Campaigns

Program Mission

Campaigns are multi-year, multi-functional efforts involving, to varying degrees, every site in the nuclear weapons complex. They provide specialized scientific knowledge and technical support to the directed stockpile work on the nuclear weapons stockpile. Deliverables are defined/scheduled in each campaign plan and then coordinated with several key nuclear weapons complex directives, including the current Nuclear Weapons Production and Planning Directive (P&PD), Nuclear Weapons Schedule, Integrated Weapons Activity Plan (IWAP), and specific weapon Program Control Documents (PCDs), Component Description Documents (CDDs), and program planning documents. Current priority for general campaign support is to provide technology for three ongoing Life Extension Programs (LEPs) and to other ongoing refurbishments. Some campaigns focus on near-term deliverables; others on longer-range improvement to specific weapons complex capabilities. A few include directly associated construction projects; most do not. Overall, they all directly support the long-term stewardship of the nuclear weapons stockpile. There are six categories.

- **Science Campaigns** (Primary Certification, Dynamic Materials Properties, Advanced Radiography, and Secondary Certification and Nuclear Systems Margins). These four campaigns develop certification methodologies and the associated capabilities and scientific understanding required to assure the safety and reliability of aged and remanufactured weapons in the absence of nuclear testing. This technology base must be in place to carry out weapons refurbishments and other stockpile support work.
- **Engineering Campaigns** (Enhanced Surety, Weapons System Engineering Certification, Nuclear Survivability, Enhanced Surveillance, and Advanced Design and Production Technologies). These five campaigns and engineering construction activities provide required tools, methods, and technologies for the continued certification and long-term sustainment (via refurbishment) of the nuclear weapons stockpile. Many of the deliverables are timed to coincide with the individual Life Extension Program (LEP) schedule, negotiated with the Department of Defense (DoD), for these refurbishments and, in a number of instances, provide capabilities lost with the cessation of underground nuclear testing.
- **Inertial Confinement Fusion Ignition and High Yield (ICF) Campaign**. This campaign advances the nation's capabilities to achieve inertial confinement fusion ignition in laboratory experiments and addresses high-energy-density physics issues required to understand key weapons physics issues.
- **Advanced Simulation and Computing (ASCI) Campaign**. This campaign provides the simulation and modeling tools that enable the design community to assess and certify the safety, performance and reliability of the U.S. nuclear weapons stockpile. Having evolved from the merging of the Accelerated Strategic Computing Initiative and the ongoing Stockpile Computing program, the Advanced Simulation and Computing campaign continues to use the acronym "ASCI".
- **Pit Manufacturing and Certification Campaign**. This campaign's mission is to regenerate the nuclear weapons complex capability to produce nuclear primaries (pits). In the near term, the campaign will focus mainly on W88 pit manufacturing and certification, while planning for a Modern Pit Facility that is capable of reestablishing and maintaining sufficient levels of production to support

requirements for the safety, reliability, and performance of all forecast U.S. requirements for nuclear weapons.

- **Readiness Campaigns** (Stockpile Readiness, High Explosives Manufacturing and Weapon Assembly/Disassembly Readiness, Nonnuclear Readiness, and Tritium Readiness). These four campaigns are technology base efforts designed to re-establish, maintain, and enhance manufacturing and other capabilities needed for the future production of weapon components, mostly needed for the near-term LEPs.

Program Strategic Performance Goal

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

Performance Indicators

Number of National Ignition Facility (NIF) project major construction milestones completed

Number of weapons systems components analyzed using ASCI codes to annually certify their performance

Amount of individual platform computing capability measured in trillions of operations per second (TeraOPS)

Percentage of major milestones completes towards W88 pit certification

Percentage of major milestones completed towards restoration of capability to manufacture the pit types in the enduring stockpile

Percentage of major milestones completed towards construction of the Modern Pit Facility

Number of tritium rods irradiated in commercial reactors

Percentage of subcritical experiments completed on/ahead of schedule

Percentage of major milestones completed on/ahead of schedule

Annual stockpile aging assessment completion

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Successfully completed directive scheduled assessments, tests, experiments, analyses, evaluations, predictions, reports, and/or studies in support of Directed Stockpile Work (DSW).	Complete directive scheduled assessments, tests, experiments, analyses, evaluations, predictions, reports, and/or studies in support of Directed Stockpile Work (DSW), base requirements, and programmatic nuclear upgrades.	Complete three additional NIF major construction milestones for a total of 13 of the 28 milestones completed. Analyze 10 of 31 weapons system components using ASCI codes to certify their performance.

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Successfully conducted or validated simulations or models in support of specific weapons, and/or the stockpile as a whole.	Conduct or validate directive scheduled simulations or models in support of specific weapons, and/or the stockpile as a whole.	Deliver an ASCI platform which can perform 40 trillion operations per second. Complete 25% of the major milestones towards achieving W88 pit certification in FY2007.
Successfully demonstrated or deployed scheduled improved required capabilities or technologies in support of specific weapon systems and/or the stockpile as a whole.	Demonstrate or deploy 85% of directive scheduled improved required capabilities or technologies in support of specific weapon systems and/or the stockpile as a whole.	Complete 20% of the major milestones towards restoration of the capability to manufacture the pit types in the enduring stockpile in FY2009. Complete 40% of the MPF major milestones towards Critical Decision (CD) -1.
Successfully identified or documented scheduled new/additional system or component requirements in support of specific weapon systems and/or the stockpile as a whole.	Identify or document 95% of new/additional system or component requirements in support of specific weapon systems and/or the stockpile as a whole, as scheduled.	Begin production of tritium by irradiating rods in the Tennessee Valley Authority's (TVA's) Watts Bar reactor. Decide, with the DoD and Nuclear Weapons Council, future tritium requirements and schedule the TVA irradiation services accordingly.
Successfully completed scheduled Critical Decision (CD) milestones for construction of related facilities.	Complete all Critical Decision (CD) milestones for related facility construction, within cost, scope, and schedule.	Complete four scheduled subcritical experiments. Complete 90% of major milestones. Meet all scheduled milestones for NIF, MESA and TEF.
Successfully deployed new/improved equipment, processes, and business practices in support of the directive schedule.	Deploy 95% of new/improved equipment, processes, and business practices in support of the directive schedule.	Complete FY2003 stockpile aging assessment and report in January 2004.

Significant Program Shifts

In FY 2004, the baseline program has been adjusted to reflect the following: slip B61 common radar First Production Unit (FPU) from FY 2008 to FY 2012; delay B61spin rocket motor FPU from FY 2008 to FY 2012; slip B61 use-control upgrade from FY 2008 to FY 2012; and delay W78 high-fidelity Joint Test

Assembly (JTA7) development. Campaign planning and deliverables have been revised to support the revised LEP schedules.

Funding Profile

(dollars in thousands)

	FY 2002 Comparable Appropriation	FY 2003 Request	FY 2004 Request	$ Change	% Change
Primary Certification	50,572	47,159	65,849	18,690	39.6%
Dynamic Materials Properties	90,032	87,594	82,251	-5,343	-6.1%
Advanced Radiography	75,577	52,925	65,985	13,060	24.7%
Secondary Certification & Nuclear Systems Margins	40,885	46,746	55,463	8,717	18.6%
Subtotal, Science Campaigns	257,066	234,424	269,548	35,124	15.0%
Enhanced Surety	32,086	37,713	37,974	261	0.7%
Weapons Systems Engineering	25,595	27,007	28,238	1,231	4.6%
Nuclear Survivability	21,902	23,394	23,977	583	2.5%
Enhanced Surveillance	73,280	77,155	94,781	17,626	22.8%
Advanced Design & Production Technologies	68,225	74,141	79,917	5,776	7.8%
Engineering Campaigns Construction - Operations & Maintenance / Other Project Costs	3,600	4,200	4,500	300	7.1%
01-D-108, Microsystems Engineering Sciences & Applications (MESA) Complex, SNL	63,500	75,000	61,800	-13,200	-17.6%
Subtotal, Engineering Campaigns Construction	67,100	79,200	66,300	-12,900	-16.3%
Subtotal, Engineering Campaigns	**288,188**	**318,610**	**331,187**	**12,577**	**3.9%**
Inertial Confinement Fusion Ignition and High Yield O&M	261,773 [a]	238,792 [a]	316,769	77,977	32.7%
96-D-111, National Ignition Facility . .	245,000	214,045	150,000	-64,045	-29.9%
Subtotal, Inertial Confinement Fusion and High Yield	**506,773**	**452,837**	**466,769**	**13,932**	**3.1%**
Advanced Simulation and Computing O&M	660,056	669,527	713,326	43,799	6.5%

[a] Reflects a comparability adjustments of $1,400,000 in FY 2002 and $1,044,000 in FY 2003 from the Secondary Certification and Nuclear Systems Margins Campaign to consolidate funding for high energy density physics grants into the Inertial Confinement Fusion Ignition and High Yield Campaign.

	(dollars in thousands)				
	FY 2002 Comparable Appropriation	FY 2003 Request	FY 2004 Request	$ Change	% Change
01-D-101, Distributed Information Systems Laboratory	8,400	13,305	12,300	-1,005	-7.6%
00-D-103, Terascale Simulation Facility	22,000	35,030	25,000	-10,030	-28.6%
00-D-107, Joint Computational Engineering Laboratory	13,377	7,000	0	-7,000	-100.0%
Subtotal, Advanced Simulation and Computing Campaign	**703,833**	**724,862**	**750,626**	**25,764**	**3.6%**
Pit Manufacturing and Certification . .	248,961 [b]	235,964 [b d]	320,228 [b]	84,264	35.7%
Stockpile Readiness	26,318	38,659	55,158	16,499	42.7%
HE/ Assembly Readiness	6,688	12,093	29,649	17,556	145.2%
Nonnuclear Readiness	17,768	22,398	37,397	14,999	67.0%
Materials Readiness	1,172	0	0	0	N/A
Tritium Readiness, O&M	45,517	56,134	59,893	3,759	6.7%
98-D-125, Tritium Extraction Facility	81,125	70,165 [c]	75,000	4,835	6.9%
98-D-126, Accelerator Production of Tritium, VL	5,847	0	0	0	N/A
Subtotal, Readiness Campaigns . . .	184,435	199,449	257,097	57,648	28.9%
Total, Campaigns	**2,189,256** [d]	**2,166,146**	**2,395,455**	**229,309**	**10.6%**

The FY 2003 Request column includes comparability adjustments as detailed in the footnotes for consistency with the FY 2004 Request.

Public Law Authorization: P. L. 107-314, Bob Stump National Defense Authorization Act for FY 2003

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[b] Includes comparability adjustment for the transfer of subcritical experiments which support the certification of the W88 pit from Directed Stockpile Work - Research and Development to the Pit Manufacturing and Certification Campaign in FY 2004. Adjustment is $44,500,000 in FY 2002; $41,800,000 in FY 2003 and $43,000,000 in FY 2004.

[c] Pending the enactment of a final FY 2003 appropriation, this amount reflects the FY 2003 Congressional Budget Request; it does not include a reprogramming of $10,000,000 from prior year funding, which was requested in FY 2002, but not approved until December 2002. If the FY 2003 appropriation provides the funding requested in FY 2003, a total of $80,165,000 will be available. An additional $10,000,000 will need to be reprogrammed into Project 98-D-125, Tritium Extraction Facility bringing the total for FY 2003 to $90,165,000.

[d] Reflects adjustment for the rescission of funds in the Weapons Activities account required by the FY 2002 Supplemental Appropriations Act for further Recovery From and Response to Terrorist Attacks on the United States (P.L. 107-206). The total amount rescinded in Campaigns is $11,614,804.

Funding by Site

(dollars in thousands)

Campaigns	FY 2002	FY 2003	FY 2004	$ Change	% Change
Chicago Operations Office					
Argonne National Laboratory	576	400	400	0	0.0%
Chicago Operations Office	2,208	31,900	27,638	-4,262	-13.4%
Subtotal, Chicago Operations Office	2,784	32,300	28,038	-4,262	-13.2%
Idaho Operations Office					
Idaho National Engineering & Environmental Laboratory	250	0	0	0	N/A
Kansas City Site Office					
Kansas City Plant	40,143	42,454	54,205	11,751	27.7%
Livermore Site Office					
Lawrence Livermore National Laboratory	666,912	648,011	645,243	-2,768	-0.4%
Los Alamos Site Office					
Los Alamos National Laboratory	495,998	478,485	523,543	45,058	9.4%
Nevada Site Office					
Nevada Site Office	101,112	82,031	84,205	2,174	2.7%
NNSA Service Center					
General Atomics	7,558	8,695	10,899	2,204	25.3%
Naval Research Laboratory	21,287	10,000	10,467	467	4.7%
University of Rochester/Laboratory for Laser Energetics	34,693	36,400	40,132	3,732	10.3%
Oakland Site Office	5,594	2,960	3,000	40	1.4%
Subtotal, NNSA Service Center	69,132	58,055	64,498	6,443	11.1%
Oak Ridge Operations Office					
Office of Science & Technical Information	149	149	140	-9	-6.0%
Oak Ridge National Laboratory	4,967	4,942	5,141	199	4.0%
Y-12 National Security Complex	47,388	57,791	78,021	20,230	35.0%
Total, Oak Ridge Operations Office	52,504	62,882	83,302	20,420	32.5%
Pantex Site Office					
Pantex Plant	16,554	22,584	41,758	19,174	84.9%

Campaigns	FY 2002	FY 2003	FY 2004	$ Change	% Change
	(dollars in thousands)				
Sandia Site Office					
Sandia National Laboratories	371,606	403,201	397,192	-6,009	-1.5%
Richland Operations Office					
Pacific Northwest National Laboratory	3,548	13,200	12,080	-1,120	-8.5%
Savannah River Operations Office					
Savannah River Site	92,017	90,041	101,999	11,958	13.3%
Washington Headquarters	276,696	232,902	359,392	126,490	54.3%
Total, Campaigns	**2,189,256**	**2,166,146**	**2,395,455**	**229,309**	**10.6%**

Site Descriptions

Los Alamos National Laboratory (LANL): The LANL supports the campaigns through unique capabilities in neutron science required for stockpile stewardship and enhanced surveillance, and shares with LLNL and the Sandia National Laboratories (SNL), the responsibility for the safety, reliability, and performance of the Nation's nuclear weapons. Other activities include plutonium fabrication and processing technology development; oversight of tritium reservoir surveillance, testing, and tritium recycle technology; support of high explosive science focused on safety, reliability and performance; detonator development, production, and surveillance; beryllium fabrication; neutron tube target loading, and pit component production and surveillance.

Among the major specialized facilities at LANL are the TA-55 Plutonium Facility for surveillance of plutonium pits and plutonium pit manufacturing, actinide research, and nuclear waste research and the Los Alamos Neutron Science Center user facility for supporting advanced materials science, nuclear science and particle-beam accelerator technology, in addition to weapons surveillance. The first axis of the Dual Axis Radiographic Hydrodynamic Test (DARHT) facility became operational for experimental use in FY 1999; Phase II is currently over 94% complete with prototype and production hardware well underway. Production of an electron beam the entire length of the second axis is scheduled for early 2003. In addition, the Strategic Computing Complex was completed in FY 2002 to house the next generation 30 TeraOps ASCI *"Q"* supercomputer. A plutonium pit manufacturing capability is being reestablished at LANL to replace units destructively tested in the Stockpile Evaluation Subprogram and to replace pits in the future, should surveillance indicate a problem with a pit.

Sandia National Laboratories (SNL): The SNL engineering efforts meet currently scheduled stockpile refurbishment requirements, and facilities such as the Testing Capabilities Revitalization project and the Microsystem and Engineering Sciences Applications (MESA) complex will provide for the design, integration, prototyping and fabrication, and qualification of microsystems into weapon components, subsystems, and systems within the stockpile. These facilities and the expertise resident at SNL provide the capabilities needed to respond to all facets of anticipated stockpile refurbishment and testing requirements. SNL provides unique capabilities in advanced manufacturing technology, microelectronics, and photonics and maintains distinctive competencies in engineered materials and processes, computational and information sciences, engineering sciences, and pulsed-power technology.

Lawrence Livermore National Laboratory (LLNL): The LLNL supports the campaigns through a broad range of world-class science and engineering capabilities, including nuclear science and technology and advanced sensors and instrumentation. LLNL also supports high explosive safety and assembly/ disassembly operations at the Pantex Plant, and oversight of uranium and case fabrication and processing technology with support from the Y-12 National Security Complex and LANL. LLNL will also conduct studies to provide the basis for an assessment of pit lifetime as well as develop and implement new diagnostics for the Stockpile Evaluation Subprogram. The lifetime work will aid NNSA in assessing the need, timing, and capacity for a large capacity pit manufacturing facility. It will utilize old pits and validated accelerated aging alloys to study the physics, engineering, and materials properties of pertinent Plutonium alloys. The work will include characterization and modeling of aging behavior to assure proper understanding of initiation system components. The final product will be age-aware performance models for use by the Primary Certification and Weapons System Engineering Certification
Campaigns to determine if potential age-induced changes are significant. Support through continuous and innovative improvement of individual manufacturing procedures and development of new technologies or materials to support refurbishments is also provided.

Kansas City Plant (KCP): The KCP provides a broad range of standard industrial processes (e.g., plating, machining, metal deposition, molding, painting, heat treating, and welding), some of which are uniquely tailored to meet special weapon reliability requirements. The Kansas City Plant evaluates components and subsystems removed from the stockpile for reuse or testing. The plant is participating with the other plants and laboratories in the Enhanced Surveillance Campaign to predict component and material lifetimes, critical elements of the Life Extension Programs, the Advanced Design and Production Technologies Campaign to develop modular, scalable, and environmentally sound manufacturing processes, and the Nonnuclear Readiness Campaign to identify, acquire, and sustain technical capabilities and production capabilities to produce nonnuclear products for DSW.

Pantex Plant: Pantex supports the Engineering Campaigns through fabrication of high explosives used in nuclear weapons and performs modifications and surveillance of nuclear weapons scheduled to remain in the enduring stockpile. During FY 2002-FY 2004, Pantex will deploy the integrated pit inspection station (IPIS); provide Engineering System Releases as required by Technical Business Practices for the IPIS to utilize eddy current measurements, acoustic resonance measurements and digital imaging technologies; install 1-2 mil resolution computed tomography for pits, X-Ray fluorescence for cases, and performance diagnostics for insensitive high explosives; provide equipment definition and process development plan for pit refurbishment activities; demonstrate process for synthesis of TATB (an insensitive high explosive small scale) in Pilot Plant; complete the engineering analyses and design for the Intrasite Pit Staging and Transportation Container; provide interfaces for automated uploading and migrate the Integrated Reporting and Information System to an Oracle platform.

Y-12 National Security Complex: Activities conducted at the Y-12 National Security Complex include manufacturing and reworking nuclear weapon components, dismantling nuclear weapon components returned from the national arsenal, serving as the nation's storehouse of special nuclear materials, and providing special production support to other programs.

Savannah River Site (SRS): The SRS is the National Nuclear Security Administration's center for the supply of tritium to the enduring nuclear weapons stockpile. SRS is the nation's only facility for recycling and reloading of tritium from the weapon stockpile, as well as the unloading and surveillance of tritium reservoirs. A new tritium extraction facility is under construction at SRS to extract new tritium that will be created by TVA's light-water reactor starting in November 2003 and shipped to the site in the fourth quarter of FY 2005. SRS tritium facilities are in the process of being upgraded and consolidated to continue to process the nations tritium.

All Other Sites

Stockpile Stewardship activities are also conducted at several other sites. Inertial fusion research is conducted at the **Naval Research Laboratory**, in Washington, D.C., through the use of its Krypton-fluoride Nike laser. This research will contribute to the direct drive application at the National Ignition Facility (NIF) and, beginning in FY 2003, does not support development of the Krypton-fluoride Nike laser for other applications. In addition, the laboratory has strong capabilities in code development and atomic physics. The **University of Rochester's** Laboratory for Laser Energetics in Rochester, New York, operates the 60-beam glass laser, Omega, primarily for research on direct drive laser fusion. The Omega facility is used to field weapons physics experiments designed by scientists from LLNL and LANL. With the shutdown of the Nova laser at LLNL, Omega is being used more extensively, pending transition to NIF operations. **General Atomics**, located in La Jolla, California, is the current contractor supplying the national laboratories with inertial confinement fusion targets.

Primary Certification

Mission Supporting Goals and Measures

Primary Certification integrates the laboratory research and development efforts in hydrotesting, subcritical experiments, 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.

Subprogram Goal

Developed tools and methodologies to certify the performance and safety of any rebuilt or aged primary to a specific yield.

Performance Indicators

Percentage of scheduled subcritical experiments completed on/ahead of schedule.
Percentage improvement in assessed predictive capability relative to goals of 2005 and 2010.

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Completed electronic archiving of prompt diagnostic data from underground nuclear tests.	Begin developing logic for quantification of margins and uncertainties (QMU) for use in the W76 and W88 warhead physics package certification.	Complete 100% of the 4 scheduled subcritical experiments.
Developed a new fiber optic diagnostic for measuring high explosive burn front; velocity was developed; improvements continue.	Evaluate historical test data for archiving.	Complete the initial 60% of FY 2005 goal in assessed predictive capability.
Made improvements to the radiographic scatter reducing collimator that allows flash X-Ray radiography of thick- weapon geometry objects. Successfully fired weapon geometry hydros.	Provide validation data for high fidelity material model development by executing a suite of subcritical experiments in U1a Complex at Nevada Test Site (to include Piano). Validate pit material equation-of-state models.	Conduct scheduled major hydrotests at DARHT and Container Firing Facility to support Life Extension Programs and Significant Findings Investigations.

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Fired Oboe 7, 8, and 9 subcritical experiments successfully; yielded excellent results.	Evaluate thermochemically based high explosive equation-of-state.	Finalize Qualitative Methodologies and Uncertainties methodology for FY 2005 implementation.
Demonstrated Stallion radiographic probe.	Execute four subcritical Experiments.	Determine jointly by Los Alamos and Lawrence Livermore National Laboratories the specific data required from radiography for primary certification.
Developed and demonstrated the radiographic capabilities used at U1A in support of subcritical experiments in support of pit certification.	Serve as the radiographic source system integrator for Los Alamos National Laboratory's (LANL's) subcritical experiments.	
	Validate first SubCritical Radiographic Prototype at LANL.	Provide a new high explosive model with improved material data.
	Install the Armando subcritical experiment radiographic probe system in U1a Complex at Nevada Test Site.	

Funding Schedule

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Legacy Data Analysis and Archiving	2,824	3,721	4,422	701	18.8%
Materials Science Integration/Analysis	12,605	15,120	21,636	6,516	43.1%
Engineering Component Analysis	250	0	0	0	??
Boost Physics	5,156	4,655	14,475	9,820	211.0%
Integrated Hydro Test Assessment	1,855	0	0	0	??
Subcritical Experiments	27,882	23,663	25,316	1,653	7.0%
Total, Primary Certification	50,572	47,159	65,849	18,690	39.6%

Detailed Program Justification

	(dollars in thousands)		
	FY 2002	FY 2003	FY 2004
Legacy Data Analysis and Archiving	**2,824**	**3,721**	**4,422**

This effort uses modern codes, tools and physics understanding to re-analyze Nevada Test Site legacy underground test data and other data to support an improved understanding of weapons in the stockpile. This is critical for developing a modern baseline against which to assess the impact on performance of significant finding investigations (SFI's) and proposed stockpile Life Extension Programs (LEP's). **This activity also mentors new scientists**.

Materials Science Integration and Analysis	**12,605**	**15,120**	**21,636**

Supports experimental work to develop and test data bases and models for properties of materials used in weapons primaries. New diagnostics are developed to provide more precise data. The new high explosive (HE) and burn models combined with improved materials models are required to support the W80 SLEP and will be used in B61 baseline work.

This effort is centered on validation of models and codes, primarily using small-scale science and engineering experiments, specifically for polymers, for the phase properties and other physics of nuclear and advanced materials, as well as interface dynamics and high explosive models. The material science work supporting primary predictive capability and certification is coordinated with and contributes to efforts in other campaigns and Directed Stockpile Work (DSW).

Engineering Component Analysis	**250**	**0**	**0**

Evaluated the impact on weapons performance provided by the development of new engineering technologies such as precision casting and laser welding.

Boost Physics	**5,156**	**4,655**	**14,475**

Supports experimental work required to develop an improved understanding of boost physics, which is the single greatest source of uncertainty in our understanding of a primary weapons system. This work supports the testing and evaluation of new code capabilities against both archived and new experimental data. This work contributes knowledge for the W80 Stockpile Life Extension Program (SLEP) and B61 baseline. Increased effort in this area represents a shift in funding in order to support the increased participation by LANL in the primary certification campaign. This effort will support the study of the role of radiography in primary certifications which is necessary in order to develop a justification for and the requirements for an advanced radiography facility. A key element of this is increased emphasis on improving boost physics models, which are the greatest source of uncertainty in our ability to certify primaries.

Integrated Hydro Test Assessment	**1,855**	**0**	**0**

Manage the hydrotest program including facilities and the integration of hydrotest schedules in support of and funded through other stockpile activities. Evaluate results of integrated hydro tests.

Subcritical Experiments	**27,882**	**23,663**	**25,316**

Coordinates and maintains the schedule for subcritical experiments in support of and funded through other stockpile activities. Funding is for Bechtel Nevada support of Lawrence Livermore National Laboratory subcritical experiments, including fielding at U1a Complex and instrumentation and diagnostics. It also supports Sandia National Laboratories' development of radiographic sources to support pit certification.

Total, Primary Certification	**50,572**	**47,159**	**65,849**

Explanation of Funding Changes

Primary Certification	FY 2004 vs. FY 2003 ($000)
• **Legacy Data Analysis and Archiving** - Increase reflects adjustment for escalation	701
• **Materials Science Integration/Analysis** - Funding increase supports subcritical experiment schedule (Piano 1, Trumpet 3 and 4), diagnostic development, and material property research	6,516
• **Boost Physics** - Increased emphasis on funding primary certification work which is generic to the stockpile through the Primary Certification Campaign	9,820
• **Integrated Hydro Test Assessment**	0
• **Subcritical Experiments** - Additional funding reflects increasing radiographic capability	1,653
Total Funding Change, Primary Certification	**18,690**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	2,684	2,765	2,847	83	3.00%
Total, Capital Operating Expenses	2,684	2,765	2,847	83	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 2003 and FY 2004 funding shown reflects estimates based on actual FY2002 obligations.

Dynamic Materials Properties

Mission Supporting Goals and Measures

The Dynamic Materials Properties Campaign provides physics-based, experimentally validated data and predictive descriptions required to guide and benchmark the development of models for all stockpile materials at the level of accuracy required by the Directed Stockpile Work (DSW) subprograms, Primary and Secondary Certification Campaigns, and Advanced Simulation and Computing (ASCI) Campaign. The measurement of fundamental materials properties is essential to establish confidence in the materials models used in next-generation codes to provide predictive relationships between materials processing and properties and stockpile performance, safety, and reliability.

More specifically, the Campaign will provide predictive descriptions and experimentally validated data of thermodynamic properties such as equation-of-state and dynamic mechanical constitutive properties including strength and plasticity, failure, spall and ejecta under the extreme conditions of interest for weapons. In addition, this campaign will investigate the properties of energetic materials, as well as the electronic, optical, and hydrogenated properties of materials needed for the stockpile. This Campaign also holds the responsibility for the characterization of materials to enable assessment of effects on material performance resulting from any process changes or optimization. The latter involves developing a scientific understanding of the inter-relationship of properties, processing and performance of key stockpile materials.

The Dynamic Materials Properties Campaign will initially focus on stockpile materials and processes with the highest leverage and greatest uncertainties. These materials include actinides (plutonium and uranium), other relevant metals, Deuterium/Tritium (DT) gas, active ceramics, high explosives, organics, foams, polymers, salt, and special materials. Important materials processes include synthesis, forming, fabrication, joining, and microsystem fabrication.

To ensure future stewardship viability, this Campaign supports a vigorous university partnership program in experimental science of broad relevance to stockpile stewardship. The objective of establishing long-term university partnerships is to engage and foster growth in the academic community active in areas of fundamental science important to stockpile stewardship such as materials, high energy density physics and nuclear science. This will assist in providing a vigorous inflow of innovative scientific ideas and trained scientists to insure the long-term health and viability of the critical scientific infrastructure at the NNSA National Laboratories.

To accomplish the mission of this campaign, the work is divided into major technical efforts (MTEs), including: equation-of-state; constitutive properties; high explosives; processing, properties and performance; university partnerships; and physical data computational support.

Subprogram Goal

Experimentally validated predictive materials descriptions and physical data required to assess the performance, safety, and reliability of stockpiled weapons.

Performance Indicators

Number of equation-of-state milestones completed on/ahead of schedule
Number of constitutive property milestones completed on/ahead of schedule

Number of high explosive (HE), polymer, and foam milestones completed on/ahead of schedule
Number of processing, properties, and performance milestones completed on/ahead of schedule
Number of university partnerships milestones completed on/ahead of schedule.

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Completed a comprehensive study of the deuterium equation-of-state to 75 Giga Pascals (GPa) utilizing five independent experimental techniques on the Z Facility at the Sandia National Laboratory. Demonstrated a 400 GPa isentropic drive on Z and used this technique to launch a titanium flyer plate to 28 km/sec, doubling the pressures achievable with flyer plates on Z. Executed a series of evaluation shots at the Joint Actinide Shock Physics Experimental Research (JASPER) facility in Nevada. Completed the oboe series of experiments. Atlas achieved operational status and successfully executed a series of friction and spall experiments. Completed new equation-of-state & spall data measurements on plutonium alloy. Completed first neutron resonance spectroscopy temperature measurements in detonating high explosive.	Complete first equation-of-state measurements on liquid deuterium at 100-200 GPa. Complete the first plutonium equation-of-state measurement at the Joint Actinide Shock Physics Experimental Research Facility in Nevada. Complete initial equation-of-state data to 300 kbar for plutonium alloy. Conduct first experiments on the Advanced Photon Source high pressure beamline (HPCAT). Successfully complete the DOE readiness review for conducting Special Nuclear Material experiments on Z. Complete and analyze the piano experiment. Deliver first equation-of-state and constitutive property measurements on weapons grade polymers and foams. Measure high explosive reaction chemistry kinetics and detonation shock dynamics parameters on PBX 9501.	Complete three equation-of-state milestones, including: -Extend the Joint Actinide Shock Physics Experimental Research Facility capability to a significant new regime of temperature and pressure to provide plutonium equation- of-state data needed for primary certification. -Complete shock measurements in hydrogen-deuterium mixtures up to 1 Megabar and demonstrate application of technique to helium-deuterium mixtures. -Install heating chamber on TA-55 gas-gun facility to extend range of materials property measurements. Complete four constitutive properties milestones, including: -Conduct a DOE workshop on ejecta, to result in a program direction decision. -Demonstrate the use of unloading from an isentropically compressed state to measure material strength in relevant materials. -Complete installation of a rotating barrel gun at TA-55 for interfacial studies. -Recommission Atlas and start scheduled Atlas experiments at the Nevada Test Site (NTS). Complete one high explosive polymer, and foam milestone:

Delivered a design recommendation for a non-carbon crucible. Successfully formulated a prototype removable conformal coating for a specific weapon system application using a reversible epoxy resin. Characterized the fracture toughness of tritium containment vessel forgings and welds at low helium concentrations. Completed solicitation, review, and selection process for all university projects to be supported through the Stewardship Science Academic Alliances Program.	Determine the properties and performance of removable encapsulents and coatings based on thermally reversible chemistry. Apply new in-situ diagnostic techniques to determine the effect of processing and chemistry on braze and weld joint properties. Complete grant and Center-of-Excellence awards.	Deliver data to the Advanced Simulation and Computing Campaign to validate first generation 3-Dimensional slow cookoff predictive capability for LX-04 explosive for delivery to the W62 Certification Team and for analyses in support of Pantex Nuclear Explosive Safety Studies. Complete three processing, properties, and performance milestones, including : -Demonstrate the ability to obtain LIGA (Acronym from German words for lithography, electroforming, and molding--a process for making small pieces) microcomponent structures consistent with theoretical prediction. -Determine the fracture toughness of containment vessel forgings and welds for reservoirs at intermediate helium concentrations. -Finalize and distribute report on ceramic strengths of curved samples. Complete one university partnership milestone: Organize, host, and document the first Stewardship Academic Alliances principal investigator conference.

Funding Schedule

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Stockpile Materials Equation of State (EOS), Melt, and Phase Transitions	13,536	14,964	14,686	-278	-1.9%
Constitutive Properties of Metals: Strength, Spall, and Ejecta	32,195	34,221	30,340	-3,881	-11.3%
High Explosives (HE) Performance and Safety; Dynamic Loading of Foams and Organics	16,887	14,310	12,825	-1,485	-10.4%
Materials Processing, Properties and Performance	8,548	10,330	9,445	-885	-8.6%
University Partnerships	17,258	13,110	14,815	1,705	13.0%
Physical Data Computational Support	151	149	140	-9	-6.0%
Nanoscience	1,457	510	0	-510	-100.0%
Total, Dynamic Materials Properties	90,032	87,594	82,251	-5,343	-6.1%

Detailed Program Justification

(dollars in thousands)

	FY 2002	FY 2003	FY 2004
Stockpile Materials Equation of State (EOS), Melt, and Phase Transitions	**13,536**	**14,964**	**14,686**

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	**32,195**	**34,221**	**30,340**

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	**16,887**	**14,310**	**12,825**

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	**8,548**	**10,330**	**9,445**

Develop a quantitative understanding of how process variables determine the microstructure and composition of materials that ultimately control their critical performance properties. Efforts in the Nanoscience major technical effort (MTE) are moved to this MTE for FY 2004.

University Partnerships	**17,258**	**13,110**	**14,815**

Establish academic alliances 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 laboratories complex.

Physical Data Computational Support	**151**	**149**	**140**

Provide physical data computational user support.

Nanoscience	**1,457**	**510**	**0**

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. Efforts under this major technical effort (MTE) are moved to the Materials Processing, Properties and Performance MTE for FY 2004.

Total, Dynamic Materials Properties	**90,032**	**87,594**	**82,251**

Explanation of Funding Changes

	FY 2004 vs. FY 2003 ($000)
Dynamic Materials Properties	
# **Stockpile Materials Equation of Sate (EOS), Melt, and Phase Transitions - Decrease in finding reflects a reduction in the number of JASPER** or Z machine experiments	-278
# **Constitutive Properties of Metals: Strength, Spall, and Ejecta - Decrease in finding reflects a reduction in the number of JASPER,** Z machine, Atlas and small scale experiments	-3,881
# **High Explosives (HE) Performance and Safety; Dynamic Loading of Foams and Organics** - Decrease in **finding** reflects a deferral in the characterization of some high explosive properties	-1,485

- # **Materials Processing, Properties and Performance** - Decrease in funding reflects a deferral in the characterization and modeling of several process technologies partially offset by approximately $450 in the movement of the Nanoscience major technical element into this major technical element . . . . -885
- # **University Partnerships** - Increase in funding will allow partial return to original funding schedule for the Stewardship Science Academic Alliances Program 1,705
- ■ **Physical Data Computational Support** - Decrease is insignificant. -9
- # **Nanoscience** - Change in funding results from the incorporation of the Nanoscience major technical effort with the Materials Processing, Properties and Performance major technical effort . . . . -510

Total Funding Change, Dynamic Materials Properties . . . . **-5,343**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	2,091	2,154	2,218	65	3.00%
Total, Capital Operating Expenses	2,091	2,154	2,218	65	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 2003 and FY 2004 funding shown reflects estimates based on actual FY2002 obligations.

Advanced Radiography

Mission Supporting Goals and Measures

Advanced Radiography supports the development of technologies for multi-view, time-gated images of imploding surrogate primaries, with sufficient spatial and temporal resolution to experimentally validate computer simulations of the implosion process. Principal radiographic facilities include the Dual-Axis Radiographic Hydrotest facility (DARHT) at LANL and the Contained Firing Facility (CFF) at LLNL. Principal efforts in this campaign support the commissioning of the recently completed second axis of the DARHT and research to optimize the performance of DARHT and CFF. The first axis of the Dual Axis Radiographic Hydrodynamic Test facility became operational for experimental use in FY 1999; on December 21, 2002, the second axis accelerator became operational generating and transporting an electron beam meeting required acceptance criteria. The project is 99% complete and will be finished during the 2nd quarter of 2003. Further activities for special materials acquisition, diagnostics 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.

Subprogram Goal

Improved technologies to deliver radiographic capabilities required to support certification of nuclear weapon primaries.

Performance Indicators

Percentage of activities completed towards making the Dual-Axis Radiography Hydrodynamic Test (DARHT II) facility ready to support the FY 2005 pit certification goal
Percent of Proton Radiography experiments completed on/ahead of schedule
Percent improvement in beam spot size and brightness for the DARHT and the Contained Firing Facility (CFF)

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Commissioned Dual-Axis Radiography Hydrodynamic Test second axis (DARHT II) injector short pulse. Demonstrated first solid-state kicker pulser with 2 kA electron beam, marking the first time that solid-state technology has been	Execute the commissioning plan for the Dual-Axis Radiography Hydrodynamic Test second axis (DARHT II). Continue operation of ETA-II accelerator at Lawrence Livermore National Laboratory in support of DARHT optimization.	Complete the initial 50% of the planned activities towards making the Dual-Axis Radiography Hydrodynamic Test (DARHT) facility ready for FY 2005 to support the pit certification goal. [Complete materials supply plans and commence production at Los Alamos and Livermore and

used with a relativistic electron beam as a load.

Developed, procured, and fabricated the diagnostics that will be used to measure long-pulse beam parameters during commissioning of the DARHT II injector.

Operated ETA II accelerator at Lawrence Livermore National Laboratory and conducted multi-pulse target experiments.

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.

Radiographed burning high explosives with protons at Los Alamos Neutron Science Center, to demonstrate features of proton radiography, including time dependence, and obtain direct data on a stockpile performance issue.

Completed trade studies of concepts for a proton- based Advanced Hydrotest Facility (AHF) project.

Combined PIC (electromagnetic)

Achieve optimum/minimum spot size on a DARHT I target.

Complete joint assessment by LANL and LLNL of surrogate materials options for future hydrodynamic capabilities.

Begin recommissioning of material separation capabilities, if required.

Complete the test stand and begin experiments to reduce electron beam emittance to reduce flash X-Ray spot size.

Establish density requirements for criticality measurement, using radiography.

commence production at both laboratories. Complete definition of requirements for the Advanced Hydro Facility].

Complete 100% of planned Proton Radiography experiments.

Achieve a 25% degree of improvement in beam spot size and brightness as measured by DARHT I .

and Monte Carlo neutron (transport) computer codes in static form to simulate e-beam/target interactions, bremsstrahlung X-Ray production, and transport through an object onto a detector.

Designed and developed a half-scale windowless, aluminum-composite containment vessel in support of multi-axis radiography systems.

Funding Schedule

	(dollars in thousands)				
	FY 2002	FY 2003	FY 2004	$ Change	% Change
DARHT Optimization	22,350	24,549	22,500	-2,049	-8.3%
Simulation and Analysis	5,100	4,230	4,200	-30	-0.7%
Provide Required Materials	10,976	9,302	14,441	5,139	55.2%
Advanced Radiography Requirements and Technology Development	35,151	14,844	24,844	10,000	67.4%
Vessel Development and Certification	2,000	0	0	0	N/A
Total, Advanced Radiography	75,577	52,925	65,985	13,060	24.7%

Detailed Program Justification

	(dollars in thousands)		
	FY 2002	FY 2003	FY 2004
DARHT Optimization	**22,350**	**24,549**	**22,500**

The commissioning effort at DARHT will peak in FY2004 and the effort in this area will decrease in FY 2005 and beyond. This includes efforts to tune the DARHT accelerators (both axes) to meet beam brightness and spot-size requirments as well as to operate the ETA II experimental accelerator at LLNL to understand multi-pulse target dynamics necessary to enable the multi-pulse operation of the second axis of DARHT. DARHT radiographic capabilities must be meet an initial dual-axis capability prior to FY 2005 in order to support an important pit certification milestone.

Simulation and Analysis	**5,100**	**4,230**	**4,200**

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	**10,976**	**9,302**	**14,441**

Develop and implement a plan for materials and demonstrate an initial processing capability at LLNL. Production of materials is scheduled to begin in FY2005.

Advanced Radiography Requirements and Technology Development	**35,151**	**14,844**	**24,844**

This element supports the development of advanced radiographic concepts, including advanced x-ray technologies, detector development, and the development of proton radiography concepts. A key element is support of the operation of LANSCE area C to conduct current small-scale proton radiography experiments that are proving to be of great value to the resolution of current stockpile issues requiring the precise measurement of dynamic materials behavior. Additionally it supports requirements studies for a proton based Advanced Hydrotest Facility (AHF) as well as experiments at the Alternating Gradient Synchrotron at Brookhaven National Laboratory. This AHF work has been slowed down in FY 2003 to support other NNSA program priorities, but is increased and coupled with the Primary Certification Campaign in FY 2004.

Vessel Development and Certification	**2,000**	**0**	**0**

Supported development and certification of experimental vessels suitable for use in multi-axis radiography, including exploration of composite vessel technologies. While this technology is an important component for an Advanced Hydro Facility, work on vessels and confinement systems for an AHF was deferred beginning in FY 2003 pending further development and understanding of requirements. A developmental vessel for use at DARHT is funded by the Pit Certification Campaign as first user.

Total, Advanced Radiography	**75,577**	**52,925**	**65,985**

Explanation of Funding Changes

Advanced Radiography	FY 2004 vs. FY 2003 ($000)
# **DARHT Optimization** - Reflects a decrease in the level of effort required as second axis commissioning activities progress.	-2,049
# **Simulation and Analysis** - Ongoing effort with a slight shift to higher priority activities within this campaign	-30
# **Provide Required Materials** - Increase is required in order to meet material delivery requirements for hydro testing	5,139
# **Advanced Radiography Requirements and Technology Development** - This element supports a long term goal to develop multi-axis multi-time radiography. Requirements studies and technology development in support of this long term goal will resume in FY 2004.	10,000
Total Funding Change, Advanced Radiography	**13,060**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	5,647	5,816	5,991	174	3.00%
Total, Capital Operating Expenses	5,647	5,816	5,991	174	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 2003 and FY 2004 funding shown reflects estimates based on actual FY2002 obligations.

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

	Total Estimated Cost	Prior Year Approp-riations	FY 2002	FY 2003	FY 2004	Acceptance Date
Switchyard Kicker	3,827	1,216	2,068	543	0	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.

Secondary Certification and Nuclear Systems Margins

Mission Supporting Goals and Measures

The Secondary Certification and Nuclear Systems Margins Campaign develops modern assessment capabilities for nuclear weapon secondaries. Modern secondary assessment is based on a reexamination of past nuclear test data and the use of low-energy-density and high-energy-density above ground experiments, all coupled to modern design codes. In addition to developing new secondary assessment tools, this campaign will also serve to help develop the future "expert judgment" for the new stewards. This effort relies heavily on the use of above ground experiments facilities and requires the development of new experimental diagnostics, measurement techniques, and targets. Examples of experimental facilities used for this campaign are the Z accelerator at Sandia National Laboratories, the Omega laser at the University of Rochester's Laboratory for Laser Energetics and will begin use of the National Ignition Facility as it becomes available.

Subprogram Goal

A secondary assessment capability to support warhead assessment and certification now and in the future.

Performance Indicators

Number of simulation and experimental capability improvement milestones completed on/ahead of schedule.
Number of completed assessments of past underground test (UGT) performance in support of secondary certification.
Number of high energy density experiments relative to secondary performance conducted on schedule.
Number of large-scale low energy density experiments relative to secondary performance conducted on schedule.
Number of completed assessments that contribute to closure of a particular Significant Finding Investigation.

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Completed 2-Dimensional revaluation of underground tests relevant to primary radiation emission performance. Conducted a series of radiation case dynamics experiments relevant to initial radiation case dynamics and current stockpile work.	Implement improved 2-Dimensional primary emission model and apply to select underground tests to improve our understanding of primary emission and the potential impact on issues related to the quantification of margins and uncertainties. Conduct a series of low-energy density experiments to assess the impact of case dynamics on	Complete three milestones, including: -Implement an improved 2-Dimensional (2-D) energy balance model for use in the analysis of past underground testing data and current Directed Stockpile Work. -Perform at least 10

Identified issues relevant to secondary assessment in support of the quantification of margins and uncertainties approach to assessment and warhead certification.

Optimized radiation environments in dynamic hohlraum experiments on the Z accelerator at Sandia National Laboratories (SNL).

Completed a series of radiation-flow experiments in complex two-and three-dimensional geometries to verify the radiation transport algorithms incorporated in 3-Dimensional Advanced Simulation & Computing codes.

Completed initial experiments studying complex interplay of coupled radiation-driven hydrodynamics and radiation energy-flow of importance to the stockpile life extension programs.

Completed initial suite of fundamental shock/strain constitutive experiments on relevant materials.

Implement improved two-dimensional primary emission model and apply to selected underground tests to improve our understanding of primary emission and the potential impact on issues related to the quantification of margins and uncertainties.

Conduct a series of low-energy weapon performance and issues related to the quantification of margins and uncertainties.

Perform assessment of preshock/prestrain properties of case materials and complete fragment capture arrested tests.

Perform experiments on the Z Accelerator at Sandia National Laboratories (SNL) to investigate radiation asymmetry in dynamic hohlraum radiation sources.

experiments to improve experimental environment on the Z accelerator at Sandia National Laboratories for secondary assessment.

-Develop initial experimental capability to obtain data relevant to secondary assessment on the National Ignition Facility (NIF).

Complete 2-Dimensional reanalysis of three past underground tests.

Using the NIF, Omega, and Z, conduct 200 High Energy Density experiments to address material properties, energy balance, complex hydrodynamics, and physics issues.

Conduct two large-scale low energy density experiments to facilitate understanding and improve simulation in the area of energy balance relevant to Directed Stockpile Work.

Complete one assessment that contributes to closure of a particular Significant Finding Investigation.

density experiments to assess the impact of case dynamics on weapon performance and issues related to the quantification of margins and uncertainties.

Perform assessment of preshock/prestrain properties of case materials and complete fragment capture arrested tests.

Perform experiments on the Z accelerator at Sandia National Laboratories (SNL) to investigate radiation asymmetry in dynamic hohlraum radiation sources.

Funding Schedule

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Radiation Source	3,651	5,798	3,649	-2,149	-37.1%
Initial Radiation Case Dynamics	9,120	10,500	15,760	5,260	50.1%
Radiation Flow	17,630	17,600	21,442	3,842	21.8%
Secondary Performance	10,422	12,848	14,612	1,764	13.7%
University Grants/Other Support	62	0	0	0	N/A
Total, Secondary Certification and Nuclear Systems Margins	40,885 [a]	46,746 [a]	55,463	8,717	18.6%

[a] Includes comparability adjustments of $1,400,000 in FY 2002 and $1,044,000 in FY 2003 from the Secondary Certification and Nuclear Systems Margins Campaign to consolidate funding for high energy density physics grants into the Inertial Confinement Fusion Ignition and High Yield Campaign.

Detailed Program Justification

	(dollars in thousands)		
	FY 2002	FY 2003	FY 2004
Radiation Source	**3,651**	**5,798**	**3,649**

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

Initial Radiation Case Dynamics	**9,120**	**10,500**	**15,760**

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

Radiation Flow	**17,630**	**17,600**	**21,442**

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 the National Ignition Facility (NIF) and other above ground experiment facilities.

Secondary Performance	**10,422**	**12,848**	**14,612**

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 facilities.

University Grants/Other Support	**62**	**0**	**0**

Headquarters supported activities include university grants in high-energy-density science and support of critical technical needs. All university grants in high-energy-density science are consolidated and are funded as an integrated program under the Inertial Confinement Fusion Ignition and High Yield Campaign beginning in FY 2004.

Total, Secondary Certification and Nuclear Systems Margins	**40,885**	**46,746**	**55,463**

Explanation of Funding Changes

	FY 2004 vs. FY 2003 ($000)
Secondary Certification and Nuclear Systems Margins	
• Decrease reflects a reduction in modeling of primary emission in favor of higher priority activities in initial radiation case dynamics	-2,149

- Increase in funding supports the ramp up of work to better model the integrity and performance of weapons radiation cases, and increases both the scope and the pace of this research program. The results from the research will reduce risk in the life extension program. 5,260
- Increase is for high energy density weapons experimentation and model development aimed at improving the understanding of radiation flow (+$3,842) and secondary performance (+$1,764). Experiments use the Z accelerator at Sandia National Laboratories, the Omega laser at the University of Rochester's Laboratory for Laser Energetics and will begin to use the National Ignition Facility as it becomes available 5,606
- Decrease reflects transfer of the University grants in high energy density science to the Inertial Confinement Fusion Ignition and High Yield (ICF) Campaign. While funding in this campaign is eliminated, the overall University grants funding including ICF remains constant 0

Total Funding Change, Secondary Certification and Nuclear Systems Margins 8,717

Capital Operating Expenses and Construction Summary

Capital Operating Expenses [b]

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	3,589	3,697	3,808	111	3.00%
Total, Capital Operating Expenses	3,589	3,697	3,808	111	3.00%

[b] 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 2003 and FY 2004 funding shown reflects estimates based on actual FY2002 obligations.

Enhanced Surety

Mission Supporting Goals and Measures

The campaign's objective to demonstrate enhanced use-denial and advanced initiation options for the entire stockpile directly supports the NNSA's first goal to ensure the safety, security, and control of the enduring nuclear weapon stockpile. The Enhanced Surety Campaign 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 life extension program (LEP) or other refurbishment. The next weapons scheduled to undergo a stockpile refurbishment are the B61, W78, and W88, in addition to the W76 and W80 Block 2 options. This multi-technology development will also open the design space and result in synergistic improvements in other weapon components. The campaign is dependent on several key facilities at the national laboratories, such as the Microelectronics Development Laboratory at SNL.

Subprogram Goal

Developed technology for use in weapon refurbishments to maximize their safety and prevent unauthorized use by: (1) delivering advanced initiation options that enable systems to fully meet modern nuclear safety standards, and (2) delivering advanced use denial options.

Performance Indicators

Develop a set of advanced initiation technologies for Life Extension Programs (LEPs)
Develop a suite of advanced use-denial technologies for LEPs
Number of micro-system technologies developed for use in ongoing stockpile weapon refurbishments (micro-system components allow weapon mass distribution to be maintained in LEPs).

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Reached consensus among weapon designers that refurbished weapons utilizing advanced detonators could be certified without requiring underground nuclear testing; extensive component testing would still be required to sufficiently characterize performance of specific detonator designs for certification.	Develop and deliver directive scheduled Full Scale Engineering Development-ready technologies for improved surety options for the stockpile with initial emphasis on the W76 & W80; develop metrology and assessment processes for LIGA (acronym for German words for lithography, electroforming, and molding –process for making small parts)	Deliver one integrated firing set and two surety subsystem to the W80-3 Life Extension Program (LEP), including any new technologies identified by the Baseline Design Review and component, subsystem, and full system testing. Deliver one set of firing set advanced use-denial

Developed enabling technology for advanced firing system for the W80 Block 1.

Developed LIGA (acronym for German words for lithography, electroforming, and molding –process for making small parts) parts for W80 electrical strong-link.

Deliver a photo-conductive semiconductor switch, an optical switch, for the W80 firing set.

Completed development for a gel-mylar weak-link capacitor design that was transferred for use in the W76 & W80 Block 1.

Demonstrated a synthesis technique an insensitive high explosive (IHE) that could be used to make production quantities of the material.

Developed elements of an enhanced surety system for the W80 Block 1, termed a category H permissive action link.

piece parts, e.g., strong-link components.

Develop and deliver directive scheduled advanced firing set components to the W80-3 and Advanced Concepts Weapon Designs.

Continue directive scheduled development of use-denial technologies for the B-61, W78, and W76 & W80 Block 2s and deliver advanced use denial technologies for the W80 Block 1.

technologies, components, and subsystem options in the Robust Nuclear Earth Penetrator (RNEP – subject to Secretary of Defense report) and Enhanced Cruise Missile Phase 6.2 activity, including identification, development, and demonstration as required to support overall system feasibility assessments.

Deliver two production quality prototype LIGA-enabled surety components for the W80-3 and W76-1.

Demonstrate sufficient maturity of products and processes to support continued inclusion as options for the LEPs' timelines, including mirroring all LEP component-level testing. (LIGA – Acronym from German words for lithography, electro-forming, and molding – a process for making small pieces).

Funding Schedule

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Advanced Initiation	23,145	22,713	23,000	287	1.3%
Enhanced Use Denial	8,941	15,000	14,974	-26	-0.2%
Total, Enhanced Surety	32,086	37,713	37,974	261	0.7%

Detailed Program Justification

	(dollars in thousands)		
	FY 2002	FY 2003	FY 2004
Advanced Initiation	**23,145**	**22,713**	**23,000**

Advanced initiation options include advanced stronglinks, the entire micro-firing and related systems, and direct optical initiation. Planned for FY 2004 is the demonstration of advanced initiation options for W80 and B61 primaries, advanced use denial elements for the W76 & W80 Block 2, and W76 systems, delivery of surety and firing set options for certain advanced concepts, and the development of high quality ("war reserve") LIGA enabled surety components for the W80-3 and stockpile.

Enhanced Use Denial	**8,941**	**15,000**	**14,974**

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 2004, use denial options will be developed for the W76 and W80 Block 2, and W78 systems.

Total, Enhanced Surety	**32,086**	**37,713**	**37,974**

Explanation of Funding Changes

	FY 2004 vs. FY 2003 ($000)
Enhanced Surety	
• An increase for escalation is related to advanced surety concepts development and certification-related testing.	261
Total Funding Change, Enhanced Surety	**261**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	363	374	385	11	3.00%
Total, Capital Operating Expenses	363	374	385	11	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 2003 and FY 2004 funding shown reflects estimates based on actual FY 2002 obligations.

Weapons Systems Engineering Certification

Mission Supporting Goals and Measures

Weapons Systems Engineering Certification establishes science-based engineering certification methods in weapons systems within a non-nuclear test program. Activities include conducting experiments and providing data necessary to develop and validate engineering computational models. These models are used to predict weapon system response to three potential types of environments: normal, abnormal and hostile. The campaign's objective is to establish the capability to predict engineering margins by integrating numerical simulations with experimental data.

Subprogram Goal

Experimental data required to validate engineering models used to support stockpile stewardship activities.

Performance Indicator

Number of experimental data sets acquired to develop and assess engineering models.

Percent of data sets to deliver instrumented Nuclear Explosive Packages (NEPs)

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
The Define Methodology, Major Technical Effort-1, is ongoing. Documented initial data/model result comparison of foam decomposition including liquefaction critical to predicting nuclear safety margins of the W76-1 and W80-3 in abnormal thermal environments. Completed postulation of joint models for mechanical response in hostile environment for the W76-1 system qualification/ certification. Obtained CD-1 approval for the Test Capability Revitalization line item.	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 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.	Deliver and document 87 experimental data sets as follows: - Two data sets used to develop and assess the fluid dynamic models used to predict the B61 roll rate over the entire performance envelope - Two data sets to assess the first-generation models used to predict the strong-link/weak-link race in the W80-2 - Two data sets to assess the first-generation models used to predict the attachment of the weapon electrical system in the W80-2

Built, deployed, and tested the High Energy Telemetry Mk11 unit for hydro test 3577.

Evaluated computational tools needed to support qualification of the W76 High Energy Telemetry and Joint Test Assembly flight test system.

Performed analysis of validation needs for simulation products of the W80-3 (Collaborated with Directed Stockpile Work to develop certification plan for the W80-3 Life Extension Program).

Developed experimental diagnostic capabilities to support abnormal environment (fire) validation experiments for the W80-3 and W76-1.

Acquired flow field velocity data to validate simulations used to qualify a new B61 Spin Rocket.

Completed experiments to validate material properties and physical phenomena critical to qualification and re-certification of B61 and B83 weapon systems in lay down environment.

Integrate with Directed Stockpile Work Stockpile to Target Sequence 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.

- 20 tensile and 20 compressed experimental data sets to assess the rate and temperature dependent structural models for the LX-17 insensitive high explosive (IHE) main charge material

- 20 tensile and 20 compressed experimental data sets to assess the rate and temperature dependent structural models for the PBX 9502 IHE main charge material

- One data set for LX-04 reactive flow model validation.

Deliver and document 60% of the experimental data sets necessary to deliver an FY 2005 instrumented Nuclear Explosive Package (NEP).

Funding Schedule

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Define Methodology	3,931	3,940	4,142	202	5.1%
Experimental Validation	21,664	23,067	24,096	1,029	4.5%
Total, Weapons Engineering Systems Certification	25,595	27,007	28,238	1,231	4.6%

Detailed Program Justification

(dollars in thousands)

	FY 2002	FY 2003	FY 2004
Define Methodology	**3,931**	**3,940**	**4,142**

This element supports engineering science research providing the experimental underpinnings for discovery critical to the development of predictive science-based computational capabilities. Diagnostics are developed and laboratory-scale experimental data gathering are performed for discovery and model validation.

Emphasis is placed on working with the Advanced Simulation and Computing (ASCI) Campaign to integrate campaign milestones and deliverables with priority to Directed Stockpile Work (DSW) needs for validated computational tools. The campaign works closely with the DSW program to establish the necessary protocols needed for maximum use of modeling and simulation tools in support of the qualification process.

FY 2004 request supports initiating assessment of computational tools needed to support design and qualification of earth penetrating weapons and microsystems to be used in future years LEPs.

	FY 2002	FY 2003	FY 2004
Experimental Validation	**21,664**	**23,067**	**24,096**

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 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. Also included is the support of model accreditation and hardware qualification. A major focus is on validating models of detonation and reaction threshold for high explosives in thermal and shock environments.

The FY 2004 work scope includes multi year 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 establish component qualification requirements from a system-level model.

Populate a material data base with 60% of the war reserve (WR) materials utilized in the W76 and W80.

Deliver a validated capability to predict gravity bomb spin rate, including the effects of vortex-fin interaction.

Total, Weapons Systems Engineering Certification	**25,595**	**27,007**	**28,238**

Explanation of Funding Changes

Weapons Systems Engineering Certification	FY 2004 vs. FY 2003 ($000)
• Funding changes incorporate escalation requirements and provide further support of the Nuclear Weapons Council-approved refurbishments for the W76 First Production Unit (FPU) of FY 2007 and the W80 FPU of FY 2006..	**1,231**
Total Funding Change, Weapons Systems Engineering Certification	**1,231**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	152	157	161	5	3.00%
Total, Capital Operating Expenses	152	157	161	5	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 2003 and FY 2004 funding shown reflects estimates based on actual FY 2002 obligations.

Nuclear Survivability

Mission Supporting Goals and Measures

The Nuclear Survivability Campaign supports the hardening of nuclear systems and components against radiation induced damage and effects to support certification and life extension of the enduring stockpile without underground nuclear tests. In the absence of underground nuclear tests, development and validation of hardening technologies and techniques are solely dependent upon modeling and simulation, and non- nuclear aboveground experiments (AGEX). This campaign supports research to understand the effects of radiation on nuclear weapons and to develop radiation-hardened technologies required to meet nuclear survivability requirements. These are basic core competencies for stewarding a nuclear weapons stockpile that must meet performance requirements despite exposures to nuclear environments. The capabilities developed in this campaign are driven by the need to develop and improve tools to support the near term W76 refurbishment and the long-term stewardship of the stockpile.

This campaign also contributes to: (1) understanding the threat environments U.S. systems must be qualified to survive; (2) developing and validating computational tools for qualifying nuclear explosive packages and non-nuclear systems and components in nuclear environments in the absence of nuclear tests; and (3) developing radiation-hardened non-nuclear components for use in our warhead systems to achieve required survivability requirements. Validated computational tools will be developed 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 (LEP). The campaign also supports nuclear weapon output and lethality modeling, tool development and validation.

Subprogram Goal

Tools and technologies needed to ensure nuclear warhead/bomb systems operate properly during and after exposure to radiation and predictions of nuclear weapons radiation outputs needed to set radiation requirements and understand effects.

Performance Indicators

Percentage of weapons outputs (warheads modeled and validation experiments conducted) milestones completed on/ahead of schedule

Milestones for nuclear component qualification tools (materials modeled) completed on/ahead of schedule

Milestones for nonnuclear component qualification tools and hardening technologies (tools, hardening techniques, and validation experiments) developed, completed on/ahead of schedule

Milestones for microelectronics and microsystems hardening (production qualification and techniques) completed on/ahead of schedule.

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Completed initial assessment of outputs for priority Navy threat systems. Completed initial debris and non-local-thermodynamic-equilibrium validation experiments. Completed 2-Dimensional (2-D) model of a Bluebook system. Completed design of W76-1 Life Extension Program (LEP) Annular Core Research Reactor Experiment 1S3. Completed validation of the 2D parallel CABANA cable System Generated Electromagnetic Pulse code for design and evaluation of cable. Demonstrated Silicon on Insulator (SOI) subsystem radiation hardness. Completed performance and survivability characterization of 0.35 micron rad-hard SOI technology to support simulation guidelines for layout of custom circuits to meet W76-1 program needs.	Complete Bluebook system outputs re-evaluation. Formalize peer review process and complete analysis of baseline data. Update materials models for finite element analysis code based on test results. Develop upgraded diagnostics for combined neutron/gamma environments and validate code to characterize neutron and gamma hostile, fratricide, and test environments. Build and validate custom 0.35micron Application-Specific Integrated Circuit of equivalent complexity to W76-1 controller chip. Begin development of 0.25 micron rad-hard Silicon on Insulator (SOI) technology.	Complete radiation output calculations for three priority warhead systems. Validate output calculations for a priority warhead system against underground test data. Complete scheduled validations. Update scheduled nuclear explosive materials models. Complete validation of 2-Dimensional (2-D) and 3-D cable system-generated electromagnetic pulse design and qualification code. Provide data for validation of thermo-mechanical shock and thermo-structural response models for first application to the W78 neutron generator. Complete the steps to production qualify 0.35-micron radiation-hardened digital silicon-on-insulator microelectronics technology.

Funding Schedule

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Modernization of Weapon Outputs	2,176	2,184	2,541	357	16.3%
Nuclear Survivability of Nuclear Components	0	400	384	-16	-4.0%
Nuclear Survivability of Nonnuclear Components	10,329	10,896	11,023	127	1.2%
Hardening of Microelectronics and Microsystems	9,397	9,914	10,029	115	1.2%
Total, Nuclear Survivability	21,902	23,394	23,977	583	2.5%

Detailed Program Justification

(dollars in thousands)

	FY 2002	FY 2003	FY 2004
Modernization of Weapon Outputs	**2,176**	**2,184**	**2,541**

Develop and validate modern output calculation tools and re-assess nuclear weapons outputs as needed. Establish and execute peer review processes for evaluation of model threat outputs. Under a nuclear test moratorium we are unable to directly validate many features of high fidelity nuclear weapon output calculations. Planning and conducting AGEX allows us to validate individual physics models in our calculational tools without full scale underground nuclear testing.

Nuclear Survivability of Nuclear Components	**0**	**400**	**384**

Develop and validate modeling and experimental nuclear survivability assessment tools for nuclear components. Analyze and incorporate data from DSW while designing and fielding Annular Core Research Reactor (ACRR) experiments that provide neutron/gamma response data for nuclear explosive package qualification of specific systems. Both new and aged materials will be tested. These data will be used by this campaign to improve modeling and simulation radiation hardness assessment tools. These improved tools better assure the DoD that our systems satisfy the full range of required military characteristics and Stockpile to Target Sequence environments.

Nuclear Survivability of Nonnuclear Components	**10,329**	**10,896**	**11,023**

Develop and validate modeling and experimental nuclear survivability assessment tools for nonnuclear components. Provide and support new tools that are needed for system-generated electromagnetic pulse and thermomechanical stress and thermostructural response assessments required for stockpile life extension programs (such assessments were previously performed in underground nuclear weapon tests.) Improved mixed-field neutron and gamma diagnostics are needed to reduce the degree of overtesting required to compensate for uncertainties, and to conserve time, materials, and funds.

Hardening of Microelectronics and Microsystems	**9,397**	**9,914**	**10,029**

Develop technologies and infrastructure for assessing and enhancing nuclear survivability of microelectronics, microsystems, and other nonnuclear components produced specifically for the nuclear weapons stockpile. (Commercial suppliers of microelectronics do not produce or conduct testing to certify components that fully meet the nuclear survivability requirements of nuclear warheads). FY 2003 and FY 2004 is focused first on assuring that the necessary components will be available for the W76-1 refurbishment and second on assuring that the U.S. will retain the capability to supply parts that will meet future radiation hardening requirements for nuclear warheads.

Total, Nuclear Survivability	**21,902**	**23,394**	**23,977**

Explanation of Funding Changes

	FY 2004 vs. FY 2003 ($000)
Nuclear Survivability	
• **Modernization of Weapon Outputs -** Increased funding supports peer review and performance of independent weapon output assessments to improve quality and confidence in outputs.	357
• **Nuclear Survivability of Nuclear Components -** Reflects minor reduction to support improvements in Modernization of Weapons Output quality and confidence	-16
• **Nuclear Survivability of Nonnuclear Components -** Increase reflects adjustment for escalation	127
• **Hardening of Microelectronics and Microsystems -** Increase reflects adjustment for escalation	115
Total Funding Change, Nuclear Survivability	**583**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	170	175	180	5	3.00%
Total, Capital Operating Expenses	170	175	180	5	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 2003 and FY 2004 funding shown reflects estimates based on actual FY 2002 obligations.

Enhanced Surveillance

Mission Supporting Goals and Measures

The Enhanced Surveillance Campaign provides validated component lifetime assessments to support individual weapon Life Extension Program (LEP) decisions and the annual assessment of the stockpile, and predictive diagnostics and models to identify weapons aging defects prior to any impact to safety, reliability, or performance. Requirements are developed based upon the assessment, certification, surveillance, and refurbishment needs of the stockpile; converted into desired results and capabilities; and incorporated into approved task plans.

Subprogram Goal

Predictive capabilities and early identification of stockpile aging effects to allow for refurbishment before nuclear weapon reliability safety or performance is impaired.

Performance Indicators

Annual stockpile aging assessment completion
Percentage of lifetime, aging, compatibility, or reuse assessments completed or updated on/ahead of schedule
Percentage of new surveillance diagnostics or methodologies completed on/ahead of schedule
Percentage of predictive aging models completed or updated on/ahead of schedule.

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Completed aging assessments of the stockpile to support the annual certification process.	Complete aging assessments of the stockpile to support the annual certification process.	Complete FY 2003 stockpile aging assessment and report in January 2004.
Predicted component lifetimes and provided life time assessment reports in accordance with the approved implementation plan to support refurbishment decisions.	Predict component lifetimes and provided life time assessment reports in accordance with the approved implementation plan to support refurbishment decisions.	Complete or update 90% of the lifetime, aging, compatibility and reuses assessments on/ahead of schedule and the remaining 10% within 60 days.
Developed and deployed diagnostics for early detection of weapon defects in the stockpile in accordance with the approved implementation plan.	Develop and deploy diagnostics for early detection of weapon defects in the stockpile in accordance with the approved implementation plan.	Complete 80% of the new surveillance diagnostics or methodologies on/ahead of schedule and the remaining 20% within 90 days.
Developed and validated predictive aging models in accordance with the approved implementation plan.	Develop and validate predictive aging models in accordance with the approved implementation plan.	Complete or update 80% of the predictive aging models on /ahead of schedule and the remaining 20% within 90 days.

Funding Schedule

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Pits	22,249	23,000	25,896	2,896	12.6%
Canned Subassemblies	12,679	12,559	17,884	5,325	42.4%
High Explosives/Energetics	8,065	8,261	9,740	1,479	17.9%
Nonnuclear Components	10,169	8,973	11,734	2,761	30.8%
Nonnuclear Materials	11,500	10,561	13,503	2,942	27.9%
Systems	8,618	13,801	16,024	2,223	16.1%
Total, Enhanced Surveillance	**73,280**	**77,155**	**94,781**	**17,626**	**22.8%**

Detailed Program Justification

(dollars in thousands)

	FY 2002	FY 2003	FY 2004
Pits	**22,249**	**23,000**	**25,896**

Provides the basis for an assessment of pit lifetime as well as develops and implements new diagnostics for the Surveillance Evaluation Program. The lifetime work will support the Pit Manufacturing and Certification Campaign and aid NNSA in assessing the need, timing, and capacity for a large capacity pit manufacturing facility. It will utilize old pits and validated accelerated aging alloys to study the physics, engineering, and materials properties of pertinent Plutonium alloys. Design sensitivity methods developed in the Primary Certification, Secondary Certification and Nuclear Systems Margins, and Engineering Campaigns will be used to determine if potential age- induced changes are significant.

Develops and implements new, nondestructive examination tools for early detection of potential flaws in the pits.

Canned Subassemblies	**12,679**	**12,559**	**17,884**

Performs canned subassemblies (CSAs) and radiation case aging experiments and modeling to determine when these major components need to be replaced. Develop and implement new, nondestructive examination tools for early detection of potential degradation in the stockpile. Evaluates the full range of compatibility issues.

High Explosives/Energetics	**8,065**	**8,261**	**9,740**

Perform high explosives/energetics aging experiments and modeling to determine when the full range of conventional and insensitive high explosives must be replaced. Develop and implement new diagnostics for early detection of potential changes in the safety and performance of explosive stockpile components. Characterize and model aging behavior to assure proper understanding of mechanisms.

Nonnuclear Components	**10,169**	**8,973**	**11,734**

Provide validated aging predictions for the performance of high-risk, nonnuclear components to determine when existing stockpile components need to be replaced. Perform analysis of potential replacement components to enable age-aware design and certification. Develop and implement new diagnostics for early detection of emerging stockpile defects to enable repairs to be made before safety or reliability problems impact the weapon system. Includes identifying failure mechanisms and developing a model-based process to certify new components including microsystems.

Nonnuclear Materials	**11,500**	**10,561**	**13,503**

Provide capability to predict changes in critical materials properties for both existing and replacement materials in enduring weapons systems. The materials to be studied will be selected based on the highest risk for producing unacceptable degradation in weapon system performance. We will develop an understanding of the time-dependent mechanisms and kinetics of materials aging and the associated degradation of materials properties. This study will develop models of materials aging by determining both chemical and structural behavior across multiple length scales.

Predict aging changes in critical nonnuclear material properties that could lead to unacceptable degradation in weapon system performance. Identify the time-dependent mechanisms of aging in both existing and replacement materials. Develop models of materials aging by determining the underlying chemical and structural behavior. Develop advanced analytical tools and diagnostics to identify and measure the physical and chemical signatures of degradation of critical materials.

Systems	**8,618**	**13,801**	**16,024**

Provide improved confidence in future weapons reliability, safety and performance. This will be accomplished by augmenting the existing surveillance program with new system level diagnostics that enhance our ability to detect, assess and predict problems in the stockpile. New technologies for flight and ground testing will be developed that will allow more data to be obtained from ground tests, while simultaneously pursuing flight test technologies that allow us to acquire additional data from each flight test, while maximizing the fidelity of the flight test warhead. New methods for assessing and describing system reliability also will be developed.

Total, Enhanced Surveillance	**73,280**	**77,155**	**94,781**

Explanation of Funding Changes

	FY 2004 vs. FY 2003 ($000)
Enhanced Surveillance	
• **Pits** - Increase provides for the start of lifetime assessment of the pit types not included in current assessment projects that support the Pit Manufacturing and Certification Campaign and decision-making on the scope and timing of a Modern Pit Facility. Provides surface corrosion and gas chemistry analysis which is critically needed to assess aging effects on the primary performance for W76, W78, W80 and W88 systems.	2,896
• **Canned Subassemblies** - Increase provides aging stockpile materials characterization needed to support the B61 LEP. Provides aging and material studies to make component lifetime predictions supporting multiple LEPs and new surveillance diagnostics for multiple weapon systems	5,325
• **High Explosives** - Increase provides additional critical experiments and modeling for the lifetime assessment of high explosives to support decisions for the W76 and W80 LEP	1,479
• **Nonnuclear Components** - Increase provides for the initiation of development of new diagnostics to enhance the ability to predict aging impacts on weapon performance. Provides evaluation and modeling of potential aging mechanisms to enable more robust design of new components for refurbished weapons in multiple LEPs.	2,761
• **Nonnuclear Materials** - Increase provides for experiments and modeling of the dynamic response of aging polymeric materials in the nuclear explosive package to gain fidelity for weapon performance codes. Provides characterization of critical material properties in Sandia components for predicting weapons performance, supporting multiple LEP refurbishment decisions, and resolving Significant Finding Investigations (SFIs).	2,942
• **Systems** - Increase provides for development and production of advanced flight test hardware for critical flight test requirements supporting the development, certification, and evaluation activities of multiple LEPs.	2,223
Total Funding Change, Enhanced Surveillance	**17,626**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
General Plant Projects	68	70	72	2	3.00%
Capital Equipment	4,793	4,937	5,085	148	3.00%
Total, Capital Operating Expenses	4,861	5,007	5,157	150	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 2003 and FY 2004 funding shown reflects estimates based on actual FY2002 obligations.

Advanced Design and Production Technologies

Mission Supporting Goals and Measures

The Advanced Design and Production Technologies (ADAPT) Campaign integrates and systematically develops new technologies and enhanced capabilities in preparation for the nuclear weapons complex of the future. This will be accomplished by developing multiple, fast turnaround engineering options through virtual prototypes and implementing modern product data management and collaboration tools. The ADAPT Campaign's guiding vision for the future is to become the essential nuclear weapons complex resource for identification, development, and integration of applied science & technology capabilities for rapid product realization to meet requirements and related national security needs. The ADAPT Campaign develops qualified manufacturing processes as deliverables which then serve as options for future applications or are required to increase capabilities by the Readiness Campaigns, Directed Stockpile Work (DSW), or a construction project for sustained manufacturing. To support the achievement of the ADAPT vision, ADAPT has developed the following 11 objectives:

- Develop and demonstrate capabilities to meet future nuclear weapon complex needs.
- Establish essential capabilities using sustainable processes.
- Identify and deliver future enterprise-wide technology and business processes.
- Optimize minimum set of technical solutions to common technology problems.
- Improve continuously the design and manufacturing processes through implementation of process-based quality.
- Develop capabilities for product and process representations that achieve rapid design and manufacturing.
- Demonstrate use of modern tools and systems to lead the complex into the 21st century.
- Incubate advanced concept efforts and drive selected capabilities to implementation.
- Attract and retain people with critical skills to meet ADAPT Vision.
- Build compelling cases to support long-term investments.
- Communicate ADAPT achievements and impacts.

Subprogram Goal

An enhanced Nuclear Weapon Complex that is capable of effectively and efficiently accomplishing necessary weapon refurbishments.

Performance Indicators

Percent of major secure networking electronic platform milestones (deliverables) completed on/ahead of schedule to support classified planning and engineering applications, (e.g., product design, manufacturing process development, tooling design, and resource planning).

Percent of major Integrated Design, Engineering, and Manufacturing milestones (deliverables) completed on/ahead of schedule to support the use of 3-Dimensional (3-D) applications for design of components, issue 3-D (or model-based) drawings, and/or develop manufacturing processes.
Percent of major manufacturing processes and capabilities milestones completed on/ahead of schedule, including foundry, machining, recovery, assembly, inspection, and verification processes to support production and Life Extension Program (LEP) requirements.

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Issued the nuclear weapons complex's Engineering Authorization infrastructure business practice in support of design and manufacturing for all planned Directed Stockpile Work (DSW) workload. Completed and demonstrated pilot plant processes for LLM-105 (a high explosive compound used in nuclear weapons). Demonstrated successful initiation of main charge explosive with Lawrence Livermore and Kansas City- produced chip slapper; if adopted by the weapon design community, this detonator may significantly enhance the nuclear safety and surety of the stockpile. Demonstrated MicroCDU component function and high explosive initiation with prototypical target detonator. Demonstrated Ultrasonic imaging capability demonstrated on development Integrated Pit Inspection Station.	Define the B61 Alteration (Alt) 357 Component Subassembly with a models-based product definition and controlled, release used to support the manufacture of Process Prove-In (PPI) components. Develop and build the W76-1 development Armed Fuzing and Firing (AF&F) for FCET 30. Deliver to Directed Stockpile Work (DSW), replacement silicone materials for manufacturing B61 refurbishment parts. Demonstrate capability to perform ultrasonic imaging of pits and transition capability to the High Explosive Manufacturing and Weapons Assembly/Disassembly Readiness Campaign. Improve Tritium Processing - Complete hydride stress tests at several load levels; start up experimental metal membrane reactor with replacement catalyst. Complete Saltless Direct Oxide	Complete 100% of scheduled major secure networking electronic platform milestones, to include: -100% of the milestones necessary to deliver a Complex-wide Integrated Programatic Scheduling System (IPSS) with full provisioning and scheduling functionality for use by all weapons program managers. -50% (a 25% increment) of Technical and Infrastructure Business Practices required for new processes and technology deployment. Complete 100% of scheduled major Integrated Design, Engineering, and Manufacturing milestones, to include: -25% of Product Realization Standards for Models-Based Manufacturing. -50% complete (a 10% increment), including models-based definitions. -40% complete (a 20% increment) for the W76-1 and W80-2/3. -100% complete with 3-

Identified improvements in lightning arrest connector processes to improve manufacturability.

Established and approved access to the IPSS via SecureNet at the Y-12 National Security Complex.

Deployed the nuclear weapons complex pilot applications that supports supply chain management initiatives.

Evaluated failure assessment methodologies for reservoir integrity and gain design agency concurrence.

Completed cleaning and filling procedure development for W87 Acorn at Savannah River Site.

Issued TBP-307 Issue D, "Use of Models in the Product Realization Process."

Demonstrated Dimensional Characterization capability for pits using a Coordinate Measuring Machine.

Reduction demonstration in Development facility; prototype for a one-button per day capacity.

Implement and demonstrate Potting Void Detection technology for production.

In the optimized pilot plant (multi-kilogram) LLM-105 process, deliver 5-10kg of recrystallized LLM-105 for formulations and testing.

Demonstrate Be powder production by gas atomization.

Deliver non-nuclear process development for neutron generators, power sources, energetics, magnetics, and explosives.

Deploying access to the Program Control Document (PCD) System at all sites.

Demonstrating large-scale pilot plant production of TATB high explosive.

Deploy eddy current and acoustic capabilities for pit requalification in support of the W76-1.

Establish Plutonium electronic properties for monitoring metal changes in processing.

Conduct detonator powder process development in support planned DSW workload.

Dimensional solid model product definition for special tooling for surveillance and re-qualification activities.

Complete 100% of scheduled manufacturing processes and capabilities, to include:

- -80% (a 10% increment) of the “Quarter Cost” Arming, Fuzing, and Firing W76 subassemblies; Major Assembly, and Warhead components for delivery to the Nonnuclear Readiness Campaign.
- -50% (a 25% increment) of providing closed-cycle processing of beryllium metal for supply conservation.
- -66% (a 33% increment) of Surveillance Pre-Screening capabilities.
- -50% (a 25% increment) of capabilities for manufacturing high explosives.
- -50% (a 25% increment) of metal purification, feedstock processes, and machining to support the Stockpile Readiness Campaign.
- -85% (a 15% increment) of neutron generator processes for support of the Nonnuclear Readiness Campaign.
- -30% (a 10% increment) of processes for continued tritium operations for the new Tritium Extraction Facility.

Funding Schedule

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Process Development Program	37,452	46,315	40,672	-5,643	-12.2%
Enterprise Integration Program	13,993	13,684	13,260	-424	-3.1%
Integrated Design and Engineering Manufacturing (IDEM)	16,780	14,142	25,985	11,843	83.7%
Total, Advanced Design and Production Technologies	**68,225**	**74,141**	**79,917**	**5,776**	**7.8%**

Detailed Program Justification

(dollars in thousands)

	FY 2002	FY 2003	FY 2004
Process Development Program	**37,452**	**46,315**	**40,672**

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 nuclear weapons complex while satisfying increased environmental constraints, improved product reliability needs, improved manufacturing efficiency and changes in available materials and processes. Activities include: Demonstrate processes for Be powder and component production to conserve metal supply and compare product to existing War Reserve material. Develop and prototype equipment and processes to recover tritium effluents from tritium facilities and assure product quality. Archive vendor process knowledge for materials that are no longer commercially produced. Develop additional manufacturing processes needed to support base workload and planned DSW workload.

Enterprise Integration Program	**13,993**	**13,684**	**13,260**

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. Activities include: Conduct product definition reviews between Design Agency and the Production Agency using secure IP-based conferencing technologies. Provide Technical and Infrastructure Business Practices for ADAPT-developed capabilities.

Integrated Design, Engineering and Manufacturing (IDEM)	**16,780**	**14,142**	**25,985**

This MTE was formerly called Integrated Product and Process Design/Agile Manufacturing. 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. It will do this through (1) model-based methods, (2) process-based quality, (3) high-resolution inspection techniques, (4) knowledge based advisors, and (5) enabling tools. Activities include: Establish model-based processes for B61 and W76 design release, configuration management, engineering certification, CAD-independent archiving, material properties database, and part numbering. Initiate model exchange and use with Pantex for W76 program. Develop capabilities for process-based quality and high-resolution inspection for production missions.

Total, Advanced Design and Production Technologies	**68,225**	**74,141**	**79,917**

Explanation of Funding Changes

Advanced Design and Production Technologies	FY 2004 vs. FY 2003 ($000)
• **Process Development**: Decrease reflects transition of process development activities to Integrated Design, Engineering, and Manufacturing for integration with models-based capabilities. Decrease also reflects increased emphasis on nuclear weapons complex infrastructure priorities and completion of process development activities to meet near term DSW schedules. Risk being managed to support additional requirements from directed production, planned DSW activities, and other NNSA priorities	-5,643
• **Enterprise Integration** Minimum capability established at each Nuclear Weapons Complex site for video conferencing equipment and infrastructure to implement Secure Internet Protocol Video Conferencing to support DSW schedules	-424

- **Integrated Design, Engineering, and Manufacturing (IDEM)**

  Change reflects increased activities to support aggressive DSW timelines for development and common Nuclear Weapons Complex solutions related to model based capabilities necessary for design and production of Mark Quality product. Also, some projects formerly funded under ADAPT Process Development but containing IDEM components were transferred to this major technical effort. This puts emphasis on developing the business practices and standards that lay the foundation for deploying models based methods in war reserve production and improves integration of these methods into operations 11,843

Total Funding Change, Advanced Design and Production Technologies 5,776

Capital Operating Expenses and Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	1,568	1,615	1,663	48	3.00%
Total, Capital Operating Expenses	1,568	1,615	1,663	48	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 2003 and FY 2004 funding shown reflects estimates based on actual FY 2002 obligations.

Engineering Campaigns Construction Activities

Mission Supporting Goals and Measures

This new budget element supports the specific construction project activities that directly support the Engineering Campaigns. In FY 2004, construction funding for the Microsystems and Engineering Sciences Applications (MESA) Complex (line item 01-D-108) and the Other Project Costs associated with this project are displayed in this budget element. Previously, they were displayed in Readiness in Technical Base and Facilities.

The MESA Complex will provide for the design, integration, prototyping, and fabrication, and qualification of microsystems into weapon components, subsystems, and systems within the stockpile. Modern electrical, optical, and mechanical components are required to ensure the continuing safety, security, and reliability of the U.S. nuclear deterrent. Achieving this objective requires integration of activities conducted within several of the Engineering Campaigns and the MESA Complex is critical to meet NNSA needs in this area. The MESA Complex must deliver capabilities that meet the long term needs of Stockpile Stewardship for continual advances in technologies that improve nuclear weapon surety, as well as the more immediate Life Extension Programs needs of incorporating advanced technologies into upcoming weapon refurbishments, eliminating present safety exceptions in the annual certification process.

Subprogram Goal

State-of-the-art facilities, within the approved baseline cost and schedule, to ensure a safe and reliable capability and source of advanced components for the nuclear weapons stockpile.

Performance Indicators

Number of major project milestones completed within approved scope, cost, and schedule baselines.

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Completed over 90% of Microsystems and Engineering Sciences Applications (MESA) Site Utilities Construction. Completed over 90% of the Final design for the MESA Complex. Awarded all five systems upgrades construction. contracts and began work.	Complete construction activities for systems upgrades and utilities. Complete Final design of the MESA complex and prepare all documents necessary to support an External Independent Review and Critical Decision (CD) 3. Receive CD-3 and begin construction on the MicroFab building. Continue to execute the baseline plan for retooling of the Microelectronics Development Laboratory (MDL).	Continue to execute the baseline plan for the construction of the MicroFab Facility. Continue to execute the baseline schedule for procurement of the MicroFab tools. Continue to execute the baseline plan for retooling of the MDL. Receive approval to start construction of the MicroLab Facility (construction activities schedule to start in FY 2005).

Funding Schedule

	(dollars in thousands)				
	FY 2002	FY 2003	FY 2004	$ Change	% Change
Operations and Maintenance / Other Project Costs (OPC)	3,600 [a]	4,200 [a]	4,500	300	7.1%
01-D-108, Microsystems and Engineering Sciences Applications (MESA) Complex	63,500 [b]	75,000 [b]	61,800	-13,200	-17.6%
Total, Engineering Campaigns Construction Activities	67,100	79,200	66,300	-12,900	-16.3%

The FY 2003 Request column includes comparability adjustments as detailed in the footnotes for consistency with the FY 2004 Request.

Detailed Program Justification

	(dollars in thousands)		
	FY 2002	FY 2003	FY 2004
Operations and Maintenance / Other Project Costs (OPC)	3,600	4,200	4,500

Operating funds are required to support "other project costs" that are related to the MESA line item construction project, but are not capitalized. Safety assessments, ES&H activities and project support personnel are funded by OPCs. The funding increase in FY 2004 is consistent with the project's Performance Baseline and includes escalation over FY 2003 and a slight increase due to the increased effort related to the first full year of heavy construction.

01-D-108, Microsystem Engineering & Science Applications (MESA)	63,500	75,000	61,800

The funding requested in FY 2004 is consistent with the project's Performance Baseline, and continues MDL retooling, and MicroFab construction and tool procurement.

Total, Engineering Campaigns Construction Activities	**67,100**	**79,200**	**66,300**

[a] Includes a comparability adjustment of $3,600,000 in FY 2002 and $4,200,000 in FY 2003 from Readiness in Technical Base and Facilities/Operations of Facilities for the Other Project Costs (OPCs) for the MESA project.

[b] Includes a comparability adjustment of $63,500,000 in FY 2002 and $75,000,000 in FY 2003 from Readiness in Technical Base and Facilities/Construction for the line item TEC for the MESA project.

Explanation of Funding Changes

Engineering Campaigns Construction Activities	FY 2004 vs. FY 2003 ($000)
• Funding change reflects escalation and is consistent with the MESA project Performance Baseline for OPC activities	300
• Funding decrease is consistent with and supports the MESA project Performance Baseline schedule, cost and scope as approved by the Secretary of Energy on October 8, 2002	-13,200
Total Funding Change, Engineering Campaigns Construction Activities	**-12,900**

01-D-108, Microsystems and Engineering Sciences Applications (MESA) Complex, Sandia National Laboratories, Albuquerque, New Mexico

(Changes from FY 2003 Congressional Budget are denoted with a vertical line [|] in the left margin.)

Significant Changes

- The Secretary of Energy approved Critical Decision 2 (Performance Baseline) for the full Microsystems and Engineering Sciences Applications (MESA) Complex project on October 8, 2002. The Performance Baseline, with a Total Project Cost of $518,500,000 and a completion date of May 2011 (completion of occupancy), is reflected in this project data sheet.

  Critical Decision 2 and Critical Decision 3 (Start of Construction) were previously approved for some work which is already complete or in progress, including: site utilities; retooling of equipment and support infrastructure in the existing Microelectronics Development Laboratory (MDL); radiation hardened integrated circuit retooling of the MDL, and critical microsystem retooling for the MDL.

- The Performance Baseline reflects construction of the three MESA facilities in a sequenced approach based on NNSA mission priority. The Microsystems Fabrication facility (MicroFab), with required tooling, is the first priority because it will partially replace the outdated Compound Semiconductor Research Laboratory and provide for transition space for prototyping new devices. Construction is scheduled to begin in the third quarter of FY 2003 with start of operations in the third quarter of FY 2007. The Microsystems Laboratory (MicroLab), will complete the replacement of the CSRL and will be used to conduct research critical to the development of microsystems components as well as rapid prototyping and testing of these components. The MicroLab is scheduled to begin construction during the second quarter of FY 2005 with start of operations in the first quarter of FY 2009. Lastly, the Weapons Integration Facility (WIF) provides both classified and unclassified facilities which will facilitate design, system integration and the qualification of weapons systems. Unclassified workspaces will encourage and provide the environment necessary for process development and two-way information transfer between partners in industry and academia. WIF is scheduled to start construction during the third quarter in FY 2008 with start of operations in FY 2011. The sequenced approach to bring the MESA Complex on line meets NNSA's priority mission requirements while at the same time being affordable within the confines of the Future Years Nuclear Security Program (FYNSP).

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 2002 Budget Request (*Preliminary Estimate*)	N/A	N/A	2Q 2002	TBD	51,000 [a]	51,000
FY 2001 Congressional Budget Supplemental	N/A	N/A	2Q 2002	TBD	68,000 [b]	68,000
FY 2003 Budget Request *(Preliminary Estimate*)	2Q 2001	1Q 2003	3Q 2003 [c]	4Q 2009	453,000	504,000
FY 2004 Budget Request *(Performance Baseline*)	2Q 2001	1Q 2003	3Q 2003 c	3Q 2011	462,500	518,500

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design [d]			
2001	10,456	10,456	6,673
2002	4,500	4,500	7,426
2003	0	0	857
Construction			
2001	9,500	9,500	0
2002	63,500 [e]	63,500	32,798
2003	75,000	75,000	79,000
2004	61,800	61,800	58,000
2005	63,654	63,654	81,000
2006	65,564	65,564	60,000
2007	7,000	7,000	31,000
2008	67,531	67,531	16,000
2009	33,995	33,995	43,000

[a] Preliminary estimate for the MDL retooling only.

[b] Preliminary estimate for the infrastructure upgrades appropriated in 01-D-103, and transferred to this line item by the FY 2001 Supplemental ($17,000,000), and the preliminary estimate for the MDL Rad-Hard IC Retooling ($51,000,000).

[c] Construction of the new facilities included in the scope of this project starts in the 3Q FY 2003. Construction of site utilities and systems upgrades began in the 2Q FY 2002.

[d] Design funding was appropriated in 01-D-103, Project Engineering and Design (PED).

[e] Original appropriation of $67,000,000 was reduced by $3,500,000 as part of the Weapons Activities general reduction.

Fiscal Year	Appropriations	Obligations	Costs
2010	0	0	37,000
2011	0	0	9,746

3. Project Description, Justification and Scope

Project Description

The Microsystems and Engineering Sciences Applications (MESA) Complex at Sandia National Laboratories (Sandia) in Albuquerque, is a proposed state-of-the-art national complex that will provide for the design, integration, prototyping and fabrication, and qualification of microsystems into weapon components, subsystems, and systems within the stockpile.

The MESA Project will respond to mission needs by providing needed capabilities to:

- Enable integrated teams of weapon system designers, subsystem designers, analysts, and microsystems scientists and technologists to work effectively and efficiently to design, integrate, and qualify for weapon use microsystems-based components and weapons subsystems and ensure their incorporation into weapon systems assemblies;
- Provide facilities and tooling to support radiation-hardened integrated circuit production and qualification in the event the United States loses the last remaining vendor;
- Conduct R&D, rapid prototyping, pre-production fabrication and analysis, and a war reserve microsystem production capability “of last resort” for DOE/NNSA and the Nuclear Weapons Complex;
- Develop and use predictive codes (characterized by high-performance, nonlinear, full-system, multi-physics models) for microscale physics and for the necessary integration with macroscale codes;
- Develop and use computational tools and capabilities (including visualization-design labs) to support microsystems design, simulation, and manufacturing; weapons performance assessments; renewal process analyses; and qualification of microsystems components, integrated subsystems, and the certification of the overall weapon system;
- Allow technology developers to contribute to both classified stewardship problems and unclassified R&D collaborations with partners in industry and academia; and
- Incorporate cost-effective recycle and reclaim systems that significantly reduce annual water use and result in other secondary benefits including reduced utility costs and bulk chemical storage.

Justification

Management of the stockpile focuses on the surveillance, maintenance, refurbishment, assessment, and certification activities necessary to extend the life of the current stockpile. As weapons approach, or exceed, their useful (warranted) lifetimes, their limited-life components require periodic refurbishment, retrofit and remanufacture. These activities are driven by the Life Extension Program (LEP), an evaluation and prioritization framework for performing systematic, life-extension upgrades on, and replacements of, subsystems and components of nuclear weapons.

The MESA Project is critical to meet NNSA needs. It must deliver capabilities to meet the long term needs of

Stockpile Stewardship for continual advances in technologies that improve nuclear weapon surety as well as the more immediate LEP needs of incorporating advanced technologies into upcoming weapon refurbishments, eliminating present safety exceptions in the annual certification process. The microsystems that will be developed in MESA will have the ability to sense, think, act, and communicate within a wide range of environments. They will employ a technology base that spans photonics, mechanics, and radiation-hardened microelectronics on size and integration scales that have not been previously achieved. MESA will radically advance the use of computational modeling and simulation technologies to develop modular design tools for microsystems that can concurrently optimize designs for performance, manufacturability, inspection, qualification, certification, procurement, and cost in the design process. It will create linked virtual prototyping environments in which a microsystem-based product and its manufacturing processes are designed concurrently. Ultimately, the integrated technologies of research, design, and production will contribute to a reduction in the overall part count in a weapon system. It is this reduction in part count that appears to be the most promising approach to achieve needed cost and schedule reductions within the Stockpile Stewardship Program, the Life Extension Program, and related weapon campaigns.

In order to meet stockpile refurbishment requirements, Sandia has developed an integration effort focused on modernizing the non-nuclear components of nuclear weapons. Modern electrical, optical, and mechanical components are required to ensure the continuing safety, security, and reliability of the US nuclear deterrent. Achieving this objective requires integration of activities conducted within several of NNSA's campaigns, and it requires capital investment. To be able to provide modern components, outmoded equipment must be replaced and upgraded. Semiconductor processing equipment, in particular, is expensive and upgrades cost millions of dollars per tool. Commercial integrated circuit technology continues to advance in terms of performance and cost. As stated in the 1997 National Technology Roadmap for Semiconductors, the semiconductor industry has maintained its growth by achieving a 25-30% per-year cost reduction per function throughout its history. Key to this reduction has been a 30% reduction in feature size every three years. The reduction in feature size, and changes in fabrication technology and materials that accompany it, drives changes and consistent improvements in the capital equipment used to fabricate integrated circuits.

Existing Sandia facilities are not adequate in size or function to support the development, prototyping, and use of advanced design and fabrication technologies. Such technologies are critical to support microsystems design, simulation, and manufacturing; weapons performance assessments; renewal process analyses; and qualification of microsystems components, integrated subsystems, and the certification of the overall weapon system. MESA will employ state-of-the-art visualization technologies in support of stockpile stewardship activities. In addition, the retooled, silicon-based production capability (currently located in the existing MDL) and the new compound semiconductor cleanroom, in combination with required new light laboratory and work spaces to replace the CSRL, will allow MESA to conduct R&D, rapid prototyping, pre-production fabrication and analysis, and house a war reserve microsystem production capability for DOE/NNSA and the Nuclear Weapons Complex (NWC).

Project Scope

<u>Infrastructure Upgrades</u>

The infrastructure upgrades portion of this project includes systems upgrades to the existing Microelectronics

Development Laboratory (MDL) and utilities upgrades to reroute existing utilities to enable construction of the MESA Complex.

| The systems upgrades to the MDL will repair and modify part of the existing building infrastructure including the acid exhaust system, specialty gas room, process chilled water, make-up air, de-ionized water plant and emergency power. These upgrades are necessary in order to prepare for the equipment retooling of the MDL.

The utilities upgrades work reroutes existing communications, power, sewer, storm drain, steam, gas and water utilities and provides a utilities corridor for the proposed MESA building site.

<u>Microelectronics Development Laboratory (MDL) Rad-hard Integrated Circuit (IC) Retooling</u>

| This portion of the project supports the costs of partially retooling the Microelectronics Development
| Laboratory with the equipment that is required in order to produce radiation hardened integrated circuits and
| provides the critical microsystem tools to allow R&D to progress during construction of the full MESA project. The MDL currently does not have the complete tool set needed to produce qualified war reserve (WR)
| radiation-hardened integrated circuits or microsystem products. The existing tool set is developmental in nature, is missing some key tools, and includes critical one-of-a-kind tools with no backup. Many of MDL's fabrication tools are more than 10 years old and have exceeded, or are approaching, the end of their useful lives. Downtime is increasing, supplier support for tool maintenance is decreasing, and spare parts are increasingly unavailable. More importantly, commercial vendors for radiation hardened integrated circuits soon will cease to exist, leaving Sandia as the only supplier for these key weapons components. Therefore, refurbishment of the MDL fabrication toolset is a critical capability that the Department must have. The parts of the MESA project involving retooling of the MDL will play a substantial role in developing weapon refurbishment options. The MDL will be an enduring, critical part of the MESA Complex.

| The retooling effort primarily provides for equipment procurement, design and fit-up costs. The average tool
| delivery time ranges from six to twelve months after order, followed by installation design, installation, inspection and start up time. Tools are ordered in sequence to maximize efficiency and minimize downtime and disruptions to on-going MDL activities.

<u>MESA Complex</u>

The MESA Project includes some work which is already complete or in progress, including:

- Site utilities (as described above under Infrastructure Upgrades)
- Retooling of equipment and support infrastructure in the existing MDL (as described above under Infrastructure Upgrades and MDL Rad-Hard IC Retooling)
- Critical microsystem retooling for the MDL.

The remaining project efforts, to begin in FY 2003 consistent with the approved Performance Baseline, include:

- A new cleanroom facility, light laboratories, and work spaces for personnel replacing the existing, but antiquated, Compound Semiconductor Research Laboratory (CSRL)
- New capital equipment associated with the cleanroom facility and light labs
- Light laboratories and work group and support spaces for researchers, scientists, and technology

developers involved in computation, engineering sciences, microsystems, and weapons design who are focused on incorporating microsystems into planned weapon refurbishments

- Special visualization facilities to enable full deployment of ASC and ADaPT modeling and simulation tools for application to microsystems and full weapon development; and
- Advanced communications cabling and network electronics to support unclassified and classified ultra-high speed local computing and inter-connectivity to supercomputing resources.
- Decontamination and decommissioning of the CSRL once vacated.

The MESA facilities comprise approximately 391,000 gross square feet (gsf) and will include:

Microsystems Fabrication (MicroFab). This facility provides cleanrooms that replace the Compound Semiconductor Research Laboratory, Building 893 (CSRL), and transition cleanroom space for prototyping new devices. Built in the late 1980s as an "interim facility" with a five-year lifetime, Sandia scientists have literally "used up" the CSRL and it is no longer practical or cost effective to maintain this facility. Moreover, the mission of the CSRL has grown over time, and the current facility does not, and cannot, meet functional requirements. Therefore, this project will replace the CSRL with the MicroFab and retool approximately 80% of the existing tools used in this facility.

Microsystems Laboratory (MicroLab). This facility will house microsystems researchers and engineers and a small group of MESA external partners. It will accommodate chemical, electrical and laser light laboratories, workspaces to support approximately 274 personnel and a Design and Education Center. This new building will be used to conduct research and development critical to the development of microsystems components as well as rapid prototyping and testing of these components.

Weapons Integration Facility

Weapons Integration Facility – Classified (WIF-C). This portion of the WIF facility will house weapons designers, analysts and computational and engineering sciences (C&ES) staff. It will include a Visual Interactive Environment for Weapons Simulation (VIEWS) Corridor, visualization lab, primarily electrical and laser light laboratories and workspace to support approximately 274 personnel. This portion of the WIF buildings will facilitate design, system integration, and the qualification of weapons systems.

Weapons Integration Facility – Unclassified (WIF-U). This portion of the WIF facility will house C&ES staff and MESA partners. It will include an advanced scientific visualization laboratory, and workspaces to support approximately 100 personnel. This facility will enable collaboration and proximity between partners from industry and academia and Sandia scientists and engineers. Workspaces will encourage and provide the environment necessary for process development and two-way information transfer.

Project Milestones:

FY 2003:	Start of construction for the MicroFab	3Q
FY 2004:	Award early tool procurements for the MicroFab	1Q
	NNSA to approve start of construction for the MicroLab	4Q

4. Details of Cost Estimate

	(dollars in thousands)	
	Current Estimate	Previous Estimate
Total, Design Phase (3.2% of TEC) [a]	14,956	14,956
Construction Phase		
Improvements to Land [b]	0	7,200
Buildings	175,000	157,200
Special Equipment	140,400	141,000
Utilities	4,800	4,600
Standard Equipment	7,800	7,500
Major Computer Items	17,500	16,600
Inspection, Design and project liaison, testing, checkout and acceptance	22,500	20,400
Construction Management (4.0% of TEC)	18,700	17,400
Project Management (2.9% of TEC)	13,200	11,800
Total Construction Costs (86.5% of TEC)	399,900	383,700
Contingencies		
Construction Phase (10.3% of TEC)	47,644	54,344
Total, Line Item Costs (TEC)	462,500	453,000

5. Method of Performance

Construction contracts will be awarded using Sandia's best value procurement process and will be awarded as firm fixed price contracts. Equipment will be procured using either design procurement and installation contracts or turnkey design/procure/install contracts as appropriate.

[a] Design funding was appropriated in 01-D-103, Project Engineering and Design (PED).

[b] Estimate for elements previously included in "Improvements to land" are now included in "Buildings."

6. Schedule of Project Funding

	(dollars in thousands)					
	Prior Years	FY 2002	FY 2003	FY 2004	Outyears	Total
Project Cost						
Facility Costs						
Design [a]	6,673	7,426	857	0	0	14,956
Construction	0	32,798	79,000	58,000	277,746	447,544
Total, Line item TEC	6,673	40,224	79,857	58,000	277,746	462,500
Total Facility Costs (Federal and Non-Federal)	6,673	40,224	79,857	58,000	277,746	462,500
Other Project Costs						
Conceptual design costs	2,100	0	0	0	0	2,100
Decontamination & Decommissioning costs	0	0	0	0	4,000	4,000
NEPA documentation costs	130	0	0	0	0	130
Other ES&H Costs	690	500	300	300	600	2,390
Other project-related costs	7,515	2,984	3,900	4,200	28,781	47,380
Total, Other Project Costs	10,435	3,484	4,200	4,500	33,381	56,000
Total Project Cost (TPC)	17,108	43,708	84,057	62,500	311,127	518,500

[a] Design funding was appropriated in 01-D-103, Project Engineering and Design (PED).

7. Related Annual Funding Requirements

(FY 2009 dollars in thousands)

	Current Estimate	Previous Estimate
Annual facility operating costs [a]	2,900	2,900
Annual facility maintenance/repair costs [b]	1,700	1,700
Programmatic operating expenses directly related to the facility [c]	215,000	215,000
Capital equipment not related to construction but related to the programmatic effort in the facility [d]	18,300	18,300
Utility costs [e]	2,400	2,400
Total related annual funding (operating from FY 2009 through FY 2038) [f]	240,300	240,300

[a] Average annual facility operating costs for material and labor, including systems engineering, infrastructure operations, custodial, and maintenance and sub-sites management. An average total of 15.5 staff years per year will be required.

[b] Average annual facility maintenance and repair costs for materials and labor. An average of 8.0 craft years per year will be required. Costs include maintenance and ordinary repair, including tasks like removals and replacements, repair and refinishing that result from normal wear and tear and maintenance of the grounds.

[c] Programmatic operating expenses directly related to the MESA complex. This estimate reflects the annual operating expenses associated with programmatic work that will be done within the MESA complex. As such, **this estimate reflects funding that is primarily already existing from other established DOE programs** (i.e., Engineering Campaigns, Readiness in Technical Base and Facilities, Advanced Simulation and Computing, etc.). This estimate is based on costs for personnel associated with the integrated occupancy of MESA (integration of weapons design personnel, present CSRL personnel, present Microsystems Development Laboratory personnel and computational and engineering sciences personnel). In addition to costs for personnel time, this estimate also reflects costs for benefits, travel, purchases, corporate loads etc.

[d] Capital equipment not related to construction, but related to the programmatic effort in the facility. This reflects the average annual investment that is required in retooling and in replacement of fabrication and computing capital equipment to maintain toolsets one generation behind industry in microsystems technologies and at state-of-the-art in computational capability.

[e] Utility costs reflect the average annual costs for electricity, gas, water and sewer discharges.

[f] The MESA Complex will be fully operational in FY 2011 using a phased approach. Separate Critical Decision 4s (Start of Operation) are planned for each building as follows: MicroFab in FY 2007, the MicroLab in FY 2009 and the WIF in FY 2011. FY 2009 represents the midpoint for the phased approach and was therefore selected as the base year for reporting related annual funding requirements.

Inertial Confinement Fusion Ignition and High Yield

Mission Supporting Goals and Measures

The Inertial Confinement Fusion Ignition and High Yield (ICF) Campaign advances the nation's capabilities to achieve inertial confinement fusion ignition in the laboratory and addresses high-energy-density physics issues required to maintain a safe, secure, and reliable nuclear stockpile. Specific campaign objectives include: (1) demonstration of laboratory inertial confinement fusion ignition; (2) enhancement of high energy density physics (HEDP) experimental capabilities; (3) design, fielding, and analysis of HEDP experiments needed to support development and validation of Advanced Simulation and Computing (ASCI) codes; and (4) assessment of options for high-yield fusion. The ICF Campaign uses a complementary suite of laser and pulsed power facilities to accomplish its mission. Core ICF 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 at Sandia National Laboratories (SNL). The campaign also currently funds HEDP research and associated operational expenses for the Nike facility at the Naval Research Laboratory and the Trident facility at Los Alamos National Laboratory (LANL).

The FY 2004 budget request contains funding for the NIF Project (including both Total Project Costs and the NIF Demonstration Program), consistent with the approved NIF Project baseline. The project continues to meet all major milestones on or ahead of schedule. In preparation for the first stewardship experiments on NIF in 2004, the budget also includes significant increases for NIF diagnostics, cryogenics, and core scientific programs in ignition and high-energy-density physics. The budget also includes funding for full single shift operation of the Z machine (Z). Refurbishment of the Z accelerator is included under the Readiness in Technical Base and Facilities Program.

High-energy petawatt lasers show considerable promise for enhancing the stewardship capabilities of major ICF compression facilities (OMEGA, Z, NIF). The FY 2004 budget includes the funding for petawatt-laser related technology development, which is the first step towards implementing high-energy petawatt lasers at NNSA facilities.

All funding for university grants in high-energy-density physics is now consolidated in this campaign, including HEDP grants previously provided in the Secondary Certification and Nuclear Systems Margins Campaign.

Funding for the High-Average-Power Laser Program, an activity relevant to inertial fusion energy production but not required by the nuclear weapons program, is not requested by NNSA in FY 2004 due to overall Future Years Nuclear Security Program (FYNSP) fiscal constraints and prioritization of research activities across Defense Programs.

The Inertial Confinement Fusion Ignition and High Yield Campaign supports the Stockpile Stewardship Program (SSP) and the NNSA goal to maintain and enhance the safety, security, and reliability of the nation's nuclear weapons stockpile. This campaign plays an important role in developing the science and technology required for weapons system assessment and certification, now and in the future.

Subprogram Goal

High energy density physics experimental capabilities and results, including fusion ignition, to support current and future Stockpile Stewardship Program requirements for modeling processes relevant to the performance of nuclear weapons and nuclear weapons effects issues.

Performance Indicators

Number of National Ignition Facility (NIF) laser beams commissioned (total number of required beams is 192).

Number of NIF Project major construction Milestones completed on/ahead of schedule (total number of milestones is 28).

Number of annual major performance targets completed for the NIF ignition program element.

Number of annual major performance targets completed for the Assessment of High-Yield Fusion on Z-Pinches program element.

Number of total shot days provided at ICF facilities.

Number of annual major performance targets completed for Stockpile Stewardship Experiments on ICF Facilities program element.

Number of annual major performance targets completed for Experimental Support Technologies program element.

Number of university high energy density physics research grants/research activities supported.

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Installed the National Ignition Facility (NIF) Cluster 3 beam path infrastructure. Positioned the NIF Target chamber. Reduced laser non-uniformity on OMEGA to planned specification. Evaluated advanced direct drive laser fusion target concepts on Nike and OMEGA. Conducted the first simultaneous measurements of X-Ray burnthrough and re-emission for Au and cocktail samples on Z OMEGA.	Make NIF Optics Assembly Building operational. Install NIF Target Positioner in target bay. Install NIF First Flashlamp canister in Laser Bay 2. Validate specific aspects of transport and radiation hydrodynamics models using experimental data from both Z and OMEGA. Complete one series of material properties experiments on Nike in coordination with the national laboratories.	Complete three additional major National Ignition Facility (NIF) construction milestones, for a total of 13 of 28. Complete 6 major NIF ignition performance targets (conduct first NIF ignition related experiment; demonstrate technique to fill NIF-scale targets with tritium gas; fabricate first NIF-scale targets using beryllium; validate use of tritium with basic NIF ignition target components; qualify the OMEGA laser facility for performing implosion experiments involving deuterium/tritium targets; and execute a set of scaled experiments on OMEGA to test design concepts for one type of

Completed initial specific coupled radiation transfer/hydrodynamics experiments in support of LEP.

Provided initial cryogenic D2 EOS data on OMEGA.

Demonstrated high temp drive and supersonic transition in radiation transport experiments at the Z facility.

Demonstrated high energy point backlighting of SSP experiments on Z.

Completed prototyping and design of defect driven hydrodynamic experiments.

Achieved 28 km/s velocities in cold Al-Ti magnetic flyer plates on Z to support DMP campaign requirements.

Consolidated management of core diagnostic and cryogenic projects under the NIF Director.

Completed preliminary studies supporting formulation of NNSA performance requirements for HEDP Petawatt laser facilities.

Completed preconceptual design of an enhanced performance high-energy-high-intensity laser modernization of OMEGA.

Completed assembly of the off-axis Final Optics Assembly for Z-Beamlet Backlighter experiments on Z and

Demonstrate imaging X-Rays from the imploded core of a capsule on Z. Provide 9 keV radiograph of an experiment on Z, using Z beamlet.

Perform multi-cone, gas-filled hohlraum symmetry experiments at OMEGA.

Complete initial specifications of first NIF hohlraums and capsules.

Develop sources and diagnostic techniques for equation of state and phase-transition experiments.

Construct NIF diagnostics and prepare for NIF experiments.

Develop sources and debris mitigation on Z to provide experimental data for validating system-generated electromagnetic pulse effects models.

Perform spherical mix experiments on OMEGA using tritium-filled targets.

NIF ignition target).

Complete 1 major performance target for the Assessment of High-Yield Fusion on Z-Pinches (a series of ICF experiments providing data for validating models for interactions between x-rays generated by z-pinches and targets).

Provide 600 shot days at ICF facilities.

Complete 3 major performance targets for Stockpile Stewardship Experiments on ICF facilities (obtain two data sets on deuterium and other materials for the Enhanced Surveillance and Dynamic Materials Properties Campaigns; develop two model validation test beds at ICF facilities to support stockpile stewardship; and conduct first experiments at NIF in support of Science Campaigns).

Complete 3 major performance targets for Experimental Support Technologies (field first two diagnostic data collection systems at the NIF; obtain time-resolved high-energy X-Ray images of experiments at Z; and develop advanced optical components for high energy short-pulsed lasers).

Support 18 university activities (one research center cooperative agreement; eight Stockpile Science Academic Alliance grants; and nine University of demonstrated improved resolution in images of capsule implosions.

Demonstrated enhanced capsule implosion performance on Z.

Supported basic science through 16 High-Energy-Density Science Grants and National Laser User Facility (NLUF) Program. Completed solicitation and merit review process for continuation of program.

Validated performance requirements for Z accelerator refurbishment.

Demonstrated high efficiency electron beam "non intercepting" diode concept on ELECTRA laser.

Achieved "First Light" on Mercury Diode Pumped Solid State Laser (DPSSL).

Rochester Laboratory for Laser Energetics (UR/LLE) National Laser User Facility grants.

Funding Schedule

	(dollars in thousands)				
	FY 2002	FY 2003	FY 2004	$ Change	% Change
Ignition	42,346	47,792	56,068	8,276	17.3%
Support of Stockpile Program	22,811	25,790	31,987	6,197	24.0%
Experimental Support Technologies	41,377	30,362	63,337	32,975	108.6%
High Yield Assessment	5,869	4,040	5,711	1,671	41.4%
University Grants/Other Support	7,413	4,200	7,450	3,250	77.4%
Inertial Fusion Technology	23,977	0	0	0	0.0%
Operations of Facilities	44,280	49,882	55,916	6,034	12.1%
NIF Demonstration Program	72,300	75,732	96,300	20,568	27.2%
NIF Other Project Costs (OPC)	1,400	994	0	-994	-100.0%
Construction	245,000	214,045	150,000	-64,045	-29.9%
Total, Inertial Confinement Fusion	506,773 [a]	452,837 [a]	466,769	13,932	3.1%

The FY 2003 Request column includes comparability adjustments as detailed in the footnotes for consistency with the FY 2004 Request.

Detailed Program Justification

	(dollars in thousands)		
	FY 2002	FY 2003	FY 2004
Ignition	**42,346**	**47,792**	**56,068**

Supports calculations, planning, design and experimental activities aimed at risk reduction and development of the physics basis for indirect drive and direct drive inertial confinement fusion ignition. Includes related ignition target fabrication R&D, diagnostics R&D, diagnostics development and fabrication and support for diagnostics, computer codes and modeling essential to ICF campaign efforts. In FY 2004, specific emphasis will be focused on ignition target technology development, laser-plasma interaction investigations and the development of the physics basis for direct drive ignition.

[a] Includes comparability adjustments of $1,400,000 in FY 2002 and $1,044,000 in FY 2003 from the Secondary Certification and Nuclear Systems Margins Campaign to consolidate funding for high energy density physics grants into the Inertial Confinement Fusion Ignition and High Yield Campaign.

Support of Stockpile Program	**22,811**	**25,790**	**31,987**

Funds HEDP experiments at ICF facilities in support of the current scope of the SSP. Provides specific data required for SSP campaigns and activities. Develops experimental capabilities and analytic tools required to perform HEDP experiments and meet requirements for HEDP support identified by SSP campaigns and activities. Includes planning and analysis of experiments as well as related HEDP target fabrication R&D, diagnostics R&D, and ongoing target and diagnostics support.

Experimental Support Technologies	**41,377**	**30,362**	**63,337**

Supports 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; fabrication of optical phase plates for NIF; NIF Target Area Systems Support; NIF User Support Organization; development of pulsed power and high-energy petawatt laser technology. Provides target production capabilities for all HEDP laboratories. Activities supported within this element of the campaign are necessary to maximize the utility of ICF facilities, including NIF. During FY 2004, major emphasis will be placed on development and delivery of NIF diagnostic systems, NIF cryogenic target support systems, and fabrication of necessary optics to support experiments.

High Yield Assessment	**5,869**	**4,040**	**5,711**

Supports Pulsed Power experimental program and assessment of pulsed-power for high yield.

University Grants/Other Support	**7,413**	**4,200**	**7,450**

Supports university grants in high-energy-density science, National Laser User Facility (NLUF) activities, and critical needs of the campaign. All university grants for HEDP research are now consolidated within this activity. Previously, HEDP grants were partially funded in the Secondary Certification and Systems Margins Campaign.

Inertial Fusion Technology	**23,977**	**0**	**0**

Develops technology options for inertial fusion and stockpile stewardship through use of high-average power lasers. It is not funded in FY 2004 due to the requirements of higher priority activities within this campaign and within NNSA.

Operations of Facilities	**44,280**	**49,882**	**55,916**

Supports the operation of facilities, including OMEGA, Z, NIKE, and TRIDENT in a safe, secure manner for ICF Ignition and High Yield Campaign activities and other authorized users.

NIF Demonstration Program	**72,300**	**75,732**	**96,300**

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. Included is the phased turnover of lasers to commissioning and operations teams. These transfers employ the Management Pre-Start Review process in which an independent team evaluates readiness (e.g. training and qualification of operators, installation and assembly drawings and procedures, and commissioning test procedures results). Pre-start reviewing, commissioning and testing activities are included in the NIF Demonstration funding.

NIF Other Project Costs (OPC)	**1,400**	**994**	**0**

Supports National Environmental Policy Act (NEPA) documentation, including environmental impact statement and environmental monitoring and permits, and assurances, safety analysis and integration. These activities will be completed by the end of FY 2003.

Construction	**245,000**	**214,045**	**150,000**

96-D-111, National Ignition Facility, Lawrence Livermore National Laboratory. Funding decreases in FY 2004, consistent with the current Project baseline. The major milestone for the Project in FY 2004 is achieving "First Light" to the Target Chamber Center.

Total, Inertial Confinement Fusion	**506,773**	**452,837**	**466,769**

Explanation of Funding Changes

	FY 2004 vs. FY 2003 ($000)
Inertial Confinement Fusion	
• **Ignition:** Increase supports ignition target design, target fabrication, and diagnostic development; additional support for direct drive cryogenic implosion research and overall ignition risk reduction; and increased ignition related activities at NIF, including preliminary experimentation	8,276
• **Support of Stockpile Program:** Increase supports activities and experiments needed for validation of advanced codes and other stockpile assessments, including target design, target fabrication, and diagnostics development; initiation of stockpile related experiments on NIF; and additional stockpile related experiments on Z	6,197
• **Experimental Support Technologies:** Increase supports accelerated construction of NIF diagnostics and cryogenic target systems to meet milestones of rebaselined ignition plan; fabrication of optical phase plates for NIF, NIF Target Area Systems Support, and NIF User Support Organization; greater target quantities and additional complexity; enhanced Z backlighting as a diagnostic tool; and high-energy petawatt technology development	32,975

- **High Yield Assessment:** Increase supports additional effort for the validation of models used to scale to high yield on pulsed power devices 1,671
- **University Grants/Other Support:** Increase provides additional funding for short-pulse high-intensity laser and other university activities including the National Laser User Facility (NLUF) 3,250
- **Operations of Facilities:** Increase supports full single shift operations at Z 6,034
- **NIF Demonstration Program:** Increase provides full support for the NIF Demonstration Program consistent with the NIF Project baseline established in March 2001, and reflects the ramp-up of activities towards full operation in FY 2009. Included is the assembly, installation, and testing of laser components, including the final optics assembly required to meet the NIF "first light to the target chamber center" milestone. The Management Pre-start Reviews required to support this milestone are also supported by this funding. 20,568
- **NIF Other Project Costs (OPC):** Decrease reflects that FY 2003 is the last year of Other Project Cost (OPC) funding for the NIF project consistent with the NIF Project baseline established in March 2001 . . . . -994
- **Construction:** Decrease in the National Ignition Facility Project line item reflects the NIF Project baseline established in March 2001 . . . . -64,045

Total Funding Change, Inertial Confinement Fusion 13,932

Capital Operating Expenses and Construction Summary

Capital Operating Expenses [b]

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
General Plant Projects	245	252	260	8	3.00%
Capital Equipment	7,713	7,944	8,183	238	3.00%
Total, Capital Operating Expenses	7,958	8,197	8,443	246	3.00%

[b] 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 2003 and FY 2004 funding shown reflects estimates based on actual FY 2002 obligations.

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

(Changes from the FY 2003 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 Completed	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 2003 Budget Request	1Q 1996	2Q 1998	3Q 1997	4Q 2008	2,094,897	2,248,097	1,200,000	3,448,097
FY 2004 Budget Request (*Performance Baseline*)	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	282,153
2003	214,045	214,045	200,615
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 NNSA Inertial Confinement Fusion (ICF) Program carries out many of the high energy density physics (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 SSP Program and a major goal of NIF and | the ICF 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

[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.

and through direct application of the high laser power. The NIF will also conduct non-ignition HEDP experiments critical to the success of the SSP. Technical capabilities provided by the ICF program also contribute to other DOE missions including nuclear weapons effects testing and the development of inertial fusion power. Ignition and other goals for NIF were 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 2003 include:

- Laser Bay 2, Cluster 3 Beampath installed — 1Q (completed 1Q FY2002)
- First Laser Bay 2 Flashlamp installed — 2Q (completed 4Q FY2002)
- Optics Assembly Building operational — 3Q (completed 1Q FY2003)
- Target Positioner (TARPOS) installed in Target Bay 2 — 3Q

Project milestones for FY 2004 include:

- First Light to Target Chamber Center — 3Q
- Achieve 10 kilo-joules 1 omega light — 4Q
- Switchyard 2 Beampath to Commissioning — 4Q (completed 1Q FY2003)

4. Details of Cost Estimate

	(dollars in thousands)	
	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design Drawings and Specifications)	219,573	203,150
Design Management Costs (1.9% of TEC)	39,400	38,400
Project Management Costs (1.9% of TEC)	40,414	39,414
Total Design Costs (14.3% of TEC)	299,387	280,964
Construction Phase		
Improvements to Land	1,800	1,800
Buildings	179,000	173,400
Special Equipment	1,268,281	1,219,828
Utilities	500	500
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	132,566	120,677
Construction Management (0.9% of TEC)	18,000	18,000
Project Management (2.8% of TEC)	59,594	55,594
Total Construction Costs (79.2% of TEC)	1,659,741	1,589,799
Contingencies		
Design Phase (1.0% of TEC; 3.5% of remaining TEC BA)	21,642	40,065
Construction Phase (5.4% of TEC; 18.5% of remaining TEC BA)	114,127	184,069
Total Contingencies (6.5% of TEC; 22.0% of remaining TEC BA)	135,769	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 2002	FY 2003	FY 2004	Outyears	Total
Project Cost						
Facility Costs						
Design	303,171	8,872	7,300	670	1,016	321,029
Construction	729,470	273,281	193,315	163,472	414,330	1,773,868
Total, Line item TEC	1,032,641	282,153	200,615	164,142	415,346	2,094,897
Other Project Costs						
R&D necessary to complete construction [a]	102,342	1,517	536	0	0	104,395
Conceptual design costs [b]	12,300	0	0	0	0	12,300
NEPA documentation costs [c]	5,514	616	975	384	3,016	10,505
Other project-related costs [d]	21,460	505	1,589	740	1,706	26,000
Total, Other Project Costs	141,616	2,638	3,100	1,124	4,722	153,200
Total Project Cost (TPC)	1,174,257	284,791	203,715	165,266	420,068	2,248,097
Other Related Operations and Maintenance Costs - NIF Demonstration Program	474,078	76,781	71,719	86,258	491,164	1,200,000
TOTAL Project and Related Costs	1,648,335	361,572	275,434	251,524	911,232	3,448,097
Budget Authority (BA) requirements [e]						
TEC (capital funding)	1,095,713	245,000	214,045	150,000	390,139	2,094,897
OPC (O&M funding)	150,806	1,400	994	0	0	153,200
NIF Demonstration Program (O&M funding) [f]	479,068	72,300	75,732	96,300	476,600	1,200,000
Total, BA requirements	1,725,587	318,700	290,771	246,300	866,739	3,448,097

[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.

[f] Funding requested and appropriated in the Inertial Confinement Fusion program and, beginning in FY 2001, under the Inertial Confinement Fusion Ignition and High Yield campaign is required to maintain the Project baseline. 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.

7. Related Annual Funding Requirements

	Current Estimate	Previous Estimate
Annual facility operating costs [a]	36,670	35,916
Annual facility maintenance/repair costs [b]	65,209	63,868
Programmatic operating expenses directly related to the facility [c]	0	0
Capital equipment not related to construction but related to the programmatic effort in the facility	216	212
GPP or other construction related to the programmatic effort in the facility	216	212
Utility costs [d]	13,944	13,657
Other costs [e]	1,777	1,740
Total related annual funding (estimate based on operating life of FY 2009 through FY 2038)	118,032 [f]	115,605 [g]

[a] 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.

[b] 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.

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

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

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

[f] In FY 2004 dollars.

[g] In FY 2003 dollars.

Advanced Simulation and Computing

Mission Supporting Goals and Measures

The core mission of the Advanced Simulation and Computing (ASCI) Campaign is to provide the tools that enable the weapons design community to assess and certify the safety, performance, and reliability of the nuclear weapons stockpile.

The ASCI Campaign is creating simulation capabilities that incorporate modern physics and engineering models validated against experimental data from both above ground and past underground nuclear testing. These baseline models are the repositories of expert designer judgment as well as the best scientific representations of our current knowledge of the performance of the complex devices currently in the stockpile. These simulation capabilities are essential if the National Nuclear Security Administration (NNSA) is to continue to meet its statutory responsibility to the nation to assess and certify the stockpile on an annual basis. The ASCI Campaign provides the means to integrate the theoretical and experimental efforts taking place within the Stockpile Stewardship Program (SSP). The products of this integration are the simulation tools that are being developed and deployed.

At the same time that ASCI continues an aggressive development of the most powerful capabilities for the future, the modern simulation tools previously developed by ASCI are being applied day-to-day to address immediate stockpile concerns. ASCI codes are being used to close Significant Finding Investigations (SFIs) as well as to support the Life Extension Programs (LEPs) for individual weapon systems. These activities are enabled by the ongoing supercomputing infrastructures at the National Laboratories, encompassing both continuing operations as well as research in new techniques for storage, visualization, networking, and all aspects of the structure that is required by the modern generation of computing capabilities.

The ASCI Campaign is integrating its efforts more tightly with the needs of Directed Stockpile Work (DSW) and other campaigns. A major manifestation of this renewed commitment to DSW is the alignment of the series of major milestones with the work that the code users must perform in support of assessment and certification. These milestones, which are reviewed semi-annually by an external review committee of experts in scientific computation, ensure a steady improvement in simulation capabilities focused on the performance of the NNSA core mission–maintaining a safe, secure, and reliable nuclear weapons stockpile.

By FY 2008, ASCI will deliver a high fidelity, full-system physics characterization of a nuclear weapon. At that time, the campaign will deliver a suite of validated codes, running on supercomputer platforms, acquired through open procurement, with user-friendly environments, advanced visualization tools for analysis, and the entire support structure to integrate the components together. Other program deliverables include high-performance storage and high-bandwidth networks. In support of a true integrated SSP effort, the ASCI Campaign continues to push the envelope in distance computing as well as in advanced encryption techniques and other approaches to ensure secure networking.

Through its University Alliances partners and through the basic research activities at the national laboratories, ASCI continues to look to the future to meet its responsibility to ensure that the tools needed to support the simulation of the most complex physics devices ever modeled will be ready when needed. The science for realistic models and a predictive capability must be available to the code developers and the weapons designers to allow them to stay ahead of the problems presented by the effects of aging on the weapons in the nuclear stockpile.

ASCI's Ongoing Computing program element has been split into two elements titled 1.) Computational Systems and 2.) Simulation Support. The primary reason for this split is for the programmatic visibility and understanding of driving factors and trends for ASCI computing center costs. This split is wholly contained by what was the Ongoing Computing program element and does not shift costs from or to the other ASCI program elements. The Computational Systems and Simulation Support elements were derived through tri-lab collaborations and apply to all three computing centers.

FY 2002 Performance Report: The ASCI Campaign successfully performed a prototype calculation of a full weapon system with three-dimensional engineering features. The result was conducted at Los Alamos National Laboratory for the W-76 and Lawrence Livermore National Laboratory for the W-80 warheads using the ASCI "White"supercomputer at Lawrence Livermore National Laboratory, as briefed to the Nuclear Weapons Council Standing and Safety Committee on June 13, 2002.

ASCI actively participated in the recent Office of Management and Budget's Program Assessment using the Program Assessment Rating Tool (PART). The PART assessment noted that the Program was well managed earning OMB's highest rating of "Effective". OMB's focus on ensuring that planned growth in the program meets requirements specifically related to the weapons stockpile and that the program does not develop unneeded redundancy is on target. In FY2004 ASCI will commission an independent review of stockpile computational requirements and will remain sensitive to unneeded redundancy, redirecting work authorizations where it is identified.

Subprogram Goal

Predictive simulation and modeling tools, supported by necessary computing resources, to maintain long-term stewardship of the stockpile.

Performance Indicators

Peer-reviewed progress, according to schedule, toward a validated full-system, high-fidelity simulation capability

Number of weapon system components analyzed using ASCI codes to annually certify their performance (as part of annual assessments and certifications process or Life Extension Program (LEP) activity)

The maximum individual platform computing capability measured in trillions of operations per second (TeraOPS)

The total computing capability of all platforms, measured in trillions of operations per second (TeraOPS), taking into consideration procurements and retirements of systems.

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Demonstrated a proof-of-principle capability for 3-Dimensional (3-D) full-system studies of weapons systems (the high quality prototype simulations shed new light on the complex	Deliver an enhanced capability for nuclear weapon primary performance assessment. Deliver an enhanced capability to study secondary design and	Complete sufficient milestones to achieve high-fidelity primary simulation and Stockpile to Target Sequence (STS) abnormal environments.

coupled dynamics of weapons, producing relevant information for comparison with nuclear test data, including the primary and secondary yields; these calculations show that it is possible to simulate an entire explosion, both primary and secondary, in three dimensions with a single computational code). Demonstrated prototype 3-D simulations for full-system weapon stockpile to target sequence (STS) abnormal environments. Demonstrated key 3-D mechanical responses of a re-entry vehicle system to normal flight environments using ASCI software. Conducted a Software Quality Assessment (this is an important part of delivering validated 3-D codes to weapon designers and other code users). Completed a new mathematical framework enabling the reconstruction and restoration of 3-D radiographic imaged objects; this contributed to the "see and understand" effort to deliver adequate user environments to the user community. Developed the initial software development environment for the 12 teraOPS computer system, ASCI White, providing the necessary compilation, debugging, middleware, Input/Output services	Directed Stockpile Work (DSW) issues. Demonstrate 3-Dimensional safety simulation of a scenario involving abnormal high-explosive initiation. Demonstrate the ability to evaluate the response of a weapon's electrical system to a hostile environment; specifically, this target will evaluate ASCI tools for predicting the transient response of electrical components in an X-Ray environment. Demonstrate a user environment that provides application development and execution, data analysis and visualization and distance computing in accordance with the ASCI Q platform and application requirements. Complete acquisition of 30 teraOPS "Q" super computer at LANL	Analyze 10 of 31 weapons systems components. Acquire : 40 teraOps; 10 Terabytes of Memory; and 240 Terabytes of Storage at Sandia National Laboratories. Acquire/maintain total ASCI capacity of 85 teraOPS.

and solver libraries required by ASCI and Directed Stockpile Work (DSW) applications; this work made ASCI White available and usable for developers, designers, and analysts from all three weapons laboratories.

Provided a common "tri-lab" security infrastructure with cross-site authentication and distributed file system enabling greater access to a secure, integrated environment; this contributed to the delivery of a proper environment to the user community and supported the platform strategy requirement for distance computing.

Supported laboratory computing centers operations and administration 24 hours/day, 7 days/week, as well as archival storage resources, local and wide-area networking and help desk; this supported all work being done within the computing centers and included troubleshooting, back-up, communications, and improved efficiency in resource usage.

Completed an Alliance program review with the decision to renew contracts for another five-year term (during the review, the important role these university partnerships play was made evident; the ASCI Alliances are all involved in large-scale simulation and provide access to some of academia's brightest minds to support science-based weapon stewardship).

Dedicated the Nicholas C. Metropolis Strategic Computing Complex at Los Alamos National Laboratory; construction was finished early and below the original cost estimate and the complex with a resident “Q” machine will be fully operational in FY 2003.

Installed 20 teraOps of the Q system at Los Alamos; when completely installed, this system will have a 30 teraOps supercomputer operating in the classified environment and a 2.5 teraOps system in the open--ASCI Q enables required DSW analysis work as well as ASCI programmatic milestones.

Funding Schedule

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Advanced Applications Development	147,812	144,769	144,019	-750	-0.5%
Verification and Validation	40,766	42,401	44,293	1,892	4.5%
Materials and Physics Modeling	67,702	69,931	69,931	0	0.0%
Problem Solving Environment (PSE)	41,489	42,148	42,198	50	0.1%
Distance Computing	28,791	16,300	16,601	301	1.8%
PathForward	10,114	14,550	15,000	450	3.1%
Visual Interactive Environment for Weapon Simulation (VIEWS)	63,006	61,260	62,298	1,038	1.7%
Physical Infrastructure and Platforms	100,300	102,000	140,000	38,000	37.3%
Computational Systems	53,729	62,739	66,534	3,795	6.0%
Simulation Support	45,770	52,978	57,102	4,124	7.8%
Advanced Architectures	5,600	5,500	0	-5,500	-100.0%
University Partnerships	48,300	47,600	47,600	0	0.0%
ASCI Integration	6,677	7,351	7,750	399	5.4%
Construction	43,777	55,335	37,300	-18,035	-32.6%
Total, ASCI	703,833	724,862	750,626	25,764	3.6%

Detailed Program Justification

(dollars in thousands)

	FY 2002	FY 2003	FY 2004
Advanced Applications Development	**147,812**	**144,769**	**144,019**

Advanced Applications is develops enhanced 3D computer codes that provide an unprecedented level of physics and geometric fidelity for full-system, component, and scenario weapons simulations. These codes are run in direct support of the Stockpile Stewardship Program and will require the integration of all the elements of ASCI, particularly the materials and physics models currently being developed and the 30 teraOPS platform planned for full operation in FY 2003. In FY 2004, Advanced Applications will focus on the 3D codes capable of simulating the high-fidelity physics for primary performance and the coupled response of re-entry vehicle systems to abnormal Stockpile to Target Sequence (STS) environments. These increased capabilities are of use today in support of Directed Stockpile Work (DSW) and compliment the work currently underway in other campaigns.

Verification and Validation	**40,766**	**42,401**	**44,293**

Assesses models and simulation designs against experimental data to establish confidence in the simulation used for nuclear weapon certification and for resolving high consequence nuclear stockpile problems thus supporting stockpile stewardship. Activities include: quantifiable assessment of the accuracy of thermal response models in stockpile-to-target sequence abnormal environments; quantitative assessments of the physics models and simulation capability used to complete a simulation related to secondary capability; and quantifiable assessment of primary capability and nuclear safety of a complex abnormal environment.

Materials and Physics Modeling	**67,702**	**69,931**	**69,931**

Develop models for physics, material properties and transport processes which are essential to the simulation of weapons under all conditions relevant to their life cycle. As platforms are allowing simulations of higher resolutions, models are becoming more detailed, providing improved confidence in the simulations. In FY 2004, new models for material properties, high explosive detonation and transport will be incorporated into weapons codes for the high-fidelity, primary burn initial capability milestone.

Problem Solving Environment (PSE)	**41,489**	**42,148**	**42,198**

Develop a computational infrastructure to allow applications to execute efficiently on ASCI computing platforms and allow accessibility from the desktops of scientists. This computational infrastructure includes of local-area networks, wide-area networks, advanced storage facilities, and software development tools. In FY 2004, PSE will deliver a common and usable application development environment for ASCI computing platforms such as Q and Red Storm systems; an end-to-end, high-performance Input/Output and storage infrastructure; and a secure and appropriate access to ASCI supercomputers and other ASCI resources across the three weapons labs, so that ASCI compute platforms are fully usable for local code development and execution.

Distance Computing (DISCOM)	**28,791**	**16,300**	**16,601**

Secure computing at a distance is required in ASCI in order to enable any of the NNSA labs to gain access to any ASCI platform. This involves application development, debugging, milepost development and execution, DSW execution and visualization activities from remote sites. As a result this element is key to the successful completion of the FY 2004 ASC targets as it provides the secure, high bandwidth, high availability infrastructure (both hardware and software) required by the engineers and scientists.

PathForward	**10,114**	**14,550**	**15,000**

Stimulate development and engineering activities with U.S. computer industry in technology areas such as interconnect, runtime system, visualization, and storage, to advance commercial-off-the-shelf (COTS) technologies needed for future ASCI-class computer systems.

Visual Interactive Environment for Weapon Simulation (VIEWS)	**63,006**	**61,260**	**62,298**

Deliver leading-edge visualization and data management software and hardware to provide the "see and understand" capabilities needed to view, interact and analyze the terascale size data produced by ASCI simulations. VIEWS provides delivery of high-end graphics to offices, enabled by emerging technologies such as improved Liquid Crystal Display (LCD) monitors, video delivery over gigabit ethernet, PC-cluster-based scalable rendering, and software to exploit such technologies. VIEWS' support of both multi- and single-user visualization capabilities will play a pivotal role in application development, debugging and assessment in performance of the FY 2004 targets.

Physical Infrastructure and Platforms (PI&P)	**100,300**	**102,000**	**140,000**

Acquire the computational platforms to support the Stockpile Stewardship Program. The 30 teraOPS ASCI Q will be deployed in FY 2003 at LANL; the Red Storm system at Sandia will be completed in FY 2004; and the major 100 teraOPS ASCI Purple is scheduled for full delivery and installation at Lawrence Livermore Laboratory in FY 2005, with an early technology demonstration system in FY 2003 and the buildup of the system in FY 2004.

Computational Systems	**53,729**	**62,739**	**66,534**

This new MTE was previously part of Ongoing Computing. The Ongoing Computing MTE has been split into two MTE's: Simulation Support and Computational Systems. The primary reason for this split is for the programmatic visibility and understanding of driving factors and trends for ASCI computing center costs. This split is wholly contained by what was the Ongoing Computing program element. Computational Systems provide for the production computational and data storage systems and their networking infrastructure at the three NNSA laboratories. For all three laboratory centers, this includes the systems management personnel, maintenance contracts, and capital operating equipment for these systems. Efforts in FY 2004 will emphasize different phases of major platform deliveries in progress. It is expected that LANL will be providing tri-lab computational support on the Q machine. At Sandia, the Red Storm system will be in its delivery and integration phases, and at LLNL, emphasis in FY 2004, will be on the integration and early use of the initial delivery system for the Purple contract and preparation for the delivery of the full Purple system in FY 2005.

Simulation Support	**45,770**	**52,978**	**57,102**

This new MTE was previously part of Ongoing Computing. The Ongoing Computing MTE has been split into two MTE's: Simulation Support and Computational Systems. The primary reason for this split is for the programmatic visibility and understanding of driving factors and trends for ASCI computing center costs. Simulation Support provides support services for computing, data storage, networking, and their users. This includes facilities and operations of the computer centers, user help desk services, training, and software environment development that support the usability, accessibility and reliable operation of high-performance, institutional, and desktop computing resources at the three NNSA laboratories.

Advanced Architectures	**5,600**	**5,500**	**0**

Address the long-term platform risk issues of cost, power, performance and size by the study of alternative architectures that have the potential to make future ASCI platforms more cost effective. By working directly with high-end computing resource providers (both current and potential new participants), this element provides an opportunity for these providers to explore innovative and novel solutions addressing ASCI's aggressive computing requirements.

University Partnerships	**48,300**	**47,600**	**47,600**

Included are activities aimed at training, recruiting and collaborating with top researchers in key disciplines required by Stockpile Stewardship in order to help establish and validate large-scale, multi-disciplinary, modeling and simulation as a viable scientific approach. The operating of Computer Science Institutes at each of the NNSA laboratories, Graduate Fellowships and University Alliances are all part of this program element.

ASCI Integration	**6,677**	**7,351**	**7,750**

Support for Super Computing 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, meetings, outreach and crosscuts.

Subtotal, ASCI	**660,056**	**669,527**	**713,326**
Construction			
01-D-101, Distributed Information Systems Laboratory, (DISL) at Sandia National Laboratories in California	8,400	13,305	12,300
00-D-103, Terascale Simulation Facility (TSF) at Lawrence Livermore National Laboratory in California	22,000	35,030	25,000
00-D-107, Joint Computational Engineering Laboratory (JCEL) at Sandia National Laboratories in New Mexico	13,377	7,000	0
Total, ASCI	**703,833**	**724,862**	**750,626**

Explanation of Funding Changes

	FY 2004 vs. FY 2003 ($000)
ASCI	
• Higher computing maintenance costs are associated with all currently operating ASCI platforms including Red, Blue Pacific, Blue Mountain, and White Q. Increases related to maintenance are the result of the machines aging, end of existing support contracts and power rate changes (Computational Systems, +$3,795; Simulation Support, +4,124). The remaining increase is the result of planned workload levels for the ASCI program elements (Advanced Applications, -$750; Verification and Validation, +1,892; Materials Physics and Modeling, +$0; Problem Solving Environment, +$50; DISCOM, +$301; Pathforward +$450; VIEWS +$1,038; One Program-Three Labs, +$399)	11,299

- Planned hardware procurement profile (Physical Infrastructure & Platforms, +$38,000; Advanced Architectures, -$5,500). This increase allows ASCI to maintain the goal of delivering a 100 teraOPS platform in FY 2005 needed to support ongoing computing requirements, support Life Extension Program schedules and continue the development, production and validation of the ASCI 3D codes 32,500
- Supports the approved construction profiles for the Terascale Simulation Facility (TSF)(-$10,030), the Joint Computational Engineering Laboratory (JCEL) (-$7,000), and the Distributed Information Systems Laboratory (DISL) (-$1,005) . . . . -18,035

Total Funding Change, ASCI 25,764

Capital Operating Expenses and Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
General Plant Projects	5,832	6,007	6,187	180	3.00%
Capital Equipment	128,887	132,754	136,736	3,983	3.00%
Total, Capital Operating Expenses	134,719	138,761	142,923	4,163	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 2003 and FY 2004 funding shown reflects estimates based on actual FY 2002 obligations.

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

(Changes from FY 2003 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

- Updated to reflect progress to date and approved CD-2/3 baseline schedule milestones and budget.

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	38,100
FY 2003 Budget Request	1Q 2001	1Q 2002	3Q 2002	1Q 2004	36,300	38,008
FY 2004 Budget Request *(Performance Baseline)*	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	2,499
2003	13,305	13,305	17,792
2004	12,300	12,300	12,651
2005	0	0	1,439

[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 budget request.

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 the 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 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 71,516 gross square feet of space to house 126 employees and up to 50 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 National Nuclear Security Administration (NNSA) is responsible for the management of the Nuclear Weapons Complex (NWC). Changes in the military-political landscape, including the cessation of underground testing, reduced defense budgets, 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 SSP include:

- The Advanced Simulation and Computing (ASC) Campaign, 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 manufacture of nuclear weapons 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. 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 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 SNL 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 NNSA can meet its critical mission responsibilities related to the 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 that is adequate in it's current state to support the distributed information systems research and development activities required to meet NNSA programmatic goals.

Project Milestones:

FY 2004: Physical Construction Complete 1Q 2004

4. Details of Cost Estimate

(dollars in thousands)

	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design	1,684	1,683
Design Management (1.4% of TEC)	508	396
Contracted Professional Management Services (0.6% of TEC)	200	160
Project Management (o.6% of TEC)	229	195
Total Design Phase (7.22% of TEC)	2,2,621	2,434
Construction Phase		
Building Construction	17,400	16,727
Standard Equipment	1,574	1,574
Major Computer Items	8,630	8,630
Project Liaison, Checkout, and Acceptance	800	1,033
Contracted Professional Management Services (1.8% of TEC)	650	643
Project Management (2.0% of TEC)	750	774
Total Construction Phase (82% of TEC)	29,804	29,381
Contingency		
1.3.1 Design Phase	0	37
1.3.2 Construction Phase (10.7% of TEC)	3,875	4,448
1.3 Total Contingency (10.7% of TEC)	3,875	4,485
1 Total Estimated Costs (TEC)	36,300	36,300

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.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 2002	FY 2003	FY 2004	Outyears	Total
Facility Costs						
Design	1,919	700	0	0	0	2,621
Construction	0	1,795	17,792	12,651	1,439	33,679
Total, Line item TEC	1,919	2,499	17,792	12,651	1,439	36,300
Total Facility Costs (Federal and Non-Federal)	1,919	2,499	17,792	12,651	1,439	36,300
Other Project Costs						
Conceptual design costs	637	0	0	0	0	637
Other project-related costs [a]	626	0	12	251	182	1,071
Total, Other Project Costs	1,263	0	12	251	182	1,708
Total Project Cost (TPC)	3,182	2,499	17,804	12,902	1,621	38,008

7. Related Annual Funding Requirements

(FY 2004 dollars in thousands)

	Current Estimate	Previous Estimate
Annual facility operating costs [b]	290	290
Annual facility maintenance/repair costs [c]	80	80

[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, Independent Cost Estimate, Construction Project Data Sheet, Validation, Readiness Assessment, Start-up, Move-in, Program Management Support, Project Close-out, and Final Cost Report.

[b] 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.

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

[d] 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-DP Office of Advanced Simulation and Computing. Lesser amounts are expected from other DOE-DP Offices for activities that support their mission needs for engineering information management.

	(FY 2004 dollars in thousands)	
	Current Estimate	Previous Estimate
Programmatic operating expenses directly related to the facility [d]	30,000	30,000
Capital equipment not related to construction but related to the programmatic effort in the facility [a]	2,500	2,500
Utility costs	310	310
Total related annual funding (operating from FY 2004 through FY 2034)	33,180	33,180

[a] 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 2003 Congressional Budget Request 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)
	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 *(Title I Baseline)* ……….……..	1Q 2001	1Q 2002	3Q 2002	4Q 2006	92,117	95,317
FY 2004 Budget Request *(Performance Baseline)* ……	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	12,092
2003	35,030	35,030	39,343
2004	25,000	25,000	31,380
2005	3,228	3,228	3,230
2006	0	0	1,230

3. Project Descriptions, 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 milestones and objectives of the Advanced Simulation and Computing (ASC) Campaign (previously the Accelerated Strategic Computing Initiative). The building will encompass approximately 253,000 square feet and 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 ASC within the Stockpile Stewardship Program (SSP). The TSF will house 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.

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[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.

Justification

The Advanced Simulation and Computing (ASC) Campaign 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 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 ASC 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 (ASC 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 (ASC 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.

Office space vacated by the completion of TSF will be returned to the institution through Space & Site Planning for reassignment or demolition, depending on site-wide needs and the quality of available facilities at that time. Specific impacts of TSF vacancies occurring in FY04 to FY06 can not be directly identified at this time, but will be administered by this process and subject to reporting and oversight of the DOE/OAK NNSA Site Office.

Project Milestones

FY 2004:	Computer Area One Complete	3rd Quarter
FY 2005:	Office Tower Complete	3rd Quarter
FY 2006:	Computer Area Two Complete	3rd Quarter

4. Details of Cost Estimate

(dollars in thousands)

	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design Drawings and Specifications – $4,800)	5,640	5,450
Design Management Costs (0.9% of TEC)	810	703
Project Management Costs (0.5% of TEC)	504	610
Total Design Costs (7.5% of TEC)	6,954	6,763
Construction Phase		
Improvements to Land	1,510	1,510
Buildings	51,880	51,670
Utilities	9,630	9,280
Standard Equipment	0	0
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	4,516	4,100
Construction Management (5.6% of TEC)	5,175	5,320
Project Management (3.7% of TEC)	3,402	3,150
Total Construction Costs (82.6% of TEC)	76,113	75,030
Contingencies		
Design Phase (0% of TEC)	0	179
Construction Phase (9.8% of TEC).[a]	9,050	10,145
Total Contingencies (9.8% of TEC)	9,050	10,324
Total, Line Item Costs (TEC).[b]	92,117	92,117

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 DOE Construction Project and Operating Expense Escalation Rate Assumptions dated January 2001.

6. Schedule of Project Funding

	(dollars in thousands)					
	Prior Years	FY 2002	FY 2003	FY 2004	Outyears	Total
Project Cost						
Facility Costs						
Design	4,842	2,002	110	0	0	6,954
Construction	0	10,090	39,233	31,380	4,460	85,163
Total, Line item TEC	4,842	12,092	39,343	31,380	4,460	92,117
Total Facility Costs (Federal and Non-Federal)	4,842	12,092	39,343	31,380	4,460	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)	7,222	12,092	39,343	31,380	5,280	95,317

[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.

7. Related Annual Funding Requirements

(FY 2006 dollars in thousands)

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

8. Design and Construction of Federal Facilities

All DOE facilities are designed and constructed in accordance with applicable Public Laws, Executive Orders, OMB Circulars, Federal Property Management Regulations, and DOE Orders. The total estimated cost of the project includes the cost of measures necessary to assure compliance with Executive Order 12088, "Federal Compliance with Pollution Control Standards"; Section 19 of the Occupational Safety and Health Act of 1970, the provisions of Executive Order 12196, and the related Safety and Health provisions for Federal Employees (CFR Title 29, Chapter XVII, Part 1960); and the Architectural Barriers Act, Public Law 90-480, and implementing instructions in 41 CFR 101-19.6.

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[a] 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.

[b] 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.

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

Pit Manufacturing and Certification

Mission Supporting Goals and Measures

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 National Nuclear Security Administration (NNSA) is committed **to "accelerate preliminary design work on a modern pit manufacturing facility so that new production capacity can be brought on-line when needed," consistent with the Administration's Nuclear Posture Review (NPR).**

The abrupt closure of the Rocky Flats Plant in 1989 ended 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 Stockpile Evaluation 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 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 is scheduled to be fabricated by third quarter FY 2003 and followed by the fabrication of qualification and production pits. During the ensuing qualification period, certifiable pits will be manufactured at Los Alamos National Laboratory (LANL) for use in experiments to demonstrate equivalent performance with Rocky Flats produced pits. A minimum set of certification experiments to determine product acceptability has been identified.

As a means to effectively and efficiently organize, plan, execute, control, and assess the process and product, the W88 pit manufacturing and certification project has adopted a rigorous set of project controls. The project has developed a work package system as a formal process for identifying, costing and scheduling task-level project work to ensure that work is done at the right time and in proper sequence. The project is measured and analyzed using an earned value management system that relates actual performance to planned technical scope, cost, and schedule performance. All work is planned, budgeted and scheduled in time-phased "planned value" increments, constituting a cost and schedule baseline. An appropriate set of milestones and deliverables has been incorporated as drivers in the work packages, and a system of project controls procedures, including a well established procedure for baseline change, has been developed to guide project execution.

Subprogram Goal

Restore the capability and some limited capacity to manufacture pits of all types required by the nuclear weapons stockpile, to include planning the design and construction of a Modern Pit Facility (MPF) to support long-term pit manufacturing.

Performance Indicators

Number of W88 pits manufactured.

Completion of major milestones on/ahead of schedule toward a goal of FY 2007 W88 pit certification.
Completion of major milestones on/ahead of schedule toward FY 2009 restoration of capability. to manufacture the pit types in the enduring stockpile.
Completion of major milestones on/ahead of schedule toward completion of the Modern Pit Facility.

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Manufactured two (2) development pits to support manufacture of a certifiable pit in FY 2003.	Manufacture a development pit and the first certifiable pit.	Manufacture five W88 qualification pits.
Manufacturing and quality infrastructure for W88 pit were put into place.	Issue engineering release, documenting completion of the qualification plan.	Complete 25% of major milestones required for a goal of FY 2007 W88 pit certification, including conduct of the Unicorn test at the Nevada Test Site.
Completed three subcritical experiments and developed plans and designs in support of future experiments; revised project baseline to support FY 2007 certification.	Define and develop authorization basis documentation, and operations procedures in support of complex integrated experiments necessary for W88 pit certification.	Complete 20% of major milestones required for restoration of capability to manufacture the pit types in the enduring stockpile in FY 2009.
Completed hydride and pressure tests on individual pits.	Conduct integrated physics tests and scheduled pit engineering tests.	Complete 40% of the major milestones required for approval of MPF Critical Decision (CD)-1, Approve System Requirements and Alternatives, including issuance of a Record of Decision whether to proceed with the MPF and selection of a host site for the MPF (if applicable).
Modern Pit Facility Critical Decision (CD 0) (Mission Need) Approved.	Establish and implement a peer process that includes at least one technical data exchange between Los Alamos National Laboratory and Lawrence Livermore National Laboratory.	
Completed projectizing W88 pit manufacturing and certification - project is measured and analyzed using earned value management system to relate actual performance to planned technical scope, cost, and schedule.	Implement an integrated technology plan to support W87 and B61 Engineering Demonstration Unit (EDU) development.	
	Initiate Modern Pit Facility (MPF) conceptual design.	

Funding Schedule

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
W88 Pit Manufacturing	103,229	112,384	126,773	14,389	12.8%
W88 Pit Certification	86,789	78,000	108,592	30,592	39.2%
Pit Manufacturing Capability	5,577	2,000	19,700	17,700	885.0%
Modern Pit Facility	8,866	2,100	22,810	20,710	986.2%
Subtotal, Pit Manufacturing & Certification	204,461	194,484	277,875	83,391	42.9%
Pit Campaign Support Activities at NTS	44,500[a]	41,480[a]	42,353	873	2.1%
Total, Pit Manufacturing & Certification	248,961	235,964[b]	320,228	84,264	35.7%

[a]Reflects a comparability adjustment for the transfer of subcritical experiments which support the certification of the W88 pit from Directed Stockpile Work - Research and Development to the Pit Manufacturing and Certification Campaign in FY 2004.

[b]Pending the enactment of a final FY 2003 appropriation, this amount reflects the FY 2003 Request; it does not include a reprogramming of $5,000,000 from prior year funding, which was requested in FY 2002, but not approved until December 2002. If the FY 2003 appropriation provides the funding requested in FY 2003, a total of $240,964,000 will be available.

Detailed Program Justification

	(dollars in thousands)		
	FY 2002	FY 2003	FY 2004
W88 Pit Manufacturing	**103,229**	**112,384**	**126,773**

Following completion of the first certifiable W88 pit in FY 2003, at least five (5) certifiable W88 pits will be manufactured in FY 2004. The increase in funding reflects the procurement and installation of additional equipment to sustain the required manufacturing rate and improvements to the manufacturing and quality infrastructure to assure consistency of the manufactured product. The FY 2004 funding estimate is based on the project's detailed scope and work package. A long-term effort involving reorganization of activities and process lines as well as purchase and installation of new and/or redundant equipment will be necessary to support achievement of a sustained W88 manufacturing capacity (in FY 2007) of 10 pits/year.

W88 Pit Certification	**86,789**	**78,000**	**108,592**

To confirm nuclear performance of the W88 pit without underground nuclear testing, the W88 Pit Manufacturing and Certification Integrated Project Plan identifies the required engineering tests, physics experiments, dynamic experiments and integral experiments. The major focus of FY 2004 activities is preparation for integral experiments in FY 2005. The experiments have been re-baselined to support the acceleration of W88 pit certification from FY 2009 to FY 2007. Following passage of the FY 2003 appropriation, this schedule will be reviewed.

FY 2004 efforts will focus on the following activities to support pit certification. 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 LANL 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 Advanced Simulation and Computing simulation codes; and to help predict and confirm military performance. Preparations for two major integral tests will be finalized in FY 2004. The 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. The increase in FY 2004 funding reflects increased work scope on subcritical and dynamic experiments to prepare for additional integral dynamic tests which will quantify performance differences that may result from differences in manufacturing processes 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	**5,577**	**2,000**	**19,700**

Pit manufacturing and certification activities not specifically supporting the W88 are conducted in the third element of the campaign. These activities include: identifying and scheduling the reestablishment of key manufacturing technologies for the W87 and B61-7 pits that together with the W88, span technical variations of pits within the stockpile. This activity also provides technology development spinoff for the Modern Pit Facility. The increase of funding from FY 2003 supports the commencement of recapture and reinvigoration of existing pit manufacturing processes needed to support W87 and B61 Engineering Demonstration Units (EDU). This activity is linked via an integrated plan to ensure the processes and technologies used to support EDU manufacture also support development of those that will be used to manufacture W87 and B61 pits in a future Modern Pit Facility.

Modern Pit Facility	**8,866**	**2,100**	**22,810**

The limited manufacturing capacity being established at LANL 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. Following approval of mission need in May 2002, conceptual design began in early FY 2003 subsequent to congressional notification of conceptual design. The total estimated cost of conceptual design is $26.1 million over four fiscal years (FY 2003 - $2.1M; FY 2004 - $7.0M; FY 2005 - 12.0M; FY 2006 - $5.0M). NNSA is currently examining five candidate sites for location of the MPF. Public scoping meetings have been completed. A draft Environmental Impact Statement is expected to be issued by Summer, 2003. The FY 2004 budget request will allow for continuation of conceptual design and other planning activities, National Environmental Protection Act (NEPA) and technology development work on a schedule to support a CD-1 decision in FY 2006. The FY 2004 funding also supports a site selection decision for the Modern Pit Facility to be made in FY 2004.

Pit Campaign Support Activities at NTS	**44,500**	**41,480**	**42,353**

This includes technology and diagnostic development, procurement, and installation as well as subcritical experimental support for the pit campaign. The FY 2002 and FY 2003 funding levels reflect comparability adjustments for the transfer of subcritical experiments which support the certification of the W88 pit from the Directed Stockpile Work Research and Development account. The major activities in FY 2004 include experimental and logistical support for subcritical experiments in FY 2004 and important integral tests in FY 2005.

Total, Pit Manufacturing & Certification	**248,961**	**235,964**	**320,228**

Explanation of Funding Changes

	FY 2004 vs. FY 2003 ($000)
Pit Manufacturing & Certification	
# **W88 Pit Manufacturing**. The increase in funding reflects a large effort to support the manufacturing needs of pit certification – additional equipment will be procured and installed to sustain the required manufacturing rate, and improvements will be made to the manufacturing and quality infrastructure to assure consistency of the manufactured product. At least 5 certifiable W88 pits will be manufactured in FY 2004.	14,389
# **W88 Pit Certification**. The change reflects increased work scope on subcritical and dynamic experiments to prepare for integral experiments in FY 2005. The experiments have been re-baselined to support the acceleration of W88 pit certification from a goal of FY 2009 to FY 2007.	30,592
# **Pit Manufacturing Capability.** The increase supports the commencement of recapture and reinvigoration of existing pit manufacturing processes needed to support W87 and B61 Engineering Demonstration Units (EDU). This activity is linked via an integrated plan to ensure the processes and technologies used to support EDU manufacture will support development of those that will be used to manufacture W87 and B61 pits in a future Modern Pit Facility.	17,700
# **Modern Pit Facility**. The increase is required to support a CD-1 decision in FY 2006 and allow for continuation of National Environmental Policy Act (NEPA) and technology development work initiated in FY 2003. The FY 2004 funding also supports a site selection decision for the Modern Pit Facility to be made in FY 2004.	20,710
# **Pit Campaign Support Activities at NTS.** Continues subcritical experiments and integrated experiments. In FY 2004, funding responsibility for subcritical experiments which support the certification of the W88 pit was transferred from Directed Stockpile Work - Research and Development to the Pit Manufacturing and Certification Campaign.	873
Total Funding Change, Pit Manufacturing & Certification	**84,264**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses [c]

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
General Plant Projects	5,375	5,536	5,702	166	3.00%
Capital Equipment	13,514	13,919	14,337	418	3.00%
Total, Capital Operating Expenses	18,889	19,456	20,039	584	3.00%

[c] 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 2003 and FY 2004 funding shown reflects estimates based on actual FY2002 obligations.

Stockpile Readiness Campaign

Mission Supporting Goals

Within this campaign, NNSA is restoring at the Y-12 National Security Complex (Y-12) full production capability and revitalizing aging processes. 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, some critical manufacturing capabilities required for weapons refurbishments planned for FY 2006 and beyond do not exist at Y-12. It is imperative to revitalize Y-12's ability to meet these mission requirements.

The Stockpile Readiness Campaign is the primary vehicle for this revitalization and it is tasked with providing processing, machining, and inspection equipment required for the planned directed stockpile work (DSW). Because much of the Y-12 current capability is based on 20 to 40 year old technology, the Stockpile Readiness Campaign is charged with improving the overall basic manufacturing capability and appropriately deploying the much needed related technology developed by the Advanced Design and Production Technologies (ADAPT) Campaign and other technology Campaigns.

Through FY 2003, the Stockpile Readiness Campaign included responsibility for the Y-12 Modernization Program. This element of activity encompasses the site planning and management tasks that integrate activities across Directed Stockpile Work (DSW), Campaigns, and Readiness in Technical Base and Facilities (RTBF) to provide the needed facilities and infrastructure required for long-term mission accomplishment. The modernization program will be moved to and funded within the RTBF Operations of Facilities Subprogram, beginning in FY 2004, to better integrate funding priorities based on short-term and long-term mission and infrastructure needs.

Subprogram Goal

Technical capabilities and production capacities in place, by 2012, at the Y12 National Security Complex sufficient to support base Directed Stockpile Work requirements, programmatic nuclear upgrades, and base workload requirements.

Performance Indicators

Percentage of inspection and testing capability restored or upgraded
Percentage of radiography capability restored or upgraded
Percentage of machining capability restored or upgraded
Percentage of network and computing upgrades deployed
Percentage of assembly/ disassembly operations upgraded
Percentage of material preparation improvements implemented

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Restored 5% of inspection and testing capability	Restore an additional 10% of inspection and testing capability	Restore an additional 10% of inspection and testing capability for a total of 25% restored.
Restored/upgraded 10% of radiography capability	Restore/upgrade an additional 15% of radiography capability	Restore/upgrade an additional 15% of radiography capability for a total of 40% restored.
Deployed 5% of network and computing upgrades	Deploy an additional 10% of network and computing upgrades	Deploy an additional 10% of network and computing upgrades for a total of 25% deployed.
	Restore 5% of machining capability	Restore an additional 10% of machining capability for a total of 15% restored.
	Upgrade 10% of assembly/ disassembly operations	Upgrade an additional 10% of assembly/ disassembly operations for a total of 20% upgraded.
		Implement 10% of material preparation improvements.

Funding Schedule

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Evaluate Material Requirements & Specifications	500	280	849	569	203.2%
Capability Assurance	2,250	3,649	4,180	531	14.6%
Establish Near-Term Process Capability	20,368	31,937	48,506	16,569	51.9%
Implement Science & Model Based Manufacturing Information Systems	3,200	2,793	1,623	-1,170	-41.9%
Total, Stockpile Readiness	26,318	38,659	55,158	16,499	42.7%

Detailed Program Justification

	(dollars in thousands)		
	FY 2002	FY 2003	FY 2004
Evaluate Material Requirements and Specifications	**500**	**280**	**849**

This activity supports development of material inventory and characterization technologies, and storage optimization; develops processes for the disposition methods for excess weapons material; designs and implements material supply/demand forecasting tools for critical material; and implements key technologies needed to certify key materials. FY 2004 activities are exclusively focused on technologies to certify key materials.

Capability Assurance	**2,250**	**3,649**	**4,180**

This activity consists of tasks that would substantially improve the Y-12 capability 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 Campaign technology to a production-ready state. FY 2004 activities will focus on the continued support of near-term processes, such as plant laboratory and digital radiography upgrades, electronic data capture for weapon-build histories, and dimensional inspection technology implementation.

Establish Near-Term Process Capability	**20,368**	**31,937**	**48,506**

This activity is focused on restoring capability, capacity, reliability, and maintainability for equipment required to support maintenance of the enduring nuclear weapons stockpile. Significant action are required to restore or upgrade inspection and testing, radiography, assembly and disassembly, and machining capability as well as deployment of critical network and computing upgrades and material preparation improvements. These investments will be leveraged to achieve improvements in manufacturability and business processes while improving efficiency of operations, safety performance, and quality assurance. Specific activities include: machine and grinding tool acquisition and selected upgrades; inspection machine and radiographic capability acquisitions; new welding capability; upgrading casting operations; and equipment upgrades for metal preparation and assembly activities.

Implement Science & Model Based Manufacturing Information Systems	**3,200**	**2,793**	**1,623**

This element addresses five thrust areas: (1) model-based product realization, (2) science-based and intelligent manufacturing systems, (3) information systems, (4) computing and telecommunications, and (5) 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 capable of delivering superior products in less time and with reduced costs. FY 2004 activities will be focused on supporting models based product realization in support of DSW requirements.

Total, Stockpile Readiness	**26,318**	**38,659**	**55,158**

Explanation of Funding Changes

	FY 2004 vs. FY 2003 ($000)
Stockpile Readiness	
• **Evaluate Material Requirements and Specifications** - Activities will increase in FY 2004 in order to support development equipment needed to certify components.	569
• **Capability Assurance** - The increase in funding is primarily based on the initiation of thin client technology in the dimensional inspection facilities, which continues into FY 2005. . . .	•531

- **Establish Near-Term Process Capability** - The significant increase in funding is primarily for procuring and installing equipment to support the Life Extension Programs. Major items being procured include: Jig Borers, 9MeV Linac, Hyroforming machines, Machine Controllers, and coordinate measuring machines. The significant increase in funding from FY2003 to FY2004 is driven by the requirements to support multiple DSW requirements simultaneously 16,569
- **Implement Science & Model Based Manufacturing Information Systems** - Reduced level reflects efficiencies resulting from the deployment of Quality Assurance and Configuration Management systems in FY 2003 and early FY 2004. . . . . -1,170

Total Funding Change, Stockpile Readiness **16,499**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
General Plant Projects	-6,645	0	0	0	0.00%
Capital Equipment	24,524	25,260	26,018	758	3.00%
Total, Capital Operating Expenses	17,879	25,260	26,018	758	3.00%

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

	Total Estimated Cost (TEC)	FY 2002	FY 2003	FY 2004	Acceptance Date
JIG Borer #1	3,100	1,868	-768	2,000	FY 2004
Procure and install a high precision mill to replace an obsolete less efficient piece of equipment.					
JIG Borer #2	3,372	1,808	1,564	0	FY 2003
Procure and install a high precision mill to replace an obsolete less efficient piece of equipment.					
Disassembly Glovebox	11,384	7,900	3,484	0	FY 2003
Procure and install a glovebox to support a new production requirement.					

[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 2003 and FY 2004 funding shown reflects estimates based on actual FY 2002 obligations.

	Total Estimated Cost (TEC)	FY 2002	FY 2003	FY 2004	Acceptance Date
Coordinate Measuring Machine #1	2,400	0	2,400	0	FY 2003
Procure and install 2 CMMs to replace obsolete pieces of equipment that are no longer supported by the vendor.					
Coordinate Measuring Machine #2	2,400	0	2,400	0	FY 2003
Procure and install 2 CMMs to replace obsolete pieces of equipment that are no longer supported by the vendor.					
Metal Working Equipment	8,877	0	0	3,500	FY 2005
Procure and install new metal working equipment to meet production requirements.					
5-Axis Mill #1	2,338	0	0	2,338	FY 2004
Procure and install a high precision mill to meet production requirements.					
Hydroforming Unit	2,938	0	0	2,438	FY 2005
Purchase and install a hydroforming unit to meet production requirements.					
Plating Process Equipment	14,431	0	0	1,931	FY 2007
Purchase and install new plating process's to restore lost capability.					
Vacuum Annealing Equipment	2,094	0	0	1,094	FY 2005
Purchase and install vacuum annealing equipment to meet production requirements.					
Electron Beam Welder	9,400	0	2,400	4,000	FY 2005
Procure and install an electron beam welder to replace an inoperable piece of equipment.					
9 MeV Linac	4,500	0	0	2,500	FY 2005
Procure and install a 9 MeV Linac to support production radiography requirements.					
Low Energy X-Ray Machine	4,043	0	0	1,643	FY 2005
Procure and install a low energy X-ray machine to restore a radiography capability.					
Scanning Electron Microscope	7,100	0	1,100	2,000	FY 2005
Install a large chamber SEM in order support a new material specification.					
5-Axis Mill #2	2,180	0	0	2,180	FY 2004
Procure and install a high precision mill to meet a new production requirements.					
Total, MIEs	83,495	11,576	12,580	28,062	

High Explosives Manufacturing and Weapons Assembly/Disassembly Readiness

Mission Supporting Goals and Measures

The High Explosives Manufacturing and Weapons Assembly/Disassembly (HEMWAD) Readiness Campaign ensures that the Nuclear Weapons Complex has the capability and capacity to: (1) requalify nuclear assembly components; (2) manufacture and assemble high explosive components (both main charge and small energetic); and (3) assemble, disassemble, and perform surveillance on nuclear weapons, adequate to meet the needs of the nation's nuclear weapon stockpile and consistent with national goals and policies. This campaign is structured to address the capability, capacity, infrastructure, workforce, and facility issues that must be resolved to serve as the vehicle to implement the appropriate technologies demonstrated by other programs/campaigns. This campaign is also charged with appropriately deploying at Pantex the much needed technology developed by the Advanced Design and Production Technologies (ADAPT) Campaign and other technology Campaigns.

To achieve needed increases in production readiness, the Pantex Plant must modernize operations, making use of available 21st Century technologies. Because of the complexity and number of interactions, a significant amount of work must be planned and executed as a single integrated effort. The focus of this campaign is to ensure that high explosives production, component requalification, and assembly/disassembly operations are fully ready to support mission requirements. These mission activities will be executed using enhanced capabilities, and science-based design, engineering, and manufacturing techniques to achieve higher efficiency and impeccable quality at reduced cost.

The objectives of the campaign are to: (1) determine the current state of readiness for the associated manufacturing and production technologies, capabilities, capacities, facilities, and personnel, and (2) identify where existing or potential shortfalls exist in each of these areas for production scenarios over the foreseeable future. This campaign will then establish and manage a program of activities to correct those shortfalls to ensure these capabilities will be available to support production readiness and fully ready to support mission and workload requirements. Specifically, the campaign addresses the gaps that exist in these operations in support of the base workload; planned refurbishments; and future states of readiness.

Subprogram Goal

A high explosives production, component requalification, and assembly/disassembly capability to ensure a safe and reliable nuclear weapons stockpile with capacities to satisfy programmatic nuclear upgrade refurbishment schedules.

Performance Indicators

Number of milestones completed on/ahead of schedule

Number of new/upgraded capabilities and capacities provided/implemented to meet base workload and programmatic nuclear upgrade requirements

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Successfully synthesized high melting explosive (HMX), in 100-liter reactor. Completed support for the Critical Decision (CD)-0 for Building 12-64 Production Bays Upgrade. Completed the relocation of capabilities for the synthesis of HMX and the formulation of PBX 9501 to New Pilot Plant. Completed support for the Conceptual Design Report (CDR) for the Special Nuclear Materials Component Requalification Facility Successfully completed installation and received Quality Engineering Release (QER) for pit dimensional characterization capacity using Coordinate Measuring Machine (CMM). Successfully completed design and fabrication of the Integrated Pit Inspection Station and received the production system for installation.	Move to Building 11-050 from 12-019 and reestablishment of formulation with increased capacity is successful. Implement Integrated Pit Inspection Station in Building 12-116. Integrate campaign database and non-conformance data into Data Warehouse (production environment). Implement Interactive Electronic Procedures to support DSW activities. Receive Quality Engineering Release for ultrasonic imaging of enduring stockpile pit types.	Complete three major milestones (deliver as operational second high explosives pressing capability; deliver as operational pit characterization; and Authorize interactive electronic procedures for W76 disassembly). Provide four new/upgraded capabilities/capacities to meet base workload and programmatic nuclear upgrades requirements (deliver high explosive main charge pressing capability in Building 12-17; deliver pilot-scale synthesis capability of TATB explosive; deliver integrated pit inspection capability for surveillance pre-screening; and deliver process modeling capability for pit inspection).

Funding Schedule

	(dollars in thousands)				
	FY 2002	FY 2003	FY 2004	$ Change	% Change
High Explosives Manufacturing	1,364	6,458	12,603	6,145	95.2%
Product Requalification	1,843	2,451	8,626	6,175	251.9%
Science-Based Manufacturing[a]	3,481	3,184	8,420	5,236	164.4%
Total, High Explosives Manufacturing and Weapons Assembly/Disassembly Readiness	6,688	12,093	29,649	17,556	145.2%

Detailed Program Justification

	(dollars in thousands)		
	FY 2002	FY 2003	FY 2004
High Explosives Manufacturing	**1,364**	**6,458**	**12,603**

Includes activities that will establish the capability and capacity for synthesizing, formulating, pressing, machining, and analytical and performance testing of all NNSA explosives to meet rebuilds, Joint Test Assembly (JTA), and programmatic nuclear upgrades. These explosive materials also support activities such as development work at the Pantex Plant and the design laboratories, component rework, component replacement, and component aging studies. In FY 2004, funding will provide for the purchase of analytical equipment for low temperature degradation of high explosives, relocation/consolidation of outdoor firing sites, and purchase and installation of additional high explosive synthesis and formulation equipment.

[a] Prior to FY 2003, this Major Technical Effort (MTE) was funded under three MTE's: Enterprise Integration, Productivity Improvement and Collaborative Manufacturing.

Product Requalification	**1,843**	**2,451**	**8,626**

Includes activities that will deploy capability and capacity associated with enhancements and new technologies. Typically, these technologies are developed under the Advanced Design and Production Technologies (ADAPT) and Enhanced Surveillance Campaigns, and other NNSA programs; and are the ones that are required to support the requalification processes for pits, canned subassemblies (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, leak testing, and other technologies identified by the design laboratories for product requalification. Many of the technologies for requalification of pits and CSAs will also be applicable to the requalification of other weapon components. In FY 2004, funding will support the hiring and start of training of the technicians for pit reacceptance and recertification, and the deployment of new capabilities at the Integrated Pit Inspection Station.

Science-Based Manufacturing	**3,481**	**3,184**	**8,420**

Includes activities associated with the deployment of enhanced or new technologies, processes, business systems, scheduling and planning tools, models-based engineering and manufacturing tools, facilities, and infrastructure. Deployed activities will reduce cycle time from concept to product, replace inoperable systems, increase efficiency, improve quality, and/or establish a required capacity. In FY 2004, funding will support activities associated with the deployment of enhanced or new technologies to improve operations, reduce costs, and improve quality. Specifically, it includes completion of implementation of Interactive Electronic Procedures (IEPs) for all non-War Reserve and War Reserve base workload programs, procurement of additional touch screens for IEP deployment, replacement of servers, and continuation of activities to populate and bring online the classified Data Warehouse.

Total, High Explosives Manufacturing and Weapons Assembly/Disassembly Readiness	**6,688**	**12,093**	**29,649**

Explanation of Funding Changes

	FY 2004 vs. FY 2003 ($000)
High Explosive Manufacturing and Weapons Assembly/Disassembly Readiness	
• **High Explosives Manufacturing:** Reflects increase in support of the programmatic nuclear weapons upgrades and base workload. Funding will provide for the purchase of analytical equipment for low temperature degradation of high explosives, relocation/consolidation of outdoor firing sites, and purchase and installation of additional high explosive synthesis and formulation equipment.	6,145
• **Product Requalification:** Reflects increase in support of the programmatic nuclear weapons upgrades. Supports implementing processes that are required for reacceptance and recertification of W76 pits for the programmatic nuclear weapons upgrades Includes the hiring and start of training of the technicians for pit reacceptance and recertification, and the deployment of new capabilities at the Integrated Pit Inspection Station	6,175
• **Science-Based Manufacturing:** Reflects increase in support of the base workload and the programmatic nuclear weapons upgrades. Supports activities associated with the deployment of enhanced or new technologies to improve operations, reduce costs, and improve quality. Specifically, it includes completion of implementation of Interactive Electronic Procedures (IEPs) for all non-War Reserve and War Reserve base workload programs, procurement of additional touch screens for IEP deployment, replacement of servers, and continuation of activities to populate and bring online the classified Data Warehouse for production related data for making decisions about the future of the stockpile	5,236
Total Funding Change, High Explosive Manufacturing and Weapons Assembly/Disassembly Readiness	**17,556**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
General Plant Projects	0	0	0	0	0.0%
Capital Equipment	0	0	936	936	100.0%
Total, Capital Operating Expenses	0	0	936	936	100.0%

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

	Total Estimated Cost	Prior Year Approp-riations	FY 2002	FY 2003	FY 2004	Acceptance Date
Data Center UPS Upgrade	2,760	0	0	0	936	FY 2005

Install two UPS systems, each with the capability of carrying the total load of production systems within 12-37 & 12-37A. Upgrade the existing 50kw generator to a 350kw generator. During normal operations the power load is divided between the two UPS systems. When UPS maintenance is required the total load can be transferred to one UPS. Building maintenance requiring power interruptions can be performed without taking computer systems down. Computer equipment with dual power feeds will be fed from both UPS power and Utility power. The 350kw generator will feed each UPS. Dependence on the UPS will be limited to less than 10 minutes of battery power. When utility power is restored the transfer switch will transfer utility power back to the UPS and shut off the Generator.

[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 2003 and FY 2004 funding shown reflects estimates based on actual FY 2002 obligations.

Nonnuclear Readiness

Mission Supporting Goals and Measures

The Nonnuclear Readiness Campaign develops and deploys the product development and production capabilities required to support the nuclear weapon stockpile's nonnuclear product requirements. The campaign has three major functions: (1) eliminate gaps in product development and production capabilities required to perform the authorized base workload, (2) eliminate gaps in product development and production capabilities required to perform authorized refurbishments, (3) achieve operational readiness of product development and production capabilities to position the Nuclear Weapons Complex to meet anticipated and emergency stockpile requirements as defined by the Production Readiness Assessment.

This campaign addresses production readiness needs for reservoirs, detonators, neutron generators, and other nonnuclear components, and, in the future, some surveillance activities. It is charged with appropriately deploying much needed related technology developed by the Advanced Design and Production Technologies (ADAPT) Campaign and other technology campaigns. This campaign is essential to supporting DSW and is complementary to additional work being performed by the DSW and Readiness in Technical Base and Facilities (RTBF) Programs.

Subprogram Goal

A nonnuclear components production and qualification capability to ensure a safe and reliable nuclear stockpile, supporting DSW in the near- and mid-term and attainment of readiness to deliver weapon components to the stockpile in the long-term.

Performance Indicators

Number of specific deliverables rebuilt, replaced, or new special equipment or product testers provided, e.g. neutron tube/neutron generator by Sandia National Laboratories (SNL) and Arming, Fuzing, and Firing by Kansas City Plant (KCP) deployed to DSW
Percentage of commercial off-the-shelf electronic component capability developed (by KCP)
Percentage of increased detonator production capability and capacity deployed to DSW [by Los Alamos National Laboratory (LANL)]
Percentage of increased neutron tube target loading capability and capacity deployed to DSW (by LANL)
Percentage of new production equipment developed and deployed to DSW
Percentage of 20 machine tool upgrades completed (KCP)
Number of site-specific deliverables in support of overall campaign requirements completed on/ahead of schedule.

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Developed and piloted initial commercial off-the-shelf (COTS) quality components process for W76-1 development parts. Submitted Critical Decision (CD)-1 & 2 for the High Power Detonator Facility. Identified suppliers for the miniature connectors, Lightning Arrestor Connectors (LACs) shells, cables, castings, and forgings to support W76 Arming, Fuzing and Firing. Achieved operability of AF&F tester for the W76. Developed and piloted the characterization of commercial electronic components for the W76-1. Qualified PT 3701 Active Ceramics Tester. Qualified two neutron tube testers: SE 3294 Conditioner and PT 3162 Acceptance Tester.	Complete analysis plan to evaluate conformance of newly supplied miniature connectors, LAC shells, cables, castings, and forgings to support W76 Arming, Fuzing and Firing (AF&F) requirements. Submit CD-3 for the High Power Detonator Facility. Characterize Laser weld and pick-and-place equipment and processes to support W80 production and release to production. Deploy operational environmental testing capabilities for W76 and W80. Upgrade PT3662 and SE3294 Tube Testers. Deploy qualified PT3690 and PT3696 Current Stack Testers. Deploy qualified PT3700 Explosive Ferroelectric (FE) Neutron Generator Tester. Deploy engineered materials supply chain assurance - confirm material supply for B61. Support B61-7/11, W80, and W76 LEPs through deployment of commercial components methodologies for War Reserve applications; deploying and characterizing modern gas transfer systems; and applying science-based manufacturing techniques.	Provide an additional eight deliverables (SNL 5 and KCP 3) increasing the total to 19 of 44 (SNL 14 of 24 and KCP 5 of 20). KCP: Develop 50% (Final Process) of commercial off-the-shelf electronic component capability. LANL: Deploy 100%--High Power Detonator Facility General Plant Project (GPP) Expansion--Los Alamos (Critical Decision 4) SNL: Deploy 80% of 1E38 Detonator (W88) Production Capability to Directed Stockpile Work (DSW) . LANL: Deploy 50% of increased neutron tube target loading capability/capacity; complete relocations and requalification of War Reserve (WR) target loader. KCP: Deploy 75% W80 Acorn gas transfer process; Characterize the Inertia Weld Process. Complete 55% of machine tool upgrades. Complete three (3) site-specific deliverables in support of overall campaign requirements, on/ahead of schedule.

Funding Schedule

	(dollars in thousands)				
	FY 2002	FY 2003	FY 2004	$ Change	% Change
Readiness of Supply Chain	2,344	5,010	4,407	-603	-12.0%
Readiness of Production Technology	0	2,452	6,870	4,418	180.2%
Readiness of Production Operations	613,584	12,080	22,212	10,132	83.9%
Readiness of Product and Process Quality	1,840	2,856	3,908	1,052	36.8%
Total, Nonnuclear Readiness	17,768	22,398	37,397	14,999	67.0%

Detailed Program Justification

	(dollars in thousands)		
	FY 2002	FY 2003	FY 2004
Readiness of Supply Chain	**2,344**	**5,010**	**4,407**

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

Readiness of Production Technology	**0**	**2,452**	**6,870**

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 electronic component miniaturization, detonator process deployment, and microsystems deployment. FY 2004 funding will support the procurement of equipment to produce mixed-mode electronic assemblies to support W76 development flight tests and equipment to characterize components for use in miniature surety mechanisms.

Readiness of Production Operations	**13,584**	**12,080**	**22,212**

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 infrared 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 replacing moribund product-acceptance testing capability, implementing required reservoir production capabilities, preparing W76 production processes, preparing W80 production processes, implementing new B61 paint cure methods, and replacement of analytical and metrology equipment required to support DSW. FY 2004 funding will support the purchase of several pieces of analytical and measurement equipment to support materials engineering and environmental testing related to W76 and W80 component and process development. Also includes the replacement of test equipment required to accept new production products in support of DSW

Readiness of Product and Process Quality	**1,840**	**2,856**	**3,908**

Readiness of product and process quality includes understanding, characterizing, and simulating products and processes to manufacture and accept products based on scientific criteria. Activities mitigate the risks to the final product resulting from new processes, process variability, cycle time, and waste. Specific tasks include process characterization and virtual prototyping, detonator production capability, and in-process neutron tube diagnostics for quality assurance. FY 2004 funding will support the implementation of as-built/design model archiving and transfer capabilities, and automated feature-based manufacturing development, manufacturing, and inspection for production of W76 and W80 components.

Total, Nonnuclear Readiness	**17,768**	**22,398**	**37,397**

Explanation of Funding Changes

	FY 2004 vs. FY 2003 ($000)
Nonnuclear Readiness	
• **Readiness of Supply Chain -** Reduction from FY 2003 level reflects completion of activities to develop commercial suppliers for W76 engineered materials.	-603

- **Readiness of Production Technology -** Reflects increase in activity related to procurement of equipment to produce mixed-mode electronic assemblies to support W76 development flight tests and equipment to characterize components for use in miniature surety mechanisms 4,418
- **Readiness of Production Operations -** Increase reflects the purchase of several pieces of analytical and measurement equipment to support materials engineering and environmental testing related to W76 and W80 component and process development. Also includes the replacement of test equipment required to accept new production products in support of DSW. 10,132
- **Readiness of Product and Process Quality -** Increase reflects implementation of as-built/design model archiving and transfer capabilities, and automated feature-based manufacturing development, manufacturing, and inspection for production of W76 and W80 components. 1,052

Total Funding Change, Nonnuclear Readiness 14,999

Capital Operating Expenses and Construction Summary

Capital Operating Expenses [a]

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
General Plant Projects	2,970	3,059	3,151	92	3.00%
Capital Equipment	7,974	8,213	8,460	246	3.00%
Total, Capital Operating Expenses	10,944	11,272	11,610	338	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 2003 and FY 2004 funding shown reflects estimates based on actual FY 2002 obligations.

Tritium Readiness

Mission Supporting Goals and Measures

Several seminal events have occurred in the past 2 years that have impacts on the Tritium Readiness Campaign. The Department of Defense developed its Nuclear Posture Review and strategies for its implementation which affect the timing and quantity of tritium production requirements. In addition, the Treaty of Moscow was signed. These changes in plans reduce the amount of tritium needed by the nuclear weapons stockpile in the outyears beyond 2012. The Tritium Readiness Program is in the process of requesting approval from the Nuclear Weapons Council to readjust tritium production plans to reflect these changes. In anticipation of approval of these readjustments, NNSA is now planning a reduction in tritium production by delaying sustained tritium production-level quantities of irradiation services from commercial reactors operated by the Tennessee Valley Authority (TVA). NNSA will still exercise all elements of its system for producing, extracting, and purifying new tritium, including initial operation of the Tritium Extraction Facility (TEF) being constructed at the Savannah River Site (SRS).

Timing of tritium production, extraction, and purification has also been delayed by approximately 17 months due to delays in completion of the TEF project. This program delay can be accommodated without impacting nuclear weapons readiness. A revised baseline has been approved increasing the Total Project Cost (TPC) from $401 million to $506 million and delaying project completion from mid FY 2006 to late FY 2007.

Since tritium decays by natural radioactivity at a rate of about 5 percent per year, and since irradiation service costs are the dominant operating cost in supplying tritium to the stockpile, it is prudent not to produce tritium beyond the stated national requirements. Since the program intends to complete and exercise all elements of the tritium production and purification system, including TVA's reactor(s) and the TEF, on a schedule that fully protects the stockpile requirements, irradiation services will be deferred in order to use funds planned for these activities to complete TEF.

The Tritium Readiness Campaign implements the Secretarial Record of Decision of May 1999, which selected the Commercial Light Water Reactor (CLWR) option as the primary technology for the production of tritium. The campaign consists of three major technical elements in FY 2004: (1) the CLWR Development Project, (2) the CLWR Tritium Production Program, and (3) the Tritium Extraction Facility (TEF) Construction Project (98-D-125). Closeout activities were initiated on APT (formerly the backup technology) in FY 2002 using prior year balances and reprogrammed funds.

Subprogram Goal

By FY 2007, an established a capability to provide a sufficient and reliable source of tritium to meet planned nuclear weapons' requirements.

Performance Indicators

Irradiation of tritium rods in commercial reactors
Commercial transport capability to move irradiated rods
Tritium extraction capability

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Targets	FY 2004 Targets
Submitted final report of laboratory examinations of tritium-producing rods that had been irradiated in TVA's Watts Bar reactor for a full 18-month operating cycle to the Congress. Nuclear Regulatory Commission issues amendments to the operating licenses of TVA's Watts Bar and Sequoyah reactors to permit tritium production. Awarded a contract for long-term services to transport irradiated, radioactive tritium-producing rods from reactor sites to the Tritium Extraction Facility. Started assembly of tritium-producing rod components at WesDyne International. Initiated APT closeout activities using prior year balances and reprogrammed funds.	Deliver tritium-producing rods to the Tennessee Valley Authority's (TVA's) Watts Bar Reactor site 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.	Begin production of tritium by irradiating rods in the Tennessee Valley Authority's (TVA's) Watts Bar reactor. Initiate and transfer development of selected rod fabrication capability to the Kansas City Plant. Decide, with the DoD and Nuclear Weapons Council, future tritium requirements and schedule the TVA irradiation services accordingly.

Funding Schedule

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Commercial Light Water Reactor Development Program	40,584	42,734	42,293	-441	-1.0%
CLWR Tritium Production Program	0	13,400	17,600	4,200	31.3%
Accelerator Production of Tritium (APT)	4,933 [a]	0 [b]	0	0	N/A
98-D-125, Tritium Extraction Facility, Savannah River Site	81,125	70,165 [c]	75,000	4,835	6.9%
98-D-126, Accelerator Production of Tritium, various locations	5,847 [a]	0	0	0	N/A
Total, Tritium Readiness	132,489	126,299	134,893	8,594	6.8%

Detailed Program Justification

(dollars in thousands)

	FY 2002	FY 2003	FY 2004
Commercial Light Water Reactor Development Program . .	**40,584**	**42,734**	**42,293**

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. For FY 2004, the program will continue fabrication of the first batch of tritium producing rods, preparation of transportation capabilities, and technical support activities.

[a] Reflects FY 2002 reprogramming for APT closeout activities of $10,780,000 ($4,933,000 in O&M and $5,847,000 in construction).

[b] After enactment of the FY 2003 appropriation, $5,335,000 requested in 02-D-103, Project Engineering and Design, will be proposed as part of a reprogramming action for reallocation to the Tritium Readiness Campaign for APT closeout activities.

[c] Pending the enactment of a final FY 2003 appropriation, this amount reflects the FY 2003 Congressional Budget Request; it does not include a reprogramming of $ 10,000,000 from prior year funding, which was requested in FY 2002, but not approved until December 2002. If the FY 2003 appropriation provides the funding requested in FY 2003, a total of $80,165,000 will be available. An additional $10,000,000 will need to be reprogrammed into Project 98-D-125, Tritium Extraction Facility bringing the total for FY 2003 to $90,165,000.

CLWR Tritium Production Program	**0**	**13,400**	**17,600**

Tritium production will begin in the first quarter coincident with scheduled refueling outages of TVA's Watts Bar reactor when tritium-producing rods are inserted in the reactor. TVA will be reimbursed for irradiation services in accordance with an interagency agreement concluded in FY 2000.

Accelerator Production of Tritium (APT)	**4,933**	**0**	**0**

Closeout activities were initiated in FY 2002 using prior year and reprogrammed funding.

Construction			
Project 98-D-125, Tritium Extraction Facility, Savannah River Site	**81,125**	**70,165**	**75,000**
Project 98-D-126, Accelerator Production of Tritium, various locations.	**5,847**	**0**	**0**
Total, Tritium Readiness	**132,489**	**126,299**	**134,893**

Explanation of Funding Changes

	FY 2004 vs. FY 2003 ($000)
Tritium Readiness	
• **CLWR Development Program**: The decrease in FY 2004 funding is consistent with anticipated changes in stockpile requirements. The development program will have completed many of its activities by FY 2004 and be well into the transition to operating the CLWR Tritium Production System. Development of tritium-producing rod technologies will be complete. Extraction process development will be complete. FY 2004 funding will be used to prepare irradiation in the Sequoyah Unit 1 reactor, preparation for transportation operations, and technical support	-441
• **CLWR Tritium Production Program**: The increase in FY 2004 supports a ramp up in operation of the tritium production system toward a steady-state rate. In FY 2003, funds were primarily to pay for incremental increases in reactor fuel enrichment costs for the Watts Bar reactor. In FY 2004 these funds will cover actual irradiation costs in the reactor	+4,200
• **TEF Construction Project**: The increase in FY 2004 funding is consistent with the baseline goals. It is consistent with the new baseline for the project and will enable it to meet its end-point milestones as scheduled	+4,835
Total Funding Change, Tritium Readiness	**+8,594**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses[a]

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
General Plant Projects	0	0	0	0	N/A
Capital Equipment	0	0	0	0	N/A
Total, Capital Operating Expenses	0	0	0	0	N/A

[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 2003 and FY 2004 funding shown reflects estimates based on actual FY2002 obligations.

98-D-125, Tritium Extraction Facility, Savannah River Site Aiken, South Carolina

(Changes from FY 2003 Congressional Budget Request are denoted with a vertical line [⁞] in the left margin.)

Significant Changes

The Tritium Extraction Facility was rebaselined in 2Q FY 2003 after the completion of Title II design. The Total Project Cost (TPC) has increased. This increase includes the addition of E-Area vault and seismic monitor scope, higher than planned costs for Title II design engineering, engineered equipment, Civil/Structural and Rest of Plant construction, as well as increases in detailed startup activity estimates. The project construction and startup strategy has changed as a result of these impacts and the overall project schedule has been extended by 17 months.

The estimate increase and schedule extension are due to the scope additions, problems encountered with extraction furnace development, higher than expected construction bids for the Rest of Plant (resulting in the need to change project construction strategy), and delays in completing the Civil/Structural construction. Contributing factors included increased design, equipment and support costs due to first of a kind facility, delays in receiving FY 2002 project funding and increased security requirements due to the September 11 event.

A reprogramming action that transferred $10,000,000 into this project was initiated in FY 2002, but was not approved until December 2002. This funding will be used in FY 2003 to expedite the procurement of long-lead equipment.

The current plan is to reprogram an additional $10,000,000 into this project in FY 2003 upon enactment of the final FY 2003 appropriation. The additional funds in FY 2003 will be used to continue the expedited procurement of long lead equipment and minimize any further schedule delays in accordance with the revised strategy for completion of this construction effort. The procurements remain a critical aspect in maintaining the TEF completion schedule and will minimize any overall future schedule impacts.

1. Construction Schedule History

	Fiscal Quarter				Total	Total
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete	Estimated Cost ($000)	Project Cost ($000)
FY 1998 Budget Request *(Preliminary*	1Q 1998	4Q 2002	1Q 1999	3Q 2005	TBD [a]	TBD
FY 2000 Budget Request	1Q 1998	3Q 2001	1Q 2000	4Q 2004	285,650	390,650
FY 2001 Budget Request *(Revised Baseline Estimate)*	1Q 1998	3Q 2001	1Q 2000	4Q 2004	323,000	401,000
FY 2002 Budget Request	1Q 1998	3Q 2001	1Q 2000	4Q 2004	323,000	401,000
FY 2003 Budget Request	1Q 1998	3Q 2001	1Q 2000	4Q 2004	323,000	401,000
FY 2004 Budget Request *(Performance Baseline)*	1Q 1998	3Q 2001	1Q 2000	4Q 2007	408,065	506,439

[a] Consistent with OMB Circular A-11, Part 3, full funding was requested for only preliminary and final design of the CLWR TEF in FY 1998.

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
1998	9,650	9,650	6,911
1999	6,000	6,000	5,889
2000	32,875 [a]	32,875	32,003
2001	74,835 [b]	74,835	56,618
2002	81,125	81,125	74,392
2003 (Request)	70,165	70,165	83,948
2003 (Planned)	20,000 [c] [d]	20,000	20,000
2004	75,000	75,000	77,800
2005	31,000	31,000	41,600
2006	7,415	7,415	7,700
2007	0	0	1,204

3. Project Description, Justification and Scope

Tritium is a radioactive isotope of hydrogen used in all of the Nation's nuclear weapons. Without tritium, nuclear weapons will not work as designed. At present, no tritium is produced by the U.S. for the nuclear weapons stockpile. Radioactive decay depletes the available tritium by approximately 5.5% each year. In order for these weapons to operate as designed, tritium must be periodically replaced. Although tritium has not been produced by the U.S. for the stockpile since the shutdown of the last production reactor in 1988, tritium requirements have been met through reuse of tritium recovered from dismantled weapons. In order to maintain the Strategic Arms Reduction Treaties (START) I force structure and five-year reserve approved by the President in the 1996 Nuclear Weapons Stockpile Memorandum, a new production capability should come on

[a] Original appropriation was $33,000,000. This was reduced by $125,000 for the FY 2000 rescission enacted by P.L. 106-113.

[b] Original appropriation was $75,000,000. This was reduced by $165,000 for a rescission enacted by Section 1403 of the FY 2001 Consolidated Appropriations Act.

[c] Pending the enactment of a final FY 2003 appropriation, this amount reflects the FY 2003 Congressional Budget Request; it does not include a reprogramming of $10,000,000 from prior year funding, which was requested in FY 2002, but not approved until December 2002. If the FY 2003 appropriation provides the funding requested in FY 2003, a total of $80,165,000 will be available.

[d] The current plan is to reprogram an additional $10,000,000 into this project in FY 2003 at the conclusion of the current FY 2003 continuing resolution. These additional funds in FY 2003 will be used to continue the expedited procurement of long lead equipment and minimize any further schedule delays in accordance with the revised stratergy for completion of this construction effort. The procurements remain a critical aspect in maintaining the TEF completion schedule and will minimize any overall future schedule impacts. If approved, a total of $90,165,000 will be available in FY 2003.

line approximately 2007. To meet this date, site preparation and construction of the Tritium Extraction Facility (TEF) began in FY 2000. As part of the dual track production strategy, stated in the Record of Decision for the Tritium Supply and Recycling Final Programmatic Environmental Impact Statement, issued on December 5, 1995, the Commercial Light Water Rector (CLWR) Tritium Extraction Facility shall be constructed at the Savannah River Site. The CLWR TEF shall provide the capability to receive and extract gases containing tritium from CLWR Tritium Producing Burnable Absorber Rods (TPBAR), or other targets of similar design. The TEF will provide shielded remote TPBAR handling for the extraction process, clean-up systems to reduce environmental impact from normal processing and accidental releases, and delivery of extracted gases containing tritium to the Tritium Recycle Facility for further processing.

The facility includes two major buildings: (1) a 152,500 (Approx) square foot Remote Handling Building (RHB) and (2) a 26,500 (approx) square foot Tritium Processing Building (TPB). The TPB will be built above ground, while the RHB will be partially below ground. Major processes and operations systems included within the TEF will be: (1) the Receiving, Handling, and Storage System that will support all functions related to the receipt, handling, preparation, and storage of incoming TPBAR and outgoing radioactive waste materials; (2) the Tritium Extraction System that will perform initial cleanup of extracted gasses; (3) the Tritium Process Systems that will separate process gases from the irradiated TPBARs; (4) the Tritium Analysis and Accountability Systems that will support monitoring and tritium accountability; (5) the Solid Waste Management System that will receive solid waste generated by TEF for management and storage prior to disposal in the E-Area vaults, which will be upgraded by TEF to accomidate that disposal; and (6) the Heating, Ventilation, and Air Conditioning System that would provide and distribute conditioned supply air to the underground RHA and the above ground tritium processing area and also discharge exhaust air to the environment via a 100-foot stack.

The TEF will provide steady-state production capability to the Replacement Tritium Recycle Facility (Building 233-H) of as much as 3Kg of tritium per year, if needed. Final purification of gases containing tritium shall be performed in the augmented process equipment located in the Tritium Replacement Facility.

The TEF shall have an operational life span of at least 40 years, minimize radiological and chemical releases to the environment; and minimize waste generation. The security requirements shall be such that TEF is designated as an exclusion area.

Project Milestones

As baselined, the operation of TEF will be dependent on the completion and operation of the Tritium Modernization and Consolidation Project. With this project being completed during 4th Quarter FY 2007, the final tritium systems will be available for processing extraction gases to ensure weapons stockpile requirements will be met in CY 2007.

FY 1998: Initiation of Preliminary Design (Complete)
Completion of Preliminary Design (Complete)
FY 1999: Critical Decision (CD) 2B Approval to Begin Final Design (Complete)
Initiation of Final Design (Complete)
CD-3 - Approval to Begin Construction (Complete)

FY 2000:	Initiation of Site Preparation (Complete)
FY 2001:	Completion of Final Design (Complete)
	Completion of Site Preparation (Complete)
	Initiation of Facility Construction (Complete)
FY 2007:	Completion of Facility Construction
	Initiation of Integrated System Testing with Tritium
	Project Completion
	CD-4 - Start of Facility Operation

4. Details of Cost Estimate

	(dollars in thousands)	
	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design Costs (Design Drawings, Specifications and Construction Support)	62,268	58,741
Design Management Costs (0.4% of TEC)	1,649	3,092
Project Management Costs (1.4% of TEC)	5,872	4,404
Total, Design Costs (17.1% of TEC)	69,789	66,237
Construction Phase		
Improvements to Land	6,801	4,719
Buildings	124,083	61,329
Special Equipment	85,178	75,377
Standard Equipment	8,403	24,043
Major Computer Items	7,630	3,496
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	26,173	22,291
Construction Management (3.5% of TEC)	14,307	8,024
Project Management (4.3% of TEC)	17,619	7,515
Total, Construction Costs (71.1% of TEC)	290,194	206,794
Contingencies		
Design Phase (0% of TEC)	0	20,000
Construction Phase (11.8% of TEC)	48,082	29,969
Total, Contingencies (11.8% of TEC)	48,082	49,969
Total, Line Item Costs (TEC) [a]	408,065	323,000

5. Method of Performance

The Savannah River Site M&O Contractor, Westinghouse Savannah River Company (WSRC) will be responsible for the design, construction, inspection and commissioning of the TEF to be built at the Savannah River Site. All conceptual, preliminary, and detail design work has been completed by site forces. Site preparation has been completed, and construction of the civil/structural portion of the project is in progress via fixed price construction contract. Remainder of plant construction is planned to begin in FY 2003 by Savannah River Site M&O contractor, with a portion of the work awarded to fixed price subcontractors. Construction turnover of components to startup testing will begin in FY 2003. Final startup testing with radioactive gases will be performed by site forces beginning in FY 2007.

[a] General and administrative current overhead rates were applied. Changes due to project rebaselining in accordance with the Final Design Estimate.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 2002	FY 2003	FY 2004	Outyears	Total
Project Cost						
Facility Cost						
Design [a]	83,125	49,386	37,553	6,961	5,339	182,364
Construction	18,297	25,006	66,394	70,839	45,165	225,701
Total, Line item TEC	101,422	74,392	103,947	77,800	50,504	408,065
Total Facility Costs (Federal and Non-Federal)	101,422	74,392	103,947	77,800	50,504	408,065
Other Project Costs						
Conceptual design cost	3,541	0	0	0	0	3,541
NEPA documentation costs	1,858	0	0	0	0	1,858
Other project costs	9,636	1,527	5,474	16,500	59,838	92,975
Total, Other Project Costs	15,035	1,527	5,474	16,500	59,838	98,374
Total, Project Cost (TPC) [b]	116,457	75,919	109,421	94,300	110,342	506,439

7. Related Annual Funding Requirements

(dollars in thousands)

	Current Estimate [c]	Previous Estimate
Annual facility operating costs	1,750	1,550
Annual facility maintenance/repair costs	2,800	2,500
Programmatic operating expenses directly related to the facility	7,600	6,800
Capital equipment not related to construction but related to the programmatic effort in the facility	800	700
GPP or other construction related to the programmatic effort in the facility	450	400
Utility costs	1,050	950
Total related annual funding (operating from FY 2006 through FY 2045)	14,450	12,900

[a] Design includes cost of engineered equipment.

[b] Changes due to re-baselining to final design estimate.

[c] Previous estimate is in FY 1998 dollars and the current estimate is escalated to FY 2002 dollars.