146.0%
Enhance Processes for New Weapons Designs	500	2,255	2,289	34	1.5%
Modernize Current Manufacturing Capabilities	2,439	8,223	11,922	3,699	45.0%
Implement Rapid Manufacturing Methods	0	5,134	2,665	-2,469	-48.1%
Total, Nonnuclear Readiness	2,939	17,857	22,398	4,541	25.4%

Performance Measures

Performance will be demonstrated by:

- Supporting B61-7/11, W80 and W76 life extension programs through deploying commercial components methodologies for War Reserve Applications; deploying and characterizing modern gas transfer systems; and applying science based manufacturing techniques of modeling and simulation to achieve programmatic goals.
- Establishing detonator production capability and expanding neutron tube target loading.
- Evaluating and Qualifying new material suppliers for the W80, W76, and B61 Life Extension Programs.
- Acquiring/qualifying detonator grade powder to meet DSW requirements.
- Upgrading neutron tube & neutron generator testers.

Detailed Program Justification

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Optimize Supply Chain	0	2,245	5,522

Focuses on improving the quality of the supply chain for future nuclear weapons complex needs addressing quality, delivery, and cost issues in three areas: procurement or certification of raw and existing materials or material parts and qualification of commercial components in weapons environments, primarily electronic, for utilization in upcoming LEP applications. Specific tasks include Engineered Materials, Commercial Component Applications and W76 procured parts.

Enhance Processes for New Weapons Designs	500	2,255	2,289

Addresses the deployment of new manufacturing processes required to meet next generation weapon systems. Focuses on advanced production technologies enabling new opportunities for weapon surety through miniaturization and reduction in part count, as well as significant enhancement in data acquisition and monitoring during flight tests. Specific tasks include Component Miniaturization and Microsystems Deployment.

Modernize Current Manufacturing Capabilities	2,439	8,223	11,922

Includes a wide cross-section of activities from manufacturing support capabilities such as upgrading test equipment, analytical laboratories and metrology to specific manufacturing processes such as IR curing, and new welding processes. This also includes product-focused technologies such as reservoir systems as well as manufacturing skill development for firing systems. Specific tasks include Advanced Test Capability, Reservoir Enhancements, W76 Production Processes, W80 Fireset Skills Development, IR Cure Development, W80 Production Processes, Analytical Services Development, and Metrology Enhancement.

Implement Rapid Manufacturing Methods	0	5,134	2,665

Addresses the utilization of new tools, methodologies and approaches to manufacturing including optimizing processes and flowtimes through improved facility layout; supporting supply linkages; simulating and visualizing processes prior to production using virtual prototyping and other database tools. Specific tasks include Science Based Manufacturing and Virtual Prototyping.

Total, Nonnuclear Readiness	**2,939**	**17,857**	**22,398**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Nonnuclear Readiness	
Optimize Supply Chain- Increase supports the evaluation of new material suppliers to establish the capability to manufacture microsystems, to weaponize lasers and electro-optics, to develop infrared cure processes, to improve Acorn reservoir production readiness, to upgrade analytical and testing services and to deploy model based manufacturing and prototyping for W80, W76, and the B61.	3,277
Enhance Processes for New Weapons Design.	34
Modernize Current Manufacturing Capabilities- Increase will support the replacement of obsolete product testers; and the development, validation, and implementation of production capacity planning models needed to address neutron generator production demand scenarios.	3,699
Implement Rapid Manufacturing Methods-Decrease reflects delaying the completion of technology upgrades initiated in FY 02 in order to support higher priorities in the **Optimize Supply Chain** and **Modernize Current Manufacturing Capabilities** major technical elements	-2,469
Total Funding Change, Nonnuclear Readiness	**4,541**

Capital Operating Expenses & Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
General Plant Projects	491	506	521	15	3.00%
Capital Equipment	299	308	317	9	3.00%
Total, Capital Operating Expenses	790	814	838	24	3.00%

[a] Since funds are appropriated for Operations and Maintenance, which includes operating expenses, capital equipment and general plant projects, we no longer budget separately for capital equipment and general plant projects. FY 2002 and FY 2003 funding shown reflects estimates based on actual FY2001 obligations.

Materials Readiness

Mission Supporting Goals and Objectives

This campaign covers both Materials Readiness and Materials Surveillance. The Materials Readiness Campaign provides the means to analyze and identify shortfalls of nuclear and critical nonnuclear weapons materials, improved material capabilities and technologies and establishes a comprehensive integrated materials information database for the Stockpile Stewardship Program. Materials Surveillance provides for management of excess materials at DP sites.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Materials Supply/Demand and Planning .	0	0	0	0	0.0%
Material Processing and Disposition Capability	0	687	0	-687	100.0%
Material Storage Optimization	0	0	0	0	0.0%
Enabling Processes, Technology, and Analytical Tools	2,941	0	0	0	0.0%
Materials Packages and Containers	0	0	0	0	0.0%
Materials Surveillance	3,222	501	0	-501	-100.0%
Total, Materials Readiness	6,163	1,188	0	-1,188	-100.0%

Performance Measures

Performance will be demonstrated by:

- Completing a survey of national security materials and requirements.
- Completing gap analysis and identifying a strategy or program elements for filling gaps.

Detailed Program Justification

	(dollars in thousands)		
	FY 2001	**FY 2002**	**FY 2003**
Materials Supply/Demand Assessment and Planning	0	0	0

Identified national security materials on hand and needed in the future, and gaps and processes needed to transform materials into forms needed and surplus materials and associated disposition paths.

Material Processing and Disposition Capability	0	687	0

Addresses the production and recovery of additional materials and upgrades/modifications to equipment used to process materials and the restart of process equipment.

Material Storage Optimization	0	0	0

Identified enhancements to storage infrastructures and develop strategy for, and defines the needs for storage of materials.

Enabling Processes, Technology, and Analytical Tools	2,941	0	0

Identified/developed processes, technology, and analytical tools needed to enable the other MRC major elements including monitoring technologies and robotics.

Materials Packages and Containers	0	0	0

Ensured the availability of new containers and packaging for storage and transportation of national security and surplus nuclear materials.

Materials Surveillance	3,222	501	0

Decrease in funding reflects a realignment of activities at the Y-12 Plant and other sites to other programs as the purpose of the campaign is further refined.

Total, Materials Readiness	**6,163**	**1,188**	**0**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Materials Readiness	
# Decrease reflects a realignment of activities at Y-12 and other sites to other programs as the purpose of the campaign is further refined	-1,188
Total Funding Change, Materials Readiness	**-1,188**

Tritium Readiness

Mission Supporting Goals and Objectives

Tritium Readiness implements the Secretarial Record of Decision, which selected the Commercial Light Water Reactor (CLWR) option as the primary technology for the production of tritium. The Accelerator Production of Tritium (APT) (formerly the backup technology) was effectively closed out to zero funding in FY 2002. The campaign's objective for the CLWR is to establish the production systems and operations systems to produce tritium in a commercial reactor so that tritium can be delivered to the stockpile. New efforts include the addition of the Tritium Production Program which provides funding beginning in FY 2003 to purchase reactor fuel enrichment for the TVA reactors.

The Tritium Extraction Facility (TEF) has realized risk associated with construction subcontracts, engineered equipment procurements, and increased security requirements that have lead to increases in existing baseline costs. The impact of these baseline cost increases will require rebaselining of TEF and schedule delays for completion of TEF. Analysis is ongoing and will be provided when received and verified. The overall CLWR project is being reviewed currently to balance tritium demand, irradiation schedules in the TVA reactors, and delivery schedules of components for production of tritium producing burnable absorber rods (TPBARS) such that the tritium readiness profile follows production schedules more closely.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Commercial Light Water Reactor Development Program	57,079	41,584	42,734	1,150	2.8%
CLWR Tritium Production Program	0	0	13,400	13,400	100.0%
Accelerator Production of Tritium (APT)	18,440	0	0	0	0.0%
Construction	89,802	81,125	70,165	-10,960	-13.5%
Total, Tritium Readiness	165,321	122,709	126,299	3,590	2.9%

Performance Measures

- Initiate tritium-producing rod assembly by the commercial fabricator (WesDyne International) using components procured by the Pacific Northwest National Laboratory. Tritium producing rod components will be manufactured at various commercial sites. The components will be assembled into complete rods at the WesDyne International facility in Columbia, SC.
- Deliver approximately 2400 tritium producing rods to the Tennessee Valley Authority's (TVA's) Watts Bar and Sequoyah reactor sites for insertion in the reactors by 4th quarter of FY 2003.

- Complete preparations at reactor sites for handling tritium-producing rods by end of FY 2003.
- Complete the transfer of designer-of-record responsibilities from the Pacific Northwest National Laboratory to WesDyne International.
- Provide incremental funding to cover costs of program related enriched fuel requirements and associated increased fuel costs for up to 96 fuel elements at each of TVA's three reactors at Watts Bar and Sequoyah.

Detailed Program Justification

(dollars in thousands)

	FY 2001	FY 2002	FY 2003
# **Commercial Light Water Reactor Development Program**	57,079	41,584	42,734
CLWR Development Program will establish by FY 2003, the production capacity and operations systems necessary to produce tritium in a commercial reactor so that tritium can be delivered to the nuclear weapons stockpile by 2nd quarter FY 2006.			
# **CLWR Tritium Production Program**	0	0	13,400
Initiate the use of commercial reactors to irradiate tritium producing rods and to extract tritium from the rods at the new Tritium Extraction Facility (TEF)on a continuing basis.			
# **Accelerator Production of Tritium (APT)**	18,440	0	0
Final project closeout of the APT project occurred in FY 2002. This funding does not include termination costs. Proposals to determine the exact amount of termination costs will be submitted by February, 2002 by the affected contractors and will be evaluated when received. A reprogramming will be necessary to cover these costs with the source of funds identified pending the final review and verification of costs.			
# **Construction**			
Project 98-D-125, Tritium Extraction Facility, Savannah River Site	74,835	81,125	70,165
Project 98-D-126, Accelerator Production of Tritium, various locations	14,967	0	0
Total, Tritium Readiness	**165,321**	**122,709**	**126,299**

Explanation of Funding Changes from FY 2002 to FY 2003

Tritium Readiness	FY 2003 vs. FY 2002 ($000)
# Increase in Commercial Light Water Reactor (CLWR) Development Program funding supports an increased level of activity in the program as outlined in the integrated funding profile of the project (planned baseline).	1,150
# Starting in FY 2003, funds will be used to cover incremental increases in the cost of fuel for the Tennessee Valley Authority's Watts Bar and Sequoyah reactors. These fuel cost increases are directly attributable to the irradiation of tritium producing burnable absorber rods in FY 2004 and FY 2005.	13,400
# Decrease in the Tritium Extraction Facility, 98-D-125, reflects approved project funding profile	-10,960
Total Funding Change, Tritium Readiness	**3,590**

Capital Operating Expenses & Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	1,250	1,288	1,326	39	3.00%
Total, Capital Operating Expenses	1,250	1,288	1,326	39	3.00%

Construction Projects

	Total Estimated	Prior Year Approp-	FY 2001	FY 2002	FY 2003	Unapprop-riated Balance
Project 98-D-126, Accelerator Production of Tritium, VL[b]	134,728	119,761	14,967	0	0	0
98-D-125, Tritium Extraction Facility, SRS	323,000	48,525	74,835	81,125	70,165	48,350

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[a] Since funds are appropriated for Operations and Maintenance, which includes operating expenses, capital equipment and general plant projects, we no longer budget separately for capital equipment and general plant projects. FY 2002 and FY 2003 funding shown reflects estimates based on actual FY2001 obligations.

[b] Project TEC does not reflect termination costs which are presently being proposed for review and validation.

	Total Estimated	Prior Year Approp-	FY 2001	FY 2002	FY 2003	Unapprop-riated Balance
Total, Tritium Readiness			**89,802**	**81,125**	**70,165**	**48,350**