Naval Reactors

Proposed Appropriation Language

For Department of Energy expenses necessary for naval reactors activities to carry out the Department of Energy Organization Act (42 U.S.C. 7101 et seq.), including the acquisition (by purchase, condemnation, construction, or otherwise) of real property, plant, and capital equipment, facilities, and facility expansion; and the purchase of not to exceed one bus; $768,400,000, to remain available until expended.

Note.—A regular 2003 appropriation for this account had not been enacted at the time the budget was prepared; therefore, this account is operating under a continuing resolution (P.L. 107–229, as amended). The amounts included for 2003 in this budget reflect the Administration's 2003 policy proposals.

Explanation of Change

Changes from the FY 2003 proposed language consist of addition of purchase authority for one bus and a change to the proposed funding amount.

Naval Reactors
Program Mission

Naval Reactors is responsible for all naval nuclear propulsion work, beginning with technology development, and continuing through reactor operation and, ultimately, reactor plant disposal. The Program ensures the safe operation of reactor plants in operating nuclear-powered submarines and aircraft carriers (constituting 40 percent of the Navy's combatants), and fulfills the Navy's requirements for new nuclear propulsion plants that meet current and future national defense requirements.

Naval Reactors is principally a technology program in the business of power generation for military application. The Program's development work ensures that nuclear propulsion technology provides options for maintaining and upgrading current capabilities, as well as for meeting future threats to U.S. security. Work is integrated as advances in various functional disciplines coalesce into the technology applicable to a naval nuclear plant. The presence of radiation dictates a careful, measured approach to developing and verifying nuclear technology, designing needed components, systems, and processes, and implementing them into existing and future plant designs. Intricate engineering challenges and long lead times to fabricate the massive, complex components require many years of effort before technological advances can be introduced into the Fleet.

The Program's number-one priority is ensuring the safety and reliability of the 103 operating Naval reactor plants. Most of the work within the Naval Reactors Program is directed toward ensuring the safe, reliable operation of these plants. Naval Reactors is also continuing shipboard acceptance testing on the next-generation reactor for the Navy's new VIRGINIA-class attack submarines, development of a high energy reactor for the Navy's new CVNX-class aircraft carrier, and design of a new Transformational Technology Core (TTC). For submarines, nuclear propulsion provides stealth, mobility, and uncertainty in the mind of a potential adversary; for aircraft carriers, nuclear propulsion provides sustainability, mobility, and increased armament capability.

Nuclear power enhances warship capability and creates the flexibility needed to sprint anywhere in the world and arrive ready for around-the-clock power projection and combat operations. Sustained high-speed capability (without dependence on a slow logistics train) enables rapid response to changing world circumstances, allowing operational commanders to surge these ships from the United States to trouble spots or to rapidly redeploy them from one crisis area to another. Nuclear propulsion helps the Navy stretch available assets to meet today's worldwide national security commitments.

When the Navy's new VIRGINIA-class attack submarine is delivered in FY04, it will provide advanced capabilities needed for the 21st century fleet at an affordable price. The reactor plant uses advanced component and system technology—including the first core specifically designed to operate without refuelings throughout the life of the ship. The VIRGINIA-class also has a simplified plant arrangement with fewer components than previous designs, which reduces construction costs and overall maintenance costs.

The nuclear propulsion plant design of the new CVNX-class aircraft carrier is well underway. The new high energy reactor design for the CVNX-class aircraft carrier represents a critical leap in capability; not only will the CVNX reactor enable the Navy to meet current forecasted operational requirements, but just as importantly, it will provide flexibility to deal with unanticipated warfighting needs in the future. The CVNX reactor will provide greater than 25 percent more energy than the reactors in NIMITZ-class ships. This reactor will have substantially more electric generating capacity than the reactors and electric plants used in NIMITZ-class ships, but will require just half the number of Sailors to operate and will be easier to maintain. The extra energy will support higher operational tempos and future electrical load growth or longer reactor life in the CVNX-class.

The CVNX lead ship is expected to be authorized in 2007 and to go to sea in 2014.

To meet the ever increasing demands on our submarine fleet, Naval Reactors is working on a TTC to deliver a significant energy increase to future VIRGINIA-class ships with minimum impact to the overall ship design. The TTC is a direct outgrowth of the Program's advanced reactor technology work and will not only help meet national security demands, but will also act as a stepping stone for future reactor plant development.

Increasing national security demands require longer and more frequent deployments of nuclear-powered ships. Operational commitments are rising and projected future demands on the nuclear fleet pose the risk of reducing expected core life below the design criteria or severely restricting ship operations.

A long-term program goal has been to increase core energy, to achieve life-of-the-ship cores, and to eliminate the need to refuel nuclear powered ships. The TTC will offset the increasing national security demands by using advanced reactor core materials to achieve a significant increase to the core energy density—more energy without increasing size, weight or space while still at a reasonable cost. With significantly more energy, the objective for TTC is to do one or more of the following: extend ship life by as much as 30-50%; increase operating hours per operating year; or allow operation at a higher average power during ship operations.

The TTC will use advanced core materials to achieve a significant increase in core density—more energy in the reactor without increasing reactor size, weight or space, but at a reasonable cost. The timing of TTC development also corresponds with the need to transition from 97 to 93 percent enriched Uranium fuel. This transition is necessitated by the shutdown of the high enrichment plant and the decision to use Uranium recovered from retired nuclear weapons as starter material for naval nuclear reactors.

The current national security requirements will only continue to grow. Accordingly, Fleet operational demands will continue to grow. The current outlook for future operational tempo will necessitate refuelings that would not be needed with TTC. The end result is significantly greater operational ability and flexibility.

The TTC is intended for forward-fitting into VIRGINIA-class submarines. The TTC development should support procurement of a prototypic core in about FY08. In FY04, Naval Reactors will begin TTC core and equipment reference design work. Naval Reactors' Reactor Technology and Analysis (RT&A) and Plant Technology (PT) budget categories are augmented by $18M and $15M, respectively. The RT&A funding for TTC supports physics and thermal hydraulic analyses required for reactor development, initial analysis and testing work on control drive mechanisms, and work to provide less restrictive operating limits derived from improved design codes. PT work focuses on improvements (e.g. steam generator, pressurizer, reactor coolant pump) to enhance performance commensurate with the anticipated performance of the TTC.

Program Strategic Performance Goal

NS3: Provide the Navy with safe, militarily effective nuclear propulsion plants and ensure their continued safe and reliable operation.

NS3-1: Ensure the safety, performance reliability, and service life of operating reactors for uninterrupted support of Fleet demands.

NS3-2: Develop new reactor plant technologies, methods and materials to support reactor plant design.

NS3-3: Maintain outstanding environmental performance.

Performance Indicators

Miles of safe reactor plant operation supporting National security requirements.

Utilization factor for operation of test reactor plants.

Percent of completion on reactor plant designs.

Ensure no one exceeds Federal limits for personnel radiation exposure from Program operations.

Ensure Program operations have no adverse impact on human health or the quality of the environment.

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Targets	FY 2004 Targets

Naval Reactors safely steamed over two million miles in nuclear-powered ships. Naval Reactors exceeded a 90 percent utilization factor for operation of test reactor plants. Next-generation submarine reactor design 96% complete. Next-generation submarine reactor design 96% complete. Next-generation aircraft carrier reactor design 40% complete. No personnel exceeded 5 rem/year. Operations had no adverse impact on human health or the quality of the environment.	Complete safe steaming of approximately two million miles in nuclear-powered ships. Achieve a utilization factor of at least 90 percent for operation of test reactor plants. Next-generation submarine reactor design 99% complete. Next-generation aircraft carrier reactor design 55% complete. No personnel exceed 5 rem/year. Operations have no adverse impact on human health or the quality of the environment.	Complete safe steaming of approximately two million miles in nuclear-powered ships. Achieve a utilization factor of at least 90 percent for operation of test reactor plants. Complete next-generation submarine reactor design. Next-generation aircraft carrier reactor design 60% complete. Establish TTC design basis from preliminary studies and development to enable the start of conceptual design. No personnel exceed 5 rem/year. Operations have no adverse impact on human health or the quality of the environment.

Funding Profile

(dollars in thousands)

	FY 2002 Comparable Appropriation	FY 2003 Original Appropriation	FY 2003 Adjustments	FY 2003 Comparable Appropriation	FY 2004 Request
Naval Reactors					
Naval Reactors Development (NRD)					
Plant Technology	116,000	112,100	N/A	112,100	131,400
Reactor Technology & Analysis	226,000	228,600	N/A	228,600	236,500
Materials Development & Verification	130,904	136,200	N/A	136,200	137,700
Evaluation & Servicing	132,341	152,390	N/A	152,390	161,300
Facility Operations	47,000	42,000	N/A	42,000	57,700
Construction	13,200	11,300	N/A	11,300	18,600
Subtotal, NRD	665,445	682,590	N/A	682,590	743,200
Program Direction	22,126[a]	24,200	N/A	24,200	25,200
Subtotal, Naval Reactors	687,571	706,790	N/A	706,790	768,400
Adjustments					
Use of prior year balances	0	0	N/A	0	0
Subtotal, adjustments	0	0	N/A	0	0
Total, Naval Reactors	687,571	706,790	N/A	706,790	768,400
Additional net budget authority to Cover the cost of fully accruing Retirement (non-add)	1,228	1,230	N/A	1,230	1,313

Public Law Authorization:

Pub. L. 83-703, "Atomic Energy Act of 1954"

Executive Order 12344 (42 U.S.C. 7158), "Naval Nuclear Propulsion Program"

Pub. L. 107-107, "National Defense Authorization Act of 2002", Title 32, "National Nuclear Security Administration"

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[a] Adjustment (-$474k) was for travel and administration rescission.

Funding by Site

	(dollars in thousands)				
	FY 2002	FY 2003	FY 2004	$ Change	% Change
Pittsburgh Naval Reactors Office					
Bettis Atomic Power Laboratory	357,540	360,928	392,200	31,272	8.7%
Pittsburgh Naval Reactors Office	7,440	7,755	8,060	305	3.9%
Total, Pittsburgh Naval Reactors Office	364,980	368,683	400,260	31,577	8.6%
Idaho Operations Office					
Idaho National Engineering & Environmental Laboratory	51,951	56,000	61,200	5,200	9.3%
Idaho Operations Office	0	0	0	0	0%
Total, Idaho Operations Office	51,951	56,000	61,200	5,200	9.3%
Schenectady Naval Reactors Office					
Knolls Atomic Power Laboratory	254,004	263,822	287,500	23,678	9.0%
Schenectady Naval Reactors Office	6,000	6,330	6,515	185	2.9%
Total, Schenectady Naval Reactors Office	260,004	270,152	294,015	23,863	8.8%
Washington Headquarters	8,686	10,115	10,625	510	5.0%
All Other Sites	1,950	1,840	2,300	460	25.0%
Subtotal, Naval Reactors Development	687,571	706,790	768,400	61,610	8.7%
Use of prior year balances	0	0	0	0	0%
Total, Naval Reactors Development	687,571	706,790	768,400	61,610	8.7%

The following funding profiles for the verification and testing of the next-generation reactor for the VIRGINIA-class of submarines and development of a new reactor plant for the CVNX-class aircraft carriers are subsets of the above funding matrix. Much of the technology is generic in nature as Naval reactor plant types are based on pressurized water reactor technology. As such, demarcating work between plant types and between operating plant and new plant development efforts is, to an extent, arbitrary, and not properly reflective of how work is actually accomplished. However, this table does give insight into the effort benefiting the next-generation and CVNX reactor developments.

(dollars in thousands)

	FY 2002	FY 2003	FY 2004
Next-Generation Reactor plant development and testing…………………………………………………………………..	17,000	14,900	12,300
Development of CVNX reactor plant……………………………………	141,000	125,900	104,100

In FY 2002, Naval Reactors implemented a fellowship program for students enrolled in nuclear science and engineering programs. In recent years, Naval Reactors has encountered increased difficulty in attracting and retaining the highly skilled workforce needed to support the unique technological activities of the Naval Reactors' program. The program was developed to ensure a continuing supply of highly qualified candidates with the critical skills and knowledge required to support Naval Reactors' Program work.

Fellowships will be provided to Masters and Doctoral degree candidates. The number of fellowships awarded by Naval Reactors has increased each year since the inception of the program. Naval Reactors is pursuing 15 fellowships to be awarded in FY 2004 for the 2003-2004 school year (including continuing those initially awarded in previous years). It is the goal of the fellowship program to reach maturity in FY 2004 and to maintain 15 fellowships awarded into the future.

Site Description

- **Pittsburgh Naval Reactors Office**

This Office oversees the Bettis Atomic Power Laboratory.

- **Bettis Atomic Power Laboratory**

This laboratory is one of two government-owned, contractor-operated laboratories solely dedicated to Naval nuclear propulsion work. Bettis' mission is to help ensure the continued safe and reliable operation of the Navy's nuclear reactor propulsion plants and to develop new reactor plants to meet evolving defense requirements. Bettis has a specialized testing facility for full scale steam generator testing, a control drive mechanism test facility and the expended core facility in Idaho for examination of spent nuclear fuel.

- **Idaho Operations Office**

This Office oversees operation of the Idaho National Engineering & Environmental Laboratory (INEEL) Advanced Test Reactor. Naval Reactors is the primary customer for the INEEL's Advanced Test Reactor (ATR). The ATR, which offers high thermal neutron flux and large test volumes, is the primary national facility with the capability for performing material irradiation testing. This facility is the Program's main source of data on the performance of reactor fuel, poison, and structural materials under irradiated conditions.

- **Schenectady Naval Reactors Office**

This Office oversees the Knolls Atomic Power Laboratory.

- **Knolls Atomic Power Laboratory**

This is the other government-owned, contractor-operated laboratory solely dedicated to Naval nuclear propulsion work. KAPL's mission is also to help ensure the continued safe and reliable operation of the Navy's nuclear reactor propulsion plants and to develop new reactor plants to meet evolving defense requirements. KAPL has fuel manufacturing development capabilities, unique thermal-hydraulic test capabilities, and two prototype nuclear propulsion plants at the Kesselring Site for operational testing of new technologies under typical operating conditions prior to fleet introduction.

- **Washington Headquarters**

This is Naval Reactors Headquarters in Washington, D.C., which administers the Naval Nuclear Propulsion Program.

NR Strategies

Due to the integrated nature of nuclear propulsion work, efforts overlap between strategies and across performance goals. For example, the strategies for meeting Navy goals for extended warship operation, ensuring the safety and reliability of reactor plants in Navy warships, and ensuring no personnel exceed Federal radiation exposure limits are closely related. Efforts within each strategy can impact safety as well as endurance. In a similar manner, development of new design components is aimed at improving operational safety and performance, but also can provide benefits in such areas as endurance, acoustic performance, cost control, improved maintenance, and effect on the environment. Despite the cross benefits, separate strategies are appropriate since they support Naval Reactors' major goals. Where efforts overlap multiple strategies and goals, the work is identified under the strategy, which receives the principal benefit.

The strategies are integrated into the detailed program justifications within the budget. Thus, within each of the Detailed Program Justifications, Naval Reactors identifies the relevant strategies from the following list, the principal activity areas which exist within each strategy (summarized below), and verifiable supporting activities for each area.

- **Conduct planned development, testing, examination and evaluation of nuclear fuel systems, materials, and manufacturing and inspection methods to ensure Naval nuclear reactors are able to meet Navy goals for extended warship operation.**

  As the Navy downsizes the fleet, demands on remaining ships increase. Each ship must carry more of the burden, be on line more of the time, and stay in service longer. Examples of the increasing demands can be seen in the operations tempo required to support military requirements worldwide, including Afghanistan, the Arabian Gulf, and the Far East.

  To support these operational demands, materials, components, and systems must be operationally reliable for longer periods than ever before. For example, plants originally designed for a twenty-year service life are now being called upon to serve up to about fifty years. Exhaustive testing, analysis, performance enhancements, and development efforts are needed so that component and system endurance—despite mechanical strain and wear, and potential corrosion due to stress and irradiation—can be ensured throughout an extended lifetime. Additionally, to meet the ever-increasing national security demands, Naval Reactors has begun conceptual studies on the TTC. The TTC is a direct outgrowth of the Program's advanced reactor technology work and will not only help meet national security demands, but will also act as a stepping stone for future reactor plant development.

  Development efforts to date have yielded significant advantages. Enhanced component reliability and improved predictive techniques have allowed the Navy to extend the intervals between major maintenance periods, increasing ship on-line time and, thus, the Navy's war fighting capability, while reducing cost. However, these advancements also generate new challenges. For example, the longer intervals between maintenance periods reduce opportunities to examine and/or replace aging components and systems. Thus, more extensive analysis and testing are required to verify materials and component performance. In a similar vein, development of a life-of-the-ship core offers major advantages in terms of ship availability, as well as reducing cost, radiation exposure and waste generation; but a life-of-the-ship core also reduces mid-life opportunities to examine components and help ensure integrity. Testing and verification, therefore, are of paramount importance.

These efforts are especially challenging given the demanding nature of nuclear propulsion technology. Components and materials must perform reliably within the harsh environment of a reactor plant. Comprehensive and rigorous analyses are needed to ensure the ability to withstand the deleterious effects of wear, corrosion, high temperature, and pressure over a lifetime measured in decades. In addition, naval reactor plants must be rugged enough to accommodate ships' pitching and rolling; have the resilience to respond to rapidly-changing demands for power; be robust enough to withstand the rigors of battle; and be safe and easily maintainable for the sailors who live next to them.

The following are principal activity areas for this strategy:

- Improve nuclear heat source (core) design and analysis methods and develop improved designs to satisfy service life requirements.

- Evaluate and test improved core manufacturing processes and inspection techniques to support extended life reactors.

- Examine fuel cells removed at the end-of-life, and perform non-destructive examinations of irradiated test specimens to confirm predicted performance and validate design methods.

- Develop improved nuclear fuel, core and reactor structural materials which extend core lifetimes up to the life of the ship, and evaluate irradiation tests of new and existing materials to verify acceptable lifetime performance and to improve predictive capabilities.

- Test and evaluate plant materials to characterize the long-term effects of the harsh operating environment, and qualify improved materials and processes to ensure endurance requirements will be met.

- Conduct irradiation testing and perform detailed examinations to provide data for material performance characterization and prediction.

▪ **Complete scheduled design, analysis, and testing of reactor plant components, systems, and performance to ensure the operational safety and reliability of reactor plants for use in Navy nuclear powered warships so they can fulfill their national defense mission.**

Naval Reactors is responsible for the operation of 103 reactors—roughly the same number of nuclear power plants as this country has commercial nuclear power plants.

Naval nuclear power plants operate over lifetimes of up to five decades. Challenges to the reliability and integrity of the plants change and grow over this long life. Continuous monitoring and analyses are thus vital to ensure continued safe and reliable performance. Also, new knowledge gained during the years of operation must be assessed against the operating plants.

Since nuclear powered warships account for such a large portion of the Navy's combatant fleet, the successful operation of their reactor plants is a key factor in the Navy's ability to perform its national defense role. The safety record of the Naval Nuclear Propulsion Program is outstanding: nuclear- powered warships have steamed more than 124 million miles without a reactor accident or a significant release of radioactivity to the environment. The continued ability of the Navy to benefit from nuclear propulsion is dependent on continuance of this record.

The following are principal activity areas for this strategy:

- Design and test improved reactor equipment including advanced control rod drive mechanisms, which eliminate gears and provide rod speed flexibility.

- Perform physics testing and analysis to confirm expected fuel system and core performance; develop improved analysis methods for predicting core performance that reduce design approximations, uncertainties, and associated conservatism.

- Conduct reactor safety and shielding analyses to ensure containment of radiation and proper protection of personnel.

- Ensure satisfactory reactor plant operation throughout life, and improve steam generator, energy conversion and steam generator chemistry technologies to enhance performance and reduce maintenance costs.

- Develop instrumentation and control equipment to replace obsolete equipment and improve reliability and performance and reduce cost.

- Develop and test reactor plant components and applicable technologies, which address known limitations and improve performance and reliability of components.

- Perform reactor plant analyses to assure safe operation and improve reactor plant chemistry controls to reduce corrosion and plant radiation levels.

▪ **Accomplish planned core and reactor component/system design and technology development efforts to support the Navy's acoustic requirements.**

One of the greatest advantages provided by submarines is stealth. Stealth—invisibility—allows submarines to operate undetected, conducting surveillance or performing offensive missions with minimal concern for defensive needs, providing, in effect, a tremendous force multiplier. This capability must be maintained in the face of ever improving means of detection. In order to do so, Naval Reactors must ensure the reactor components and systems used in submarines meet tightening Navy operating parameters for quieting.

The principal activity for this strategy is to develop and qualify improved core and reactor component thermal and hydraulic designs.

- **Maintain a utilization factor of at least 90 percent for operation of test reactor plants to ensure availability for planned tests of cores, components, systems, materials, operating procedures, and for scheduled training, and provide for development of servicing equipment to help ensure reactor safety and reliability.**

Naval Reactors has two operating land based prototype Naval nuclear propulsion plants at the Kesselring site in New York and also is the principal customer of the Advanced Test Reactor (ATR) located at the Idaho National Engineering and Environmental Laboratory.

The prototype plants are an essential component in meeting Naval Reactors' mission of ensuring the safe and reliable operation of Naval reactor plants. Prototypes provide platforms for testing under actual operating conditions, which cannot be duplicated in the laboratory. This testing yields important technical data and experience, and allows potential problems to be identified and addressed before they occur in shipboard operating reactor plants. The prototypes are used to test new components and to verify reactor performance predictions by depleting the core faster than would be done in an operating shipboard plant. For example, the advanced fleet reactor, now used in the SEAWOLF class attack submarine, has achieved the equivalent of 25 years of shipboard operation in the S8G prototype plant. The prototypes are also used to train Navy nuclear plant operators. Training and qualification of nuclear operators remains a key part of the Program's direct support of the operating Fleet; over 100,000 Navy nuclear power plant operators have been qualified in the Program's rigorous training program.

Operation of the ATR provides a unique capability to irradiate test specimens, which are then examined to provide data on the effects of radiation on materials. The ATR's arrangement permits varying conditions within the reactor test loops allowing accelerated life testing of materials, a major benefit. Utilization factor is a measure of prototype and ATR availability for planned testing, training, or maintenance. To meet this goal, Naval Reactors must be forward thinking in identifying potential problems before they occur.

At the end of core life, a servicing activity must remove the spent core from a reactor plant. This is an extremely critical operation given the inherent radioactivity in the spent fuel. If the reactor plant is to remain in service, a new core must be installed at this point. Fuel handling equipment is designed for safe operation under all possible normal and abnormal conditions, and thorough evaluations are made of the design and fabrication processes. Engineering models are tested to demonstrate proper operation and detailed procedures are prepared to cover use of the equipment.

The following are principal activity areas for this strategy:

- Operate the prototype plants to provide component and core depletion data and verification, plant integration experience, and to train reactor plant operators.

- Service land-based test reactor plants to ensure continued safe and efficient operation, and develop equipment and procedures to provide for safe and efficient servicing of nuclear reactor plants.

- Operate and service the ATR to provide for material irradiation testing.

- **Safely and responsibly inactivate shutdown land-based reactor plants in support of Program and Departmental environmental cleanup goals.**

  Naval Reactors has shut down six prototype reactor plants no longer required for testing or training. With the Windsor, Connecticut facility removed and land-transfer nearly complete, the three prototypes at NRF in an environmentally benign lay-up, and inactivation work on the Kesselring Site prototypes expected to be complete by 2007, major prototype inactivation work is nearly finished.

  The public expects and deserves prompt inactivation and remediation of shutdown reactor prototypes. Prompt dismantlement is also consistent with the Department's environmental clean-up goals, and is the most efficient and cost effective approach to this work.

  The following are principal activity areas for this strategy:

  - Continue efforts at the Windsor site in Connecticut to release applicable areas for unrestricted use.

  - Continue inactivation and remediation efforts at the Kesselring Site in New York to eliminate surplus facilities, remediate and dismantle plant facilities and release applicable areas.

  - Continue inactivation and remediation efforts at the Naval Reactors Facility in Idaho to eliminate surplus facilities, remediate and dismantle plant facilities and release applicable areas.

- **Maintain outstanding environmental performance through radiological, environmental and safety monitoring, and continue cleanup of Program facilities.**

  Naval Reactors continues to have an outstanding environmental performance record, despite today's stricter government regulations. Naval Reactors cleans up after itself in a rigorous, environmentally safe, and correct manner—including properly maintaining our facilities. The Program has established environmental compliance programs to meet all applicable regulations directed toward environmental excellence. This includes areas such as remediation of historical facilities, emphasis on recycling and waste minimization, strict standards for air and water emissions and monitoring programs to validate that Program activities have no adverse effect on the environment.

  When properly and diligently dealt with, nuclear propulsion is a safe, efficient power source, and is environmentally less damaging than other sources. With regard to radiation, Naval Reactors has an aggressive program to minimize personnel exposure to as low as reasonably achievable such that since 1980 no Program personnel have received more than two rem in any one year.

  The following are principal activity areas for this strategy:

- Conduct radiological control, environmental, and safety operations necessary to protect laboratory employees, minimize release of hazardous effluents to the environment, and comply with all applicable regulations.

- Conduct ongoing clean up of test facilities to reduce hazards to personnel, and reduce potential liabilities due to changing conditions or accidental releases.

- Conduct decontamination and decommissioning necessary to minimize the potential for future environmental chemical or radiological releases, minimize the costs of maintaining idle facilities, and free up central areas at various sites for future Program use.

Performance Measure Funding Matrix
FY 2004

Budget Categories
(dollars in thousands)

Performance Measures	Reactor Technology & Analysis	Plant Technology	Materials Development & Verification	Evaluation & Servicing
Meet Navy goals for extended warship operation, through:				
Nuclear heat source design and analysis methods	69,400			
Core manufacturing processes and inspection techniques	37,800			
Removed fuel cell and irradiated test specimen examination				28,190
Fuel, core and reactor structural material development & testing			48,000	
Plant materials development and testing			32,100	
Irradiations testing and examination			57,600	
Ensure safety and reliability of reactor plants, through:				
Reactor equipment design & testing	35,300			
Physics testing and analysis	21,100			
Safety and shielding analyses	13,800			
Steam generator, energy conversion, and chemistry technologies improvements		31,800		
Instrumentation and control equipment development		50,800		
Reactor plant components development & testing		39,100		
Reactor plant performance analyses and chemistry control		9,700		
Support Navy's acoustic requirements, through:				
Core and reactor component thermal and hydraulic design	16,100			
Ensure prototype plant availability, through:				
Operation of land-based test reactor plants				42,000
Servicing of land-based test reactor plants				16,400
Operation and servicing of the advanced test reactor				18,000
Inactivate shutdown prototype plants, through:				
Inactivation efforts in Connecticut				--
Inactivation efforts in New York				15,200
Inactivation efforts in Idaho				400
Maintain outstanding environmental performance, through:				
Radiological, environmental and safety operations	43,000			
Cleanup of test facilities				42,900

Reactor Technology & Analysis
Mission Supporting Goals and Objectives

Reactor Technology and Analysis supports the work required to ensure safety and reliability of operating reactor plants in U.S. warships, extend the operational life of Navy nuclear propulsion plants, support Navy acoustic requirements, and preserve the Program's level of excellence in radiological and environmental control. Work focuses on developing a greater fundamental understanding of reactor behavior; designing new, longer lived reactors with improved reliability, efficiency, and greater energy density; improving and streamlining manufacturing and assembly processes to achieve cost savings and reduce waste; developing production techniques that incorporate new materials and processes; and a continued record of excellence in safety.

Development of reactor design and analytical techniques provides a more accurate forecast of reactor performance, thereby yielding more advanced next generation designs. Likewise, work is underway to improve analysis tools to better understand basic nuclear data. The objective is to predict performance over longer core and reactor lifetimes, allowing these lifetimes to be extended beyond current estimates. New tests and analyses will also lead to the production of reactors with greater endurance, which will reduce cost and high level nuclear waste.

Development and qualification of core and reactor component thermal/hydraulic designs will further optimize reactor power while reducing coolant flow, thus facilitating improved acoustic performance. To accomplish this, emphasis is on thermal/hydraulics, structural/fluid mechanics, vibration analyses, and nuclear core design/analysis work. In addition, improved core manufacturing processes and inspection techniques also are being pursued to improve efficiency and support extended life requirements.

Other initiatives are dedicated to designing and testing simpler, more reliable reactor equipment, and developing improved shield designs that reduce cost and minimize weight without increasing personnel radiation exposure. Radiological and environmental monitoring and controls ensure operations are conducted without adverse impact on employees or the environment.

Funding Schedule

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Total, Reactor Technology and Analysis	226,000	228,600	236,500	7,900	3.45%

	(dollars in thousands)	
FY 2002	FY 2003	FY 2004

I. Conduct planned development, testing, examination, and evaluation of nuclear fuel systems, materials, and manufacturing and inspection methods to ensure Naval nuclear reactors are able to meet Navy goals for extended warship operation.

	FY 2002	FY 2003	FY 2004
A. Improve nuclear reactor core design and analysis methods and develop improved designs to satisfy service life requirements……………………………………………………	**57,400**	**63,800**	**69,400**

The demand for extended service life and for more operational flexibility necessitates achieving a better understanding of the reactor core environment. As testing provides more comprehensive data, new analytical models can be qualified, which establish new, or revise existing, core performance criteria. Reactor operating guidelines are developed with these new or revised criteria. Engineering analyses and testing in the areas of nuclear analysis, thermal-hydraulics, structural mechanics, fluid mechanics, dynamic structural load tests, and shock and vibration are needed to show the acceptability and performance of the core and reactor component designs.

New designs (next generation reactor for VIRGINIA-class submarines, high energy reactor being developed for the new CVNX-class aircraft carriers, and Transformational Technology Core (TTC)) and less restrictive operating limits derived from improved design codes will enable new reactors to meet service life and performance requirements. The core for the VIRGINIA-class is the first designed from inception to last the life of the ship. The core for CVNX will provide greater than 25 percent more energy than the NIMITZ-class cores. TTC will use advanced reactor core materials to gain a significant energy increase without increasing size or weight.

Development work for new core designs entails using independent models and analysis techniques to calculate and validate the structural and thermal-hydraulic design of the new core. The long-term goal of this work is to develop and fully qualify three-dimensional thermal/hydraulic and structural models to accurately predict core performance under all operating and casualty conditions. Key reactor plant components and design features are tested under prototypic operating conditions to demonstrate the mechanical, thermal/hydraulic, and flow-induced vibration acceptability of the design and manufacturing processes.

Verifiable Supporting Activities:

FY 2002 Developed, executed, and reported key mechanical design qualification, reactor safety, and hydraulic/flow design qualification tests for the High Energy Reactor (HER) test program.

Further developed advanced computational capabilities to better understand factors which affect hydraulic performance and thereby reduce costs by reducing the need for extensive hydraulic testing.

Issued VIRGINIA RSPA Test Protection Analysis for critical tests required to support lead ship delivery.

Finalized and issued HER core design recommendation.

Continued evaluation of advanced energy conversion and advanced energy transport systems to maximize core operating efficiency, extend core life and develop a more attractive reference concept.

FY 2003 Design and initiate performance-mapping tests for advanced energy conversion test arrays to aid in the development of high efficiency direct heat-to-electricity energy conversion devices.

Develop improved parallel processing capabilities for computationally intensive structural analyses to enable enhanced review capability to optimize reactor design.

Complete core mechanical design and analysis and issue drawings to support initiation of HER core manufacturing.

Continue HER reactor hydraulic and mechanical design qualification tests and procure equipment for flow and shock/ vibration test programs for HER fuel cell to validate the design and improve hydraulic and structural design methods.

Continue preparations for the VIRGINIA critical test program.

FY 2004 Initiate HER reactor hydraulic, flow-induced vibration and shock test programs for HER fuel cell that validate the design and improve hydraulic and structural design methods.

Pursue integration of core performance analysis codes to be applied to development of the TTC.

Perform thermal-hydraulic analysis evaluations to extend high power capability to longer lifetimes and higher power gradients demanded by TTC.

Integrate advanced energy conversion test arrays into system concepts and tests to demonstrate improved system efficiency.

Initiate development of an HER core design utilizing lower enriched fuel for use in CVNX-2.

Update thermal hydraulic engineering processes to improve design and analysis work efficiency and continue long-term operation support.

Complete the VIRGINIA critical test program.

	(dollars in thousands)	
FY 2002	FY 2003	FY 2004

Continue to develop improved parallel processing capabilities for computationally intensive structural analyses and implement methodology to remove excess conservatism from fracture analysis procedures.

	FY 2002	FY 2003	FY 2004
B. Evaluate and test improved fuel and core-manufacturing processes and inspection techniques to support extended life of reactors……………………………………….	**30,000**	**28,800**	**37,800**

Desirable new core design features and the drive for cost savings necessitate manufacturing process improvements. These improvements are dependent on technological advancements. Fuel and core manufacturing limitations in previously designed naval reactor cores require compensatory margins in core designs and operating limits that constrain power density and life expectancy. Modifying the fuel and core manufacturing process allows cores to operate longer and with greater power output capability. In addition, the modified manufacturing process will minimize waste. This process is technically challenging, but necessary to improve the fuel to produce more energy-dense cores, such as TTC**,** at a lower cost for new core designs.

Verifiable Supporting Activities:

FY 2002 Fabricated manufacturing prototypes to demonstrate and qualify the fuel systems and new assembly processes required for HER cores.

Demonstrated baseline core manufacturing by completing preliminary process qualifications and initiated formal process qualifications of the assembly manufacturing to include control rod, manifold and core structural processes.

Continued manufacturing process development for high temperature fuel clad using new materials and advanced technologies to reduce costs.

Continued to fabricate model elements and specimens to qualify new reactor materials, designs, and manufacturing technologies, including a new process for fabricating fuel material.

FY 2003 Construct additional model elements and core structural components with new reactor manufacturing techniques to reduce fuel costs and verify new inspection technologies to improve inspection efficiency and reduce reliance on destructive tests.

Complete fuel element process qualifications to support starting HER core manufacturing.

Continue fabrication of prototypes to refine the fuel systems and assembly process required for CVNX prior to committing resources to large-scale production.

FY 2004 Initiate production efforts associated with the lead HER core and identify new technologies to improve baseline processes.

Conduct manufacturing development for TTC utilizing advanced clad and fuel materials. Conduct extensive fuel, fuel element, and fuel assembly development work to determine whether to commit to a full-scale demonstration core in a VIRGINIA-class ship.

Continue to construct additional model elements and core structural components with new reactor manufacturing techniques to reduce fuel costs and evaluate new inspection technologies to improve inspection efficiency and reduce reliance on destructive tests.

II. Complete scheduled design, analysis, and testing of reactor plant components, systems, and performance to ensure the operational safety and reliability of reactor plants for use in Navy nuclear powered warships so they can fulfill their national defense mission.

	FY 2002	FY 2003	FY 2004
A. Design and test improved reactor equipment, including advanced control drive mechanisms……………………………	**49,300**	**42,000**	**35,300**

Reactor safety/reliability demands that the mechanisms that drive control rods to moderate the reactivity of the reactor perform without incident. The next generation reactor control drive mechanism is the first fundamentally new mechanism to be designed in 25 years. With the design in the final stages of qualification, remaining testing focuses on providing consistent rod control and protection against potential casualties for the entire life of the ship. For the A1B reactor plant, a new scaled-up control drive mechanism is required. The sheer size of the control rod presents engineering challenges for mechanism design. One challenge is the design and development of bearings required to operate for sixty years. Not only must the new control drive mechanism be developed to handle an unprecedented load, but it is also constrained by plant-wide limitations on space and mechanism operating power. Additionally, a more accurate control rod position indicator is being developed to meet increased plant control and safety goals.

Naval Reactors also must develop and qualify reactor heavy equipment, including reactor vessels, closure heads, closure studs, and core baskets to accommodate new core designs. Work is focused on extending technologies developed for next generation reactor equipment to the design of the CVNX reactor equipment and supporting longer carrier service lives. As part of this effort, three-dimensional structural analyses will be developed and applied.

Verifiable Supporting Activities:

FY 2002 Delivered the A1B control drive mechanism development unit and performed airstand and autoclave tests.

Conducted A1B reactor heavy equipment structural analyses and design reviews to support the final design phase.

Finalized reactor vessel and closure head design and initiated reactor vessel and closure

	(dollars in thousands)	
FY 2002	FY 2003	FY 2004

head fabrication process.

Continued design of the reactor head area to include tolerance, alignment studies, structural analyses, and design compliance checklists.

FY 2003 Complete final design of the A1B control drive mechanism (CDM) and fabrication of the CDM Lead units for prototypical tests that demonstrate that they function as intended.

Complete final engineering certification of reactor vessel and closure head that shows on paper that all design requirements have been met.

Continue A1B reactor heavy equipment structural analyses and design reviews and complete core basket final design.

Continue design of the reactor head area to include tolerance, alignment studies, structural analyses, and design compliance checklists to ensure trouble-free assembly at the shipyard and successful operation for the life of the ship.

FY 2004 Conduct life and shock and vibration tests on the A1B CDM Lead Units and resolve design issues experienced during CDM prototype fabrication.

Initiate analysis and testing work on control rod drive mechanisms to account for additional energy demands of TTC.

Continue detailed A1B reactor engineering analyses and design reviews and complete core basket final engineering certification.

Continue detailed design of the reactor head area to include tolerance, alignment studies, structural analyses, and design compliance checklists to ensure trouble-free assembly at the shipyard and successful operation for the life of the ship.

	FY 2002	FY 2003	FY 2004
B. Perform physics testing and analysis to confirm expected fuel system and core performance and develop improved analysis methods for predicting core performance that reduce design approximations, uncertainties, and associated conservatism	**21,100**	**21,100**	**21,100**

The first cores Naval Reactors developed had expected service lives of two years. Subsequent research and development resulted in core service lives of over twenty years, and current design work will deliver a life-of-the-ship core that will last over thirty years.

While yielding significant advantages in terms of reduced radiation exposure, reduced cost, and increased ship availability, the longer core life is pushing nuclear analysis tools beyond proven experience. These tools are limited in their ability to accurately predict core physics performance in later phases of life. Consequently, Naval Reactors is developing improved methods and tools to continue safe and reliable operation at stages in life which extend well beyond current operating experience.

Physics models use approximations that limit design precision and require allowances to be built into the design. Naval Reactors is developing, and has begun using, advanced, more precise nuclear design methods and software that reduce uncertainties and associated costly conservatism in advanced reactor design. The reduction in uncertainty and bias applied to core reactivity predictions leads to reduced costs and improved reactor performance through more accurate predictions of power levels in the various regions of a core under transient and steady state conditions.

Qualification of these improved analytical and design methods require extensive testing, comparison of calculations to experimental results and operating experience, and validation of predictions against prototype core measurements. Likewise, differences between calculations and experimental results must be resolved and the results factored into improved methods and computer programs.

Improved basic nuclear data, such as neutron cross-sections, are needed to improve performance of existing cores and optimize new core designs. Naval Reactors is working to identify and perform experimental programs that would lead to improvements in this area.

Verifiable Supporting Activities:

FY 2002 Finalized HER core design specifications for production core manufacturing.

Measured and evaluated physics data developed from cross section measurements at the linear accelerator to further reduce uncertainties in nuclear design calculations.

Established a comprehensive and reconciled procedure for estimating the reactivity uncertainty with depletion of nuclear cores.

Evaluated physics data from late-in-life operation of the S8G prototype core.

Continued nuclear data measurements to reduce uncertainties in nuclear design calculations.

FY 2003 Initiate physics analyses needed to establish detailed CVNX operating limits and control system characteristics.

Measure and test new cross-section data derived from linear accelerator experiments to improve accuracy of nuclear design calculations.

Improve accuracy of core burnup predictions by applying improved physics methods, modeling procedures and cross section data.

(dollars in thousands)		
FY 2002	FY 2003	FY 2004

Continue to evaluate physics data from late-in-life operation of the advanced fleet reactor prototype core to validate performance predictions for S6W.

FY 2004 Implement advanced solution strategies to improve reactor physics computation efficiency for supercomputers and distributed computing environment.

Develop physics data required to support the conceptual design phase for TTC .

Continue physics analyses needed to establish detailed CVNX operating limits and control system characteristics.

Continue to measure and test new cross-section data derived from linear accelerator experiments to reduce uncertainties in nuclear design calculations for emergent core concepts.

Continue to evaluate physics data from late-in-life operation of the advanced fleet reactor prototype core to validate performance predictions for S6W and S9G.

	FY 2002	FY 2003	FY 2004
C. Conduct reactor safety and shielding analyses for nuclear reactor plants to ensure containment of radiation and proper protection of personnel………………………………….	**13,800**	**13,800**	**13,800**

Naval Reactors conducts reactor safety analyses of all plants and new core designs to ensure that their operation poses no threat to operators or the public. Safety assessments are conducted for specific reactor plant designs to identify any potential safety vulnerabilities and assess the likelihood of a core-damaging casualty.

Shielding analyses are also conducted to ensure effective attenuation of radiation and continued safe operation. Alternative shield and plant materials and fabrication methods are sought to improve shield effectiveness, while improving reactor plant affordability, reducing weight, and eliminating the use of hazardous materials such as lead. Shielding analysis method improvements permit a more accurate prediction of radiation shielding effectiveness, as well as the extent of radiation received by personnel, reactor components, and materials. As a result, shielding is better optimized to reduce radiation exposure to personnel and equipment during reactor plant servicing and operation and during the handling and shipment of spent nuclear fuel and other highly radioactive materials. Naval Reactors is working to reduce the weight and resultant cost of installed shielding without impacting radiation exposure to personnel.

Verifiable Supporting Activities:

FY 2002 Resolved technical issues and completed presentations to the NRC/ACRS during their review of the next generation reactor safety documents.

Evaluated and qualified improved parallelized transport code.

Provided improved analytical methods, computer codes, and nuclear data to support radiation analyses for current and future shield design.

FY 2003 Determine the scope of thermal/hydraulic tests necessary to support HER reactor safety modeling and analysis.

Evaluate improvements to neutron and gamma transport codes to support advanced shield designs that reduce shield weight and cost.

Complete the NRC/ACRS review of the next generation reactor and provide technical support as necessary.

Complete radiation analyses for final design of A1B reactor plant equipment.

FY 2004 Develop new shield materials for advanced plant design and develop and install new shield design software.

Implement improvements to neutron and gamma transport codes to support advanced shield designs and the more stringent TTC energy density in a cost-effective manner.

Perform penetration shield design studies and support validation of the shipyard CVNX penetration shield analysis.

Initiate containment test program in support of A1B reactor plant safety analyses.

III. Accomplish planned core and reactor component/system design and technology development efforts to support the Navy's acoustic requirements.

	FY 2002	FY 2003	FY 2004
A. Develop and qualify improved core and reactor component thermal and hydraulic designs……………………..	**16,100**	**16,100**	**16,100**

The acoustic signature of a reactor is driven principally by the flow of water through the core. Reductions in the flow, and corresponding improvements in acoustic performance, are limited by the necessity to safely maintain reactor power, which requires a flow of water through the core to dissipate heat. Naval Reactors continues to improve core performance and quieting, in part due to advancements in thermal and hydraulic design which enable greater power per unit flow, allowing flow to be reduced while safely maintaining power.
Work in this area focuses on developing more advanced calculation methods and software used in thermal hydraulic analytical models and codes. These improved tools will enable a more realistic approximation of flow requirements. This work is helping to deliver more balanced reactor designs with reduced reliance on expensive tests in reactor design.

Major thermal and hydraulic objectives include: refinement of design codes to support long lived cores, and qualification of computational fluid dynamics codes to aid in system design with the goal of reducing the number of components needed to support operation and to reduce flow field features which could lead to unacceptable acoustic phenomena.

Verifiable Supporting Activities:

FY 2002 Developed and qualified advanced codes for steady state and transient flow analyses.

Extended advanced safety analysis code to small break loss of coolant casualty calculations.

Performed testing for development of thermal criteria for future flow technologies.

FY 2003 Extend thermal-hydraulic analysis methodology to apply advanced codes to transient thermal-hydraulic analyses to reduce reliance on complex and expensive transient tests.

Update and complete additional testing of advanced code analysis that solves basic physical equations for flow and heat transfer.

Initiate development of advanced Computational Fluid Dynamics tools for prediction of broad band noise while continuing testing for development of thermal criteria.

FY 2004 Extend thermal-hydraulic analysis methodology to apply advanced codes to flow oscillation thermal-hydraulic analyses of HER that are needed to enable a simplified, lower cost plant concept.

Develop additional advanced thermal-hydraulic analysis tools to reduce reliance on expensive testing

Perform testing to assess capability of Computational Fluid Dynamics tools for prediction of broad band noise.

IV. Ensure no personnel exceed Federal limits for radiation exposure and no significant findings result from environmental inspections by state and federal regulators.

	FY 2002	FY 2003	FY 2004
A. Conduct radiological control, environmental, and safety operations necessary to protect laboratory employees, minimize release of hazardous effluents to the environment, and comply with all applicable regulations……………………..	**38,300**	**43,000**	**43,000**

Proper control of radiological materials is paramount to the health and safety of workers, the public, and the environment. Naval Reactors enforces strict compliance with requirements for the management and disposal of radioactive, hazardous, and mixed waste. Additional procedures are in place to ensure full compliance with evolving environmental, health, and safety requirements. The principal focus of this environmental work is to prevent the creation of environmental hazards by minimizing wastes and preventing pollution. Areas where historical operations were conducted are evaluated to assess environmental impacts and determine the extent of remedial actions. Training is conducted to ensure radiological safety and environmental requirements are understood. Audits are routinely conducted to assess the adequacy of facilities and equipment, employee training, and effective enforcement of existing controls. Emergency response capabilities are in place to control or mitigate any problems, while personnel and affected work areas receive routine radiological monitoring to ensure exposure is within minimal limits. Environmental, safety, and industrial hygiene monitoring is performed to confirm operations do not impact Program sites or the surrounding communities.

Verifiable Supporting Activities:

All Years Survey and document radiological conditions; train personnel for all phases of radiological work and environmental work.

Maintain strict accountability methods and fuel handling for nuclear fuel.

Ensure compliance with all safety and environmental regulations; train personnel to comply with latest standards and practices.

Minimize the production and safely dispose of all waste in accordance with applicable regulations.

Characterize historical operations areas and determine appropriate remedial actions.

Audit compliance to all regulations to ensure effectiveness of controls.

Total, Reactor Technology & Analysis.	**226,000**	**228,600**	**236,500**

Explanation of Funding Changes from FY 2003 to FY 2004

	FY 2003 vs. FY 2004 ($000)
I.A Funding level reflects requirements for the CVNX test program and new TTC development requirements ……………………………………………..	+5,600
I.B Funding level reflects increased TTC development work……..……………..	+9,000
II.A Funding level reflects finalizing CVNX CDM lead unit and reactor heavy equipment design work………………………………………. ..…………	-6,700
Total Funding Change, Reactor Technology & Analysis: ………………………….	+7,900

Plant Technology
Mission Supporting Goals and Objectives

Plant Technology focuses on developing, testing and analyzing components and systems which transfer, convert, control and measure power created by the nuclear reactor in a ship's power plant. Reactor plant performance, reliability, and safety are maintained via a thorough understanding of component performance and system condition throughout the life of a ship. Also, new components and systems are needed to support new reactor plants and to replace obsolete or degraded equipment and systems. Development and application of new analytic methods, predictive tests, and design tools are required to identify potential problems before they become actual problems. This enables preemptive actions to ensure continued safe operation of reactor plants. Advances in modeling, analysis, and water chemistry are already permitting the safe operation of components beyond their original design life. Continued progress in various technologies such as manufacturing/welding processes, fluid dynamics, predictive models/analysis and thermal-hydraulics are enhancing operating plant performance and allowing major improvements in performance for new reactor plants. For example, the reactor plant systems and components now under development for the VIRGINIA- and CVNX-class will be more dependable, improve operating efficiency, and reduce life cycle costs.

Reactor plants require constant monitoring and analysis due to exposure to extreme temperatures and pressures. Steam generators are especially susceptible to corrosion due to the intense boiling environment required to convert reactor heat to steam. Naval Reactors is pursuing technologies to greatly reduce corrosion through fundamental design changes in components and water chemistry.

Wear and tear on operating reactor machinery, such as pumps with constantly rotating parts, limit system and component life and can require extensive and costly maintenance. Plant Technology provides funding for programs to combat wear and tear through the implementation of better materials and lubricants, as well as more resilient designs, creating longer-lived and more reliable components and systems with reduced maintenance requirements. In addition, these programs provide for the comprehensive testing and review required to ensure improvements for one area of the plant do not cause unanticipated problems in another area of the plant.

Extensive development work is devoted to applying advances in electronics to instrumentation and control equipment and systems. Due to the harsh and intense operating environment and rapid obsolescence of electronic equipment, this equipment must be replaced during the lifetime of an operating plant. While this presents a continuing challenge, rapid technical advances are providing distinct advantages. For example, improved accuracy and reliability of the new design instrumentation extend the long-term useable power obtained from the reactor. Also, developing human-machine interface and data collection schemes allows for a less expensive incorporation of new display technologies while presenting data to the operator in a more effective manner.

Funding Schedule

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Total, Plant Technology	116,000	112,100	131,400	19,300	17.2%

	(dollars in thousands)	
FY 2002	FY 2003	FY 2004

I. Complete scheduled design, analysis, and testing of reactor plant components, systems, and performance to ensure the operational safety and reliability of reactor plants for use in Navy nuclear powered warships so they can fulfill their national defense mission.

	FY 2002	FY 2003	FY 2004
A. Ensure satisfactory reactor plant operation throughout life and improve steam generator, energy conversion, and steam generator water chemistry technologies to enhance performance and reduce maintenance costs……………………………………………..	**23,062**	**21,100**	**31,800**

Steam generators provide energy to the main turbines by converting heat from the reactor plant into a usable medium — steam. To accomplish this, extremely hot pressurized water from the reactor primary system flows through multiple thin-walled tubes necessary to efficiently transfer the reactor heat in the heat exchanger within the steam generator. A shell containing secondary water surrounds these tubes. The secondary water is at a lower pressure and boils into steam. Consequently, integrity of steam generator pressure boundary parts and tubing is crucial to prevent leaks and radioactive contamination of the steam leaving the steam generator to power the turbines.

Maintaining steam generator integrity over the full service life, especially as we extend the service life of ships, requires improving understanding of high temperature corrosion processes, assessment of potential causes and corrective actions, and development of alternative water chemistries which can inhibit or abate corrosion. Trace impurities become highly concentrated by the boiling process in areas of low flow and form deposits. The concentration of impurities in these deposits can become corrosive and threaten the integrity of the unit. Development work focuses on evaluating corrosion mechanisms, devising methods to locate and remove deposits, minimizing input of impurities, and evaluating and testing water chemistries and corrosion inhibitors for benefits and drawbacks to ensure they mitigate the consequences of impurities over the life of the plant.

Development and final testing is underway on alternative energy transfer methods and the testing of creviceless steam generators. By utilizing advanced energy conversion devices, significant gains may be made to the power conversion generator and propulsion plant efficiencies which could possibly result in a quieter, simpler, and more cost-effective naval plant. This will support future Naval nuclear propulsion feasibility assessments. The intent of the New Concept Steam Generator design is to minimize the propensity for concentration of impurities and low flow regions resulting in inherently more corrosion resistant, reliable equipment. Also, development work is underway for steam generator improvements to meet energy and power requirements for the Transformational Technology Core (TTC).

CVNX shipbuilding schedules and goals for reduced weight, manning, and life cycle costs, require development of an improved steam generator. Development work centers on new tubing materials, new corrosion controls, improved heat transfer methods, and steam separation predictive tools used to meet goals of cost and weight reduction while enhancing performance.

	(dollars in thousands)	
FY 2002	FY 2003	FY 2004

Verifiable Supporting Activities:

FY 2002 Designed and built improved in-plant chemistry and electrochemistry monitoring capabilities to identify and address steam generator corrosion issues.

Developed, modeled and improved performance of energy conversion systems. Incorporated latest technology and engineered improvements into power dense and efficient power conversion systems. Investigated alternative power conversion systems.

Completed steam generator pressurizer, and main coolant pump testing in support of VIRGINIA, CVNX, LOS ANGELES, and NIMITZ Projects.

Continued to monitor and evaluate use of alternate chemistries in LOS ANGELES- and OHIO-class steam generators to reduce cost and frequency of inspections and cleaning.

FY 2003 Conduct steam generator thermal and hydraulic testing to support analysis tool qualification and reduced inspection frequency and cost for steam generators.

Continue to monitor and evaluate LOS ANGELES- and OHIO-class steam generators to reduce cost and frequency of inspections and cleaning.

Continue to design and build improved in-plant chemistry and electrochemistry monitoring capabilities to identify and reduce steam generator corrosion issues.

Continue development of advanced power conversion systems incorporating state of the art technology and engineered improvements. Evaluate application feasibility of alternative power conversion systems.

FY 2004 Pursue steam generator improvements required to meet energy and power demands for the Transformational Technology Core.

Perform additional evaluations and testing of emergent alternate power conversion concepts to demonstrate larger scale advanced power conversion systems achieving high power conversion efficiency to support future cores.

Complete steam generator thermal and hydraulic testing to support analysis tool qualification and reduced inspection frequency and cost for steam generators.

Continue to monitor and evaluate LOS ANGELES- and OHIO-class steam generators through the use of corrosion testing to reduce cost and frequency of inspections and cleaning, as well as prolong steam generator service life.

Continue to implement use of in-plant corrosion monitors in prototype steam generators to provide data defining actual conditions in operating steam generators.

	(dollars in thousands)	
FY 2002	FY 2003	FY 2004

	FY 2002	FY 2003	FY 2004
B. Develop instrumentation and control equipment to replace obsolete equipment and improve reliability and performance……………………………………………......	**44,938**	**46,200**	**50,800**

Naval reactor plant operators rely on instrumentation to monitor plant conditions, take corrective action, and determine position and speed of the control rods used to regulate reactor output. Safe and reliable operation of the plant is dependent on the reliability and performance of this equipment. Improved performance characteristics of instrumentation and control equipment is key to improving reactor performance and extending reactor core life. The development of highly reliable and efficient advanced power conversion equipment can increase actual usable power available from the reactor.

Rapid technical advances in the electronics industry provide opportunities to improve equipment. The downside of these advances is the rapid obsolescence of equipment because industry does not maintain the parts or capability to support outdated equipment. Therefore, lifetimes are much more limited for the electrical interfaces than for heavy reactor equipment, and the instrumentation and control (I&C) equipment must be replaced periodically over the life of a plant. Development concentrates on adapting equipment to reactor plant specifications that are more functionally integrated, less costly to support, and allow for easier upgrade.

Improving the design of I&C equipment will increase its lifetime and reduce the maintenance required for I&C equipment during the lifetime of the plant. An example is the development of circuit breakers using solid state technology to provide circuit breakers with no moving parts. Moving parts in mechanical circuit breakers have been prone to failure due to the thousands of cycles they are subject to in normal use. Circuit breakers without moving parts will increase the lifetime of the plant's electrical equipment.

Verifiable Supporting Activities:

FY 2002 Built and initiated testing of selected solid state motor drives with advanced control techniques for proof-of-concept testing.

Began developing functional requirements and equipment specifications for a CVNX reactor plant instrumentation system.

Developed advanced power electronic controls to support test and evaluation of advanced design motors.

Completed NIMITZ-class pre-production equipment fabrication and initiated composite testing. Commenced initial issue of OHIO system functional requirements.

FY 2003 Commence development of OHIO-class system laboratory models.

Conduct design, testing, and qualification of high voltage power conversion technology and selected solid state motor drives with advanced control techniques for proof-of-concept testing.

Begin detailed design of a CVNX reactor plant instrumentation system and issue CVNX functional requirements.

Complete LOS ANGELES-class generic I&C production equipment fabrication and NIMITZ-class production equipment design and fabrication.

FY2004 Install improved generic I&C equipment in LOS ANGELES-class ships and complete composite test facility procedure checkout and crew familiarization. Initiate OHIO-class generic instrumentation and control preproduction equipment fabrication. Generic I&C equipment establishes common system architecture for all plants.

Design, develop and qualify field changes to address emergent needs for I&C equipment changes and parts obsolescence in order to improve reliability of existing hardware in existing plants.

Complete OHIO-class functional requirements and conduct further development of system laboratory models.

Continue design, testing, and qualification of high voltage power conversion technology and selected solid state motor drives with advanced control techniques for proof-of-concept testing to improve efficiency, maintenance, and performance.

Continue detailed design of a CVNX reactor plant instrumentation system with state-of-the-art equipment that will have an available vendor base.

	FY 2002	FY 2003	FY 2004
C. Develop and test reactor plant components and applicable technologies which address known limitations and improve performance and reliability of components……………………………………………………	**39,400**	**35,100**	**39,100**

Naval Reactors evaluates current technologies and applies them to develop simpler components that maximize plant efficiency, reliability and safety. For example, the main coolant pump used in the NIMITZ-class carrier reactor plant, originally designed in the early 1960's, is being redesigned for placement on CVN77 to incorporate current technologies addressing problems related to wear, improving performance and reliability over the pump's operating life.

Studies are also underway to develop technologies that will improve the military characteristics and affordability of future naval nuclear propulsion plants. Specific design work is ongoing for a cost-effective next-generation aircraft carrier, CVNX, which will provide improved capability and a simplified, more affordable propulsion plant. Simplifying the reactor plant will not reduce the reliability of the plant. Improvements will provide for a greater ease of operation and more power available for other uses throughout the ship. An important consideration in each redesign is fluid flow through each component and system in the reactor plant because pressure changes in each component have an effect on flow through the core. Deviations from nominal flow can cause a heat level imbalance within the core; therefore, strict tolerances are essential for safe and efficient operation of the entire plant. Additionally, improvements to reactor plant components are needed for the development of the Transformational Technology Core which will extend ship life and increase power output in VIRGINIA-class ships.

The overriding goal of plant arrangement/development and testing is to develop more affordable reactor components/systems arrangements that have the potential to improve the military characteristics and affordability of future naval nuclear propulsion plants without compromising safety or performance.

Verifiable Supporting Activities:

FY 2002 Resolved VIRGINIA plant construction design issues.

Completed qualification testing for the redesigned NIMITZ-class main coolant pump lead unit.

Continued design of CVNX reactor plant fluid systems and began development of design details which will be used for ship construction.

Continued detailed design effort of CVNX main coolant pump and procured long lead material.

FY 2003 Continue to resolve VIRGINIA plant construction design issues.

Continue design of CVNX reactor plant fluid systems and complete development of design details. Begin development of the CVNX reactor plant operating procedures.

Continue design of the CVNX main coolant pump and continue manufacture of the prototype CVNX Reactor Coolant Pump.

Continue design of the CVNX steam generator and pressurizer. Prepare detailed ordering requirements for fabrication.

FY2004 Perform development work on improvements to plant components (e.g. pressurizer, reactor coolant pump) to enable performance enhancements commensurate with the anticipated performance of the Transformational Technology Core.

Finalize VIRGINIA reactor plant construction design issues to have an arrangement which incorporates innovative construction techniques and which is technically sound and economical in size.

Complete design of the CVNX main coolant pump so that it incorporates the latest technologies and is affordable. Complete the manufacture of the prototype CVNX Reactor Coolant Pump.

Complete design of the CVNX steam generator and pressurizer incorporating the latest technologies while remaining affordable. Initiate shipset fabrication.

Continue design of CVNX reactor plant fluid systems and continue development of the CVNX reactor plant operating procedures in order to develop a primary propulsion plant that is less costly to build, operate, and maintain.

D. Perform reactor plant analyses to assure safe Operation and improve reactor plant chemistry Controls to reduce corrosion and plant radiation levels………	**8,600**	**9,700**	**9,700**

Under pressure, the reactor core heats primary system water system that then flows through the steam generator. The steam generator absorbs the transferred heat in the secondary, producing steam to power the turbines. Any corrosion products present in the primary reactor water cycle will be carried through the plant and irradiated in the core. Build-up of corrosion products in the core acts as insulation and narrows the water channels, reducing flow and heat transfer.

Proper chemistry control is crucial to reducing corrosion. Development work focuses on improving primary side chemistry, filtration, and surface conditioning technology to reduce corrosion, permit improved design, and the reduction of radiation levels. A constant flow of data from test facilities and operating plants plays a key role in the development process.

Detailed reactor system performance analyses are also performed to ensure naval reactor plants are safe during normal, transient and casualty conditions. The automated reactor plant protection systems that provide automatic shutdown when the operating limits established by the performance analyses are exceeded ensure the plant will operate safely and reliably during all phases of operation.

Through continuous improvement in chemistry, reactor protection system analyses and advances in metallurgy discussed in the Materials Development and Verification category, Naval Reactors has consistently maintained radiation levels well below regulatory requirements and maintained an enviable record of safeguarding the environment, health of the crew, and servicing personnel. These advances have also provided enhanced reliability and a reduction of maintenance costs.

Verifiable Supporting Activities:

FY 2002 Performed emergent radiochemical, chemical and microchemical analyses on primary system samples and components to resolve operating plant problems.

Performed the necessary reactor protection analyses for the CVNX final core design.

Continued to monitor results of zinc treatment in LOS ANGELES-class reactor coolant.

Completed next generation reactor systems performance analysis for abnormal operational limits.

FY 2003 Qualify use of advanced reactor coolant chemistry analysis methods in OHIO- and NIMITZ-class ships to improve the quality of data and reduce operator training requirements.

Continue to monitor results of zinc treatment in reducing radiation levels in LOS ANGELES-class ships.

Continue to evaluate open items and emergent issues to support the VIRGINIA-class reactor systems performance analysis.

Continue to perform the necessary reactor protection analyses for the CVNX final core design.

FY 2004 Evaluate initial test problem issues and results for impact on VIRGINIA-class reactor systems performance analysis.

Continue to monitor results of zinc treatment in reducing radiation levels and associated personnel exposure during maintenance evolutions in LOS ANGELES-class ships.

Implement use of advanced reactor coolant chemistry analysis methods in OHIO- and NIMITZ-class ships to improve the quality of data and reduce operator training requirements.

Continue to perform reactor protection analysis to support development of the CVNX Primary Nuclear and Core Protection Instruments in order to optimize the operational flexibility of CVNX and ensures the safe operation of the reactor.

	FY 2002	FY 2003	FY 2004
Total, Plant Technology	**116,000**	**112,100**	**131,400**

	(dollars in thousands)	
FY 2002	FY 2003	FY 2004

Explanation of Funding Changes from FY 2003 to FY 2004

		FY 2003 vs. FY 2004 ($000)
I.A.	Requirements increase due to the increased effort to improve steam generator design for TTC……………………………	+10,700
I.B.	Requirements reflect scaled up effort to support advanced I&C development and power electronics activities …………………………………………...	+4,600
I.C	Requirements increase due to a scaled up effort for TTC……………………	+4,000
	Total Funding Change, Plant Technology:	+19,300

Materials Development & Verification
Mission Supporting Goals and Objectives

Materials Development & Verification work ensures shipboard reactor plants meet Navy goals for extended warship operation by developing materials that will withstand the rigors of the harsh naval reactor plant environment—irradiation, high temperature, high pressure, and corrosion—for fifty-plus years. Submarine and aircraft carrier reactor plants are also unique in that they must operate under rapidly changing conditions as the ships maneuver and change speed.

Examining or replacing materials in an operational reactor plant is especially difficult because of system complexity and personnel radiation exposure concerns; thus it is imperative that materials be qualified prior to Fleet use. To support reactor plant material needs, materials exhibiting desired characteristics are identified, developed, and subjected to long-term, strenuous testing and verification to ensure they will meet demands. These materials are also continuously reassessed based on evolving knowledge, and analytical and testing techniques. Test data is collected from both destructive and non-destructive surveys of prototypical specimens and materials removed from service. This information is used to develop predictive models. The ability of these models to reliably predict material performance is vital to operating plant safety and is key to qualifying materials for longer lifetimes.

An important objective of this work is to drive the costs of materials and processes to as low a level as possible, without compromising the safe operation of naval reactors.

Work in this category is divided into three areas: core and reactor structural materials, plant materials, and irradiation testing. The first two areas concern the different challenges and demands placed on materials based on their location and function. For example, fuel materials used in the reactor core must maintain high integrity to retain radioactive fission products under intense heat and irradiation during operating lifetime, and they must continue to maintain that integrity over thousands of years when eventually they are placed into a long-term spent fuel repository. The materials used in plant pressure-boundary components must maintain the high integrity of the primary coolant boundary under high stress in a corrosive environment. Irradiation testing of specimens is performed at the Advanced Test Reactor (ATR) located at the Idaho National Engineering and Environmental Laboratory (INEEL). The specimens are subsequently examined at the Naval Reactors' Expended Core Facility in Idaho and the Radioactive Materials Laboratory (RML) at the Knolls Atomic Power Laboratory to obtain data that are used to support both core and plant materials development.

Materials Development & Verification provides the high performance materials necessary to ensure Naval nuclear reactor plants meet Navy goals for extended warship operation and greater power capabilities in the most economical manner possible.

Funding Schedule

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Total, Materials Development & Verification	130,904	136,200	137,700	+1,500	1.1%

	(dollars in thousands)	
FY 2002	FY 2003	FY 2004

I. Conduct planned development, testing, examination and evaluation of nuclear fuel systems, materials, and manufacturing and inspection methods to ensure Naval nuclear reactors are able to meet Navy goals for extended warship operation.

	FY 2002	FY 2003	FY 2004
A. Develop improved nuclear fuel, core and reactor structural materials, which extend core lifetimes up to the life of the ship, and evaluate irradiation tests of new and existing materials to verify acceptable lifetime performance and to improve analytical capabilities……………………………	**49,500**	**48,800**	**48,000**

Materials used in a reactor core as fuel, poison, cladding, and structural pieces must be capable of maintaining their physical integrity in an operating reactor environment which subjects them to the harmful effects of irradiation, pressure, corrosion, and heat. These materials are required to withstand the harsh environment of an operating reactor for decades. Naval Reactors is pursuing the development and testing of economically attractive materials with improved physical or nuclear characteristics to support core life expectations of more than 30 years. Improvements in material characteristics offer the potential for increased core lifetime, reductions in analytical conservatism, and cost savings.

Quality control is an integral part of all materials work, and manufacturing processes are developed and refined to ensure materials are produced efficiently and to stringent specifications. The ability to qualify materials for specific core applications is dependent upon fabrication, welding and other process development, as well as testing and development of predictive models to cover design applications. For example, new welding materials, combined with potentially more efficient cost-saving processes, are being evaluated for application to naval reactor manufacturing and construction. Where appropriate, manufacturing and other process developments are qualified and released for vendor use.

Materials used in long life core designs must be qualified in advance by collecting data on their performance during tests, examining their condition after testing and at end of use, and assembling the collected data into sound predictive models.

Verifiable Supporting Activities:

Materials work supporting long life core concepts, by nature, involves extended testing conducted over many years. The verifiable supporting activities described below provide examples of evaluations and tests performed each year thus representing outcomes within the continuing general scope of work.

FY 2002 Initiated design of a fuel processing system to support alternate methods of fuel material development.

Evaluated long-term feasibility of alternative high-temperature fuel.

Conducted qualification of faster and more accurate fuel analysis models and verification of current corrosion models to reduce fuel design cost and better predict the effects of long-term repository storage.

Continued expended core examinations, including initiating comparative examination of the first Fleet zinc chemistry core to evaluate corrosion effects.

Developed and employed cost-effective improvements to joining techniques and processes, including implementation of welding technology improvements such as fiber optic laser welding.

FY 2003 Prepare for operations of improved, newly installed fuel fabrication process.

Develop advanced semiconductor materials for thermophotovoltaic (TPV) direct energy conversion and obtain performance data of materials to improve efficiency and reduce cost of cell, module, and system design.

Continue expended core examinations to improve understanding of zircaloy corrosion in Naval cores and provide improved predictive capability.

Continue developing and implementing improved, cost effective joining techniques and processes for advanced materials, including fiber optic laser welding.

Continue long term evaluations of high-temperature, high-depletion fuel.

FY 2004 Initiate operations of the newly installed fuel fabrication process.

Evaluate the high temperature properties of new molybdenum alloys.

Conduct corrosion exams of USS OHIO fuel elements to validate performance of the OHIO-class submarine core.

Continue expended core examinations to improve understanding of zircaloy corrosion in Naval cores and provide improved predictive capability.

Continue developing and implementing improved, cost effective joining techniques and processes for advanced materials, including fiber optic laser welding.

Continue testing, evaluating, and development of new high temperature fuel and poison compatible with high temperature fuel.

	(dollars in thousands)	
FY 2002	FY 2003	FY 2004

	FY 2002	FY 2003	FY 2004
B. Test and evaluate plant materials to characterize the long-term effects of the harsh operating environment and qualify improved materials and processes to ensure endurance requirements will be met……………………………..	**31,100**	**32,100**	**32,100**

The strength and integrity of materials used throughout the reactor plant are critical as degradation can lead to reduced performance, shorter lifetime, increased maintenance, or component failure. Consequently, Naval Reactors focuses on developing and qualifying high integrity, corrosion resistant materials that will provide performance and sufficient lifetimes to support increasingly longer lived nuclear cores. One of the leading concerns in material degradation is stress corrosion cracking. Stress corrosion cracking is the damage potentially occurring to materials carrying high tensile loads exposed to fluids, radiation, and/or high temperatures. Other plant material concerns include embrittlement resulting from irradiation and the presence of cobalt corrosion and wear products, which increase the radiation level in the reactor compartment during maintenance operations. Development and qualification of low or non-cobalt materials is underway.

Naval Reactors employs various methods to test, evaluate, and qualify improved plant materials. Testing and evaluating plant materials provides needed science based performance measures, the ability to predict component performance, and a foundation for advanced material improvements. In addition to permitting development of cost effective remedial actions for existing Fleet problems, testing and evaluating plant materials support advanced technologies for plants with life of the ship reliability and for future high performance components. Materials that have been in service are examined to provide critical operating data on material performance and reliability. Non-destructive testing is generally less expensive and allows repeated examination of materials, as well as analysis of the material condition of components still in service; however, some key data on the strength and vulnerabilities of materials can only be obtained through destructive means.

Verifiable Supporting Activities:

Because understanding the long term behavior of materials and phenomenon such as stress corrosion cracking is an incremental learning process, the verifiable supporting activities described below represent milestones within the continuing overall effort.

FY 2002 Tested fasteners and welded metals to verify hypotheses of stress corrosion cracking mechanisms for use in predictive modeling and application to CVNX- and VIRGINIA-Class development.

Continue thermal and irradiation embrittlement and fracture toughness testing to reduce design conservatism as appropriate and extend operating fleet, VIRGINIA-Class, and CVNX service life.

Conducted engineering testing and qualification of low-cobalt hard surfacing alloys and evaluated their application to CVNX.

Conducted high temperature and pressure testing of new, potentially more robust reactor plant materials using corrosion potential monitoring. Continued thermal and irradiation embrittlement testing of pressure vessel steel.

FY 2003 Continue fastener testing and weld metals testing to verify hypotheses of stress corrosion cracking mechanisms for use in an advanced model for component stress corrosion cracking incorporating temperature, stress, and environmental variables to enable lifetime predictions of advanced component stress corrosion cracking performance.

Support studies of weld parameters changes with the objective of reducing weld residual stresses

Conduct corrosion and cracking testing of new, potentially more robust reactor plant materials using corrosion potential monitoring.

Continue testing and qualifying improved wear resistant low cobalt materials and evaluate their application to CVNX and future plant types.

FY 2004 Develop joint advanced stress corrosion cracking modeling to develop better tools for predicting material reactions to operating plant environment. The improved predictions can potentially decrease the number of required inspections and increase the time between required inspections.

Test and evaluate results from post-service exam of EISENHOWER core fasteners to support fleet applications and stress corrosion cracking model refinement.

Conduct testing to quantify the next generation reactor vessel material margin to ensure material is more resistant to brittle fracture.

Complete development and evaluation of low cobalt valve coating materials, which improve wear of plant machinery and reduce radiation emission.

Initiate preparations for a new Low Level Examination Facility (LLEF) to support irradiated plant materials and component test evaluations.

	FY 2002	FY 2003	FY 2004
C. Conduct irradiation testing and perform detailed examinations to provide data for material performance characterization and prediction…………………………..	**50,304**	**55,300**	**57,600**

Exposing reactor materials to the harsh characteristics of irradiation compounds the demands caused by other environmental factors. The Advanced Test Reactor (ATR), located at the Idaho National Engineering and Environmental Laboratory, produces very high neutron flux, which allows the effects of many years of operation in other reactor environments to be simulated in as short as one-tenth the time. Subsequent evaluations of test specimens in the Expended Core Facility and the

Radioactive Materials Laboratory facilities are the main source of data on the performance of reactor fuel, poison, and structural materials under irradiated conditions.

Operation of the facility is partly funded in the Evaluation and Servicing budget category, work in the Materials Development and Verification category includes fabricating test specimens for insertion into the ATR, designing irradiation test trains to expose materials to selected reactor conditions, and conducting interim and post-irradiation detailed examinations to analyze how the material withstood reactor operating conditions. Test trains are specially engineered structures that hold material specimens in place during irradiation, and are periodically inserted and withdrawn allowing acquisition of data from a wide variety of materials and configurations.

One of the advantages of the ATR is the precision with which the power level (or neutron flux) can be adjusted at the various test positions. An individual test trains internal arrangement and location in the ATR determines exposure to specific conditions.

Naval Reactors continues to develop enhanced systems for high temperature irradiation testing with precise temperature control and environmental monitoring in the ATR.

Verifiable Supporting Activities:

Testing and collection of data from these tests is an ongoing, often long-term activity. The verifiable supporting activities reflect significant testing work. These activities should be viewed as a part of the overall continuing effort.

FY 2002 Conducted transient testing on alternate model fuel elements.

Examined vendor-produced specimens of advanced fuel to assess performance against qualification standards.

Continued long-term examination of irradiation tests to improve understanding of zircaloy corrosion.

Employed Multiple Irradiation Capsule Experiment (MICE) system to increase irradiation capacity and enable further advanced fuel testing.

FY 2003 Design and analyze an additional MICE test train.

Increase the MICE work scope; the focus will be on improved real time neutron flux monitoring, the feasibility of obtaining accurate in-pile dimensional, thermal conductivity, and corrosion film measurements.

Develop and demonstrate advanced techniques for monitoring in-pile test specimens.

Continue transient testing on alternate model fuel elements.

	(dollars in thousands)	
FY 2002	FY 2003	FY 2004

Continue irradiation of vendor-produced specimen of advanced fuel to qualify high integrity fuel for advanced reactor cores.

Continue long-term examination of irradiation tests to improve understanding of zircaloy corrosion and oxide blistering.

Remove RML in-cell waste to allow for increased evaluation capability.

FY 2004 Continue to establish the processes to qualify new fuel and cladding materials and manufacturing methods for advanced concepts core designs.

Continue MICE testing and manufacture irradiation test specimens.

Obtain data on irradiated fuel, poison, clad structural materials for use on current and advanced cores.

Continue transient testing on alternate model fuel elements.

	FY 2002	FY 2003	FY 2004
Total, Materials Development & Verification……………………..	**130,904**	**136,200**	**137,700**

Explanation of Funding Changes from FY 2003 to FY 2004

		FY 2003 vs. FY 2004 ($000)
I.A.	Requirements reflect a decrease in high temperature structural materials work……………………………………………………………………	-800
I.C.	Reflects continued testing in MICE work scope and development of new processes to qualify new fuel and cladding materials……………………	+2,300
Total Funding Change, Materials Development & Verification:…..……………		**+1,500**

Evaluation & Servicing
Mission Supporting Goals and Objectives

Evaluation and Servicing work encompasses the operation, maintenance, and servicing of land-based prototype Naval nuclear propulsion plants, the Advanced Test Reactor, the enhancement of Fleet reactor reliability and longevity through testing and examination of reactor materials, components, and new designs under prototypical operating conditions, development of a spent fuel dry storage facility that will be integral to moving spent nuclear fuel from water pit storage to more environmentally benign dry storage at the Naval Reactors Facility (NRF), and remediation and environmental work at all Naval Reactors sites.

Evaluation and Servicing supports the performance measures for ensuring maximum availability of prototype plants for testing and training, safely and responsibly inactivating shutdown prototype plants, and test facilities supporting Navy goals for extended warship operation, and maintaining excellence in radiological and environmental control.

Included in this effort are post-operation examinations of the core materials and nuclear fuel at the Idaho Expended Core Facility (ECF). End-of-life fuel cell examinations and non-destructive examinations of irradiated test specimens contribute to extended warship operation by validating design predictions, reducing uncertainty with regard to core behavior, and providing information that can be used to improve future designs.

Keeping the prototype plants and the Advanced Test Reactor running efficiently is essential, as information obtained from testing provides valuable feedback for designing new cores and supporting operating Fleet reactor plants. Testing of materials, components, cores, and systems in these reactor plants provides important technical data and experience under actual operating conditions, thereby avoiding potential costly delays when designs are later inserted into the operating Fleet.

The accumulation of operational data from the prototype and Fleet operating plants, expended core examinations, and increases in the capability of computer modeling have enabled Naval Reactors to shut down six of the Program's eight prototype plants resulting in substantial cost savings. Work is aimed at dismantling and laying up the shutdown plants to place them in an environmentally benign state.

The Evaluation and Servicing category also funds ongoing cleanup of facilities at all Naval Reactors sites to reduce hazards to personnel, and reduce potential liabilities due to aging facilities, changing conditions or accidental releases.

Funding Schedule

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Total, Evaluation & Servicing	132,341	152,390	161,300	+8,910	+5.8%

	(dollars in thousands)	
FY 2002	FY 2003	FY 2004

I. Maintain a utilization factor of at least 90% for prototype plants to ensure their availability for scheduled testing, training, and servicing needs, and provide for development of servicing equipment and testing of plant components, materials and procedures.

	FY 2002	FY 2003	FY 2004
A. Operate land-based test reactor plants to provide for prototypical testing, core depletion analysis, and reactor plant operator training……………………………………	**33,100**	**40,200**	**42,000**

Naval Reactors operates the MARF and S8G prototypes on an around-the-clock basis to test and evaluate new/improved equipment, components, materials and operating procedures. Each prototype provides for testing under actual operating conditions far superior to a laboratory environment. A major objective is to aggressively deplete the advanced fleet reactor in S8G to gather data essential to validating the design methods currently in use in SEAWOLF and VIRGINIA-class submarines. Additionally, the data collected is being used in the development of the CVNX aircraft carrier reactor as well as the next-generation submarine reactor core.

The MARF prototype is depleting the developmental materials core at varying power levels, and periodic physics tests are being performed to determine how the nuclear fuel reacts with an advanced poison material being tested in that core. These tests are conducted multiple times over the life of the core to verify predicted behaviors as the fuel depletes.

Naval Reactors performs routine preventive and corrective maintenance on the MARF and S8G prototypes, while also making necessary improvements, to ensure the plants remain in compliance with strict safety and reliability standards. Work necessary for safe, effective prototype operation includes: operating support systems essential for reactor plant operations; monitoring plant and equipment performance to ensure problems are promptly identified and resolved; performing routine radiological monitoring of plant operations and personnel radiation exposure; maintaining proper plant and support system chemistry control; replacing plant components as they age to ensure continued, reliable plant operations; and maintaining technical manuals to reflect changes in operating and test procedures.

Verifiable Supporting Activities:

FY 2002 Performed depletion and testing of the cores in MARF and S8G.

Conducted the sixth MARF high power physics test and various S8G high power physics tests and document results.

Performed thermal analysis on the MARF core and revised the operations manuals to incorporate emergent technical issues.

Conducted operational testing of advanced instrumentation and control equipment to verify its operability and serviceability prior to Fleet implementation.

	(dollars in thousands)	
FY 2002	FY 2003	FY 2004

FY 2003 Meet depletion objectives for MARF and S8G cores.

Conduct the fifth MARF low power physics test and various S8G high power physics tests and document results.

Upgrade site and prototype plant infrastructure including Demineralized Water System Demolition and Site Service Water System modifications.

FY 2004 Meet depletion objectives for MARF and S8G cores.

Complete Cooling Tower Maintenance in conjunction with the S8G Selected Restricted Availability.

Complete periodic integrity testing to verify continued satisfactory performance of the prototype containment systems.

Conduct the seventh MARF high power physics test and various S8G high power physics tests and document results.

Test automated reactor coolant chemistry process at the S8G prototype in support of future Fleet usage. This will allow for more consistent reactor coolant chemistry as automated adjustments are more precise than technician-measured, manual additions.

Test alternate power conversion device at MARF. When successful, this will replace motor generators in operating power plants, making power supply more reliable and easier to maintain.

	FY 2002	FY 2003	FY 2004
B. Service land-based test reactor plants to ensure they continue to operate safely and efficiently, and develop equipment and procedures to provide for safe and efficient servicing of nuclear reactor plants…………….……………….	**6,100**	**17,100**	**16,400**

In order to ensure continued safe and reliable operation of its prototype plants, Naval Reactors performs major servicing efforts according to strict timelines. A major servicing of the S8G prototype plant will be initiated in FY04 and completed in FY05, which includes inspection of key primary loop components, welds, and joints. These types of inspections verify the continued integrity and structural adequacy of the primary plant components and help to maintain the highest safety and operational efficiency standards. Numerous other major work evolutions are planned in conjunction with these prototype servicings, including the overhaul of the main seawater valves and refurbishment of the general material condition of the plant.

Naval Reactors ensures the feasibility of defueling and refueling operations is taken into consideration as part of design and development of new reactor cores. Work in FY04 will focus on completing the next-generation reactor servicing design for the VIRGINIA class submarine,

	(dollars in thousands)	
FY 2002	FY 2003	FY 2004

continuing work on the A1B reactor servicing design, and developing reactor servicing equipment designs to enhance reactor fueling, maintenance and defueling capability. Specifically, Naval Reactors is progressing well on the next-generation reactor servicing design to reduce servicing costs. Included in this work is the development of all-power-unit loading, maintenance and defueling equipment, and all fueling and defueling software, planning documents, and analyses required for shipment and installation of the next-generation reactor power unit, as well as shipment and disposal of recoverable irradiated fuel and irradiated core components. This same work also is continuing for the CVNX reactor to ensure servicing capability through simplified operations to reduce overall CVNX costs. Requirements increase due to a major non-refueling overhaul and associated work evolutions in FY04.

Verifiable Supporting Activities:

FY 2002 Continued design work on next-generation submarine reactor maintenance software.

Continued development of detailed designs for CVNX reactor servicing equipment.

Performed a resin discharge of the S8G prototype.

FY 2003 Support CVNX reactor equipment activities and evaluate CVNX reactor equipment designs to enhance reactor fueling, maintenance and defueling capability.

Continue design work on next-generation submarine reactor maintenance software and hardware.

FY 2004 Develop CVNX designs for reactor head area seal servicing to meet new core closure specifications. The new designs include control rod drive mechanism weld and cutting machines and main omega seal cutting machine.

Begin a major non-refueling overhaul of the S8G prototype, including overhaul of the S8G main seawater valves, and execution of component/weld inspections of the S8G plant.

Perform a resin discharge of the MARF prototype.

Continue development of detailed designs for CVNX reactor servicing equipment.

Complete next-generation submarine reactor maintenance hardware, continue development of maintenance capability software.

C. Operate and service the Advanced Test Reactor to provide for materials irradiations testing…………………….. **18,000** **18,000** **18,000**

	(dollars in thousands)	
FY 2002	FY 2003	FY 2004

As the principal customer of the Advanced Test Reactor (ATR), Naval Reactors funds operation and maintenance of the reactor to support materials irradiations testing. This is the only facility in the nation capable of performing these tests. The ATR provides the ability to irradiate six train-type experiments with various flux conditions in pressurized water or flowing gas loops at the same time. Actual testing is funded in the Materials Development and Verification category.

The ATR is the source of test data on the performance of reactor fuel, poison, and structural materials under irradiated conditions. The irradiation test program supports operating Naval reactor plants, material selections made for the next-generation reactor, and database development that positions Naval Reactors to better understand emergent problems with existing reactors and to make informed material selections for new reactor designs.

Verifiable Supporting Activities:
All Years Meet operating efficiency goals.

II. Meet cost and schedule goals to safely and responsibly inactivate shutdown land-based reactor plants in support of the Department's environmental clean-up goals.

	FY 2002	FY 2003	FY 2004
A. Continue efforts at the Windsor site in Connecticut to release applicable areas for unrestricted use……………………	**1,800**	**500**	**0**

The S1C plant is defueled. Inactivation is complete. All facilities have been removed from the site. Completion of process to satisfy the EPA and the State that the site may be released for unrestricted future use is expected in FY03. Resources decrease as documentation work supporting the inactivation work is finalized and site is released for unrestricted future use.

Verifiable Supporting Activities:

FY 2002 Continued site closeout and release process.

FY 2003 Complete site closeout and release process.

Release land for unrestricted future use.

FY 2004 None.

	FY 2002	FY 2003	FY 2004
B. Continue inactivation efforts at the Kesselring site in New York to eliminate surplus facilities, remediate and dismantle plant facilities, and release applicable areas……….	**22,300**	**12,700**	**15,200**

The S3G and D1G plants at the Kesselring site in New York are defueled. In 1997, an Environmental Impact Statement (EIS) and Record of Decision recommending prompt dismantlement of the S3G and D1G reactor compartments were issued. The EIS had public, state, and local government support. The S3G engine room has been completely dismantled. Ongoing

	(dollars in thousands)	
FY 2002	FY 2003	FY 2004

site/reactor plant-related remediation work is planned for FY04 and future years. This work would reduce radiological and environmental hazard liabilities associated with historic prototype operations, but is limited by funding constraints.

Verifiable Supporting Activities:

FY 2002 Continued D1G pressure vessel removal and continued S3G and D1G reactor compartment disassembly in accordance with the EIS Record of Decision.

FY 2003 Complete removal and shipout D1G pressure vessel for disposal.

Continue S3G and D1G plant disassembly and disposal in accordance with the EIS Record of Decision and consistent with available funding.

FY 2004 Remove S3G primary shield tank.

Pump out, decontaminate and inactivate S3G fuel service facilities water pit.

Continue S3G and D1G plant disassembly and disposal in accordance with the EIS Record of Decision and consistent with available funding.

	FY 2002	FY 2003	FY 2004
C. Continue inactivation efforts in Idaho to eliminate surplus facilities, remediate and dismantle plant facilities and release applicable areas…………………………	**6,741**	**1,800**	**400**

All fuel has been removed from the prototype plants at the Naval Reactors Facility (NRF). The prototype plants are now in a safe layup condition, with all plants being maintained in a low-maintenance, environmentally benign state. Based on progress to date, Program priorities, and budget constraints, minimal site/reactor plant-related remediation effort is planned for FY04 and future years, with additional work to be performed as funding becomes available.

Verifiable Supporting Activities:

FY 2002 Provided engineering direction and subcontracted preparation, placement, and execution for the demolition of NRF buildings no longer needed to support the NRF mission.

FY 2003 Continue preparations for the current characterization and demolition of NRF buildings no longer needed.

FY 2004 Maintain plants in environmentally benign layup.

Demolition of NRF buildings no longer needed.

	(dollars in thousands)	
FY 2002	FY 2003	FY 2004

III. Maintain outstanding environmental performance by ensuring that no personnel exceed Federal limits for radiation exposure and ensure operations have no adverse impact on human health or the quality of the environment.

	FY 2002	FY 2003	FY 2004
A. Conduct ongoing cleanup of site facilities to reduce potential hazards to personnel and reduce potential liabilities due to changing conditions or accidental releases……………	**25,700**	**30,900**	**41,110**

Operation of test, examination, and manufacturing facilities has involved the use of hazardous materials. Decontamination and unconditional release of previously contaminated facilities minimizes potential the environmental, health and safety impact of those facilities, with the benefit of making previous site areas available for reuse. This work reduces the potential for materials such as asbestos, heavy metals, other chemicals, or radioactivity to enter into the environment. To validate the effectiveness of remediation work, environmental monitoring and control efforts are in place to ensure compliance with all regulations at all Naval Reactors' sites.

Remediation is achieved through a deliberate multi-step process which may involve facility structures and equipment being cleaned, physically abraded, or removed according to strict engineering controls that protect personnel and the environment, and that minimize the amount of waste generated. Resultant wastes are packaged and disposed of off-site according to applicable requirements. Facilities are surveyed and sampled to verify the contamination has been removed.

Facilities and equipment are characterized to determine the extent and nature of cleanup needed. The results of these characterizations are analyzed and the work prioritized based on regulatory requirements and resources available to perform the work. As such, the order in which the following verifiable supporting activities are performed is subject to change based on this prioritization process. Requirements reflect increased remediation efforts planned for FY04 and beyond.

Verifiable Supporting Activities:

FY 2002 Continued remediation of obsolete fuel processing facility at the Bettis Pittsburgh site.

Continued decontamination and stabilization of selected Knolls site areas to reduce potential environmental liabilities.

Continued selected CERCLA remediation activities at NRF site.

Disposed of ECF radiological systems and areas no longer in use.

FY 2003 Remediate and dispose of equipment from obsolete fuel-processing facility at the Bettis-Pittsburgh site.

(dollars in thousands)		
FY 2002	FY 2003	FY 2004

Sample, characterize, and remediate, as necessary, radiological tanks, sumps, pits, and other potential sources of environmental release and personnel exposure on the Bettis-Pittsburgh site.

Provide engineering direction and subcontract preparation, placement, and execution for the repair and maintenance of the prototype buildings. Additionally, conduct remedial actions at NRF based on the Record of Decision.

Remove highly contaminated equipment from the Bettis-Pittsburg site L-Building, while decontaminating other inactive radiological areas on site.

Maintain layup support systems in working condition and perform environmental monitoring to ensure that the plants remain in a safe, environmentally benign state.

Continue decontamination and removal of obsolete systems at ECF.

Continue decontamination and stabilization of selected Knolls site areas and removal of old test reactor facilities to reduce potential environmental liabilities.

FY 2004 Remove radiological legacy waste from Radioactive Materials Laboratory at KAPL-Knolls site.

Remove regulated materials from various buildings at KAPL-Knolls site.

Conduct remediation of obsolete facilities to reduce potential environmental liabilities at all program sites, such as the obsolete fuel facility at the Bettis-Pittsburgh site.

Develop the preliminary design efforts for establishing the infrastructure associated with the deconstruction of the Materials Evaluation Laboratory, Hot Waste Building, N-Building W4R and W5R laboratories, and piping servicing these facilities.

Continue waste processing in the Waste Reduction Facility.

Continue CERCLA remediation work at NRF site.

Continue environmental sampling and remediations at the KAPL-Knolls site.

IV. Conduct planned development, testing, examination and evaluation of nuclear fuel systems, materials, and manufacturing and inspection methods to ensure Naval nuclear reactors are able to meet Navy goals for extended warship operation.

A. Examine removed fuel cells at end-of-life and perform non-destructive examinations of irradiated test

	(dollars in thousands)		
	FY 2002	FY 2003	FY 2004
specimens to confirm predicted performance and validate design methods……………………………………	**18,600**	**31,190**	**28,190**

This effort concentrates on the examination of expended reactor cores and irradiated test specimens to provide data necessary for further operation of nuclear reactors in the fleet and future generation of nuclear reactors. The results of examinations are used to reduce uncertainties in behavior of cores and components, to produce improvements in existing ship performance, and to extend reliable operational life. Predictive and analytical tools are updated based on differences between calculations and observed performance and are used to ensure the safety and improve the performance of reactor designs. Work in this area includes support for the initiation of a spent fuel dry storage facility that will allow for the return and placement into dry storage of Naval spent nuclear fuel currently stored at the Idaho Nuclear Technology and Engineering Center (INTEC) to the Naval Reactors Facility (NRF).

Verifiable Supporting Activities:

FY 2002 Provided support for shipping of all hazardous and radioactive waste from NRF.

Continued core component examinations of D2W prototype, A4W/A1G prototype, and S5G prototype cores.

Developed tooling and examine scheduled ATR irradiated test specimens.

FY2003 Provide waste disposal and shipping support for NRF.

Assemble, disassemble, and ship irradiated test specimens for ATR.

Perform examinations of A1G/A4W, D2W, and S8G core components.

Provide support for the establishment of dry storage cababilities for spent Naval fuel, including fuel module basket designs and core dependent Safety Analysis Report/Safety Analysis Report for Packaging (SAR/SARP).

Support startup of spent fuel dry storage facility at NRF in preparation of spent fuel shipments from INTEC.

FY 2004 Provide support for the establishment of dry storage capabilities for spent Naval fuel by evaluating materials and fuel elements to ensure they do not release fission products under environmental conditions found in the repository.

Procure fuel element punch equipment for removing expended fuel samples for hot cell analyses to compare actual fuel reactions to predicted fuel reactions.

Provide general project support to prepare for and execute ECF construction projects.

	(dollars in thousands)	
FY 2002	FY 2003	FY 2004

Perform nuclear criticality and safety analyses to ensure configurations of moving and stored fuel elements meet safety standards.

Provide support for shipping of all hazardous and radioactive waste from NRF.

Continue A1W-3 and commence miscellaneous fuel type dry fuel storage, transportation, and repository evaluations and fuel type LCC criticality analyses.

	FY 2002	FY 2003	FY 2004
Total, Evaluation and Servicing.	**132,341**	**152,390**	**161,300**

Explanation of Funding Changes from FY 2003 to FY 2004

		FY 2003 vs. FY 2004 ($000)
I.A.	Funding level reflects increased operation and maintenance costs associated with FY04 non-refueling overhaul…………………………………………..….	+1,800
I.B.	Decrease due to completing an emergent S8G non-refueling major equipment replacement in FY03……………………………….…………..	-700
II.A.	Resources decrease to zero when the site is released for unrestricted future use.	-500
II.B.	Reflects increased effort to inactivation efforts at the Kesselring site.	+2,500
II.C.	Requirements decrease based on progress to date, Program priorities, and budget constraints ……………………….…………………………….……….	-1,400
III.A.	Requirements reflect increased remediation efforts planned for FY04…….	+10,210
IV.A.	Decrease due to completing emergent procedural requirements to support improved dry storage effort at NRF in FY03……………………………..	-3,000
Total Funding Change, Evaluation and Servicing…………………………		**+8,910**

Program Direction
Mission Supporting Goals and Objectives

Due to the critical nature of nuclear reactor work, Naval Reactors is a centrally managed organization. This places a heavy burden on the Federal employees who oversee and set policies/procedures for developing new reactor plants, operating existing nuclear plants, facilities supporting these plants, contractors, and the Bettis and Knolls Atomic Power Laboratories. In addition, these employees interface with other DOE offices and local, state, and Federal regulatory agencies.

The FY 2004 request includes Working Capital Fund resources to cover the costs of goods and services at Naval Reactors' Headquarters such as payroll processing and telephone services.

Funding Schedule

(dollars in thousands, whole FTEs)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Headquarters					
Salary and Benefits……………………….	7,466	8,525	9,005	+480	+5.6%
Travel………………………………………	520	530	540	+10	+1.9%
Support Services…………………………	0	0	0	0	0%
Other Related Expenses…………………	700	1,060	1,080	+20	+1.9%
Total, Headquarters………………………	8,686	10,115	10,625	+510	+5.0%
Full Time Equivalents……………………	56	57	57	0	0%
Pittsburgh Naval Reactors					
Salary and Benefits……………………….	6,365	6,655	6,935	+280	+4.2%
Travel …………………………………….	125	130	135	+5	+3.8%
Support Services…………………………	0	0	0	0	0%
Other Related Expenses…………………	950	970	990	+20	+2.1%
Total, Pittsburgh Naval Reactors ………	7,440	7,755	8,060	+305	+3.9%
Full Time Equivalents……………………	71	70	70	0	0%

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Schenectady Naval Reactors					
Salary and Benefits……………………….	5,310	5,625	5,805	+180	+3.2%

Travel	95	95	95	0	0%
Support Services	0	0	0	0	0%
Other Related Expenses	595	610	615	+5	+0.8%
Total, Schenectady Naval Reactors	6,000	6,330	6,515	+185	+2.9%
Full Time Equivalents	64	64	64	0	0%
Total Naval Reactors Program					
Salary and Benefits	19,141	20,805	21,745	+940	+4.5%
Travel	740	755	770	+15	+2.0%
Support Services	0	0	0	0	0%
Other Related Expenses	2,245	2,640	2,685	+45	+1.7%
Total, Program Direction	22,126[1]	24,200	25,200	+1,000	+4.1%
Full Time Equivalents	191	191	191	0	0%
Additional net budget authority to cover the cost of fully accruing retirement (non-add)	1,228	1,230	1,313	+83	+6.7%

[1]This reflects a $474,000 administrative and travel rescission.

Detailed Program Justification

(dollars in thousands)

FY 2002	FY 2003	FY 2004

Salaries and Benefits……………………………………………… **19,141** **20,805** **21,745**
Federal Staff continue to direct technical work and provide management/oversight of laboratories and facilities to ensure safe and reliable operation of Naval nuclear plants. Naval Reactors' staffing projections are in accordance with Departmental employment ceilings. The change is due to projected salary adjustments in accordance with allowable inflation and achieving FTE target in FY04.

Travel…………………………………………………………… **740** **755** **770**
Travel includes funding for the transportation of Government employees, their per diem allowances while in authorized travel status and other expenses incidental to travel. FY 2003 travel funding supports trips required to provide management and oversight of the Naval Reactors Program. FY04 requested funding represents only inflationary growth compared to FY03.

Support Services……………………………………………… **0** **0** **0**
Naval Reactors does not use Support Services contractors.

Other Related Expenses………………………………………… **2,245** **2,640** **2,685**
Includes provision of funds for the Working Capital Fund, based on guideline estimates provided by the Working Capital Fund Manager. Funding also supports goods and services such as training and ADP maintenance, and includes labor costs for Bettis contractor services and ADP requirements for NR Headquarters' internal classified local area network.

Total, Program Direction………………………………………… **22,126**[1] **24,200** **25,200**

Additional Cost of Fully Accruing Federal Retirements **1,228** **1,230** **1,313**

[1]This reflects a $474,000 administrative and travel recission.

Explanation of Funding Changes FY 2003 to FY 2004

	FY03 vs. FY04 ($000)
Salaries and Benefits… The change is due to salary adjustments in accordance with allowable inflation and achieving FTE target in FY04.	**+940**
Travel… The change is due to adjustments in accordance with allowable inflation.	**+15**
Other Related Expenses… The change is due to adjustments in accordance with allowable inflation.	**+45**
Total Funding Change, Naval Reactors Program Direction…	**+1,000**

Other Related Expenses

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Training…	127	137	140	+3	+2.2%
Working Capital Fund and Rent …	350	560	560	0	0.0%
Software Procurement/Maintenance Activities/ Capital Acquisitions…	750	860	875	+15	+1.7%
Other…	1,018	1,083	1,110	+27	+2.5%
Total, Budget Authority…	2,245	2,640	2,685	+45	+1.7%

Capital Operating Expenses & Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 2002	FY2003	FY 2004	$ Change	% Change
General Plant Projects	14,100	16,200	12,900	-3,300	-20.4%
Capital Equipment	32,900	25,800	44,800	+19,000	+73.6%
Total, Capital Operating Expense	**47,000**	**42,000**	**57,700**	**+15,700**	**+37.4%**

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior Year Approp-riations	FY 2002	FY 2003	FY 2004	Unapprop-riated Balance
90-N-102 Expended Core Facility Dry Cell	109,500	84,011	4,200	2,000	18,300	989
01-D-200 Major Office Replacement Building	12,397	1,297	9,000	2,100	0	0
03-D-201 CleanroomTechnology Facility	7,500	0	0	7,200	300	0
Total, Construction		**85,308**	**13,200**	**11,300**	**18,600**	**989**

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

	(dollars in thousands)					
	Total Estimated Cost (TEC)	Prior Year Appropriations	FY 2002	FY 2003	FY 2004	Acceptance Date
Network Upgrade	3,000	0	0	0	1,000	FY 2006
Local Area Network Replacement	4,900	3,300	1,600	0	0	FY 2002
Low Level Exam Equipment	4,800	0	0	0	700	FY 2006
Generic I&C	5,400	0	0	0	100	FY 2009
Scalable Computer Modification/Upgrade	10,728	6,728	4,000	0	0	FY 2002
Scalable Parallel Supercomputer	2,000	0	0	2,000	0	FY 2003
Scalable Parallel Supercomputer	14,000	0	0	0	14,000	FY 2004
S8G Prototype/Off Hull	6,100	0	0	0	1,400	FY 2007
Network Convergence	3,100	0	0	0	1,500	FY 2006
Total, Major Items of Equipment		10,028	5,600	2,000	18,700	

03-D-201, Cleanroom Technology Facility, Bettis Atomic Power Laboratory, West Mifflin, Pennsylvania

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

Significant Changes

In order to provide the most functional cleanroom possible to support current and future programmatic needs, the installation of the Molecular Beam Epitaxy (MBE) deposition system is now included in the project. This will be accommodated by removing the Optics Laboratory, including Laser laboratory and Storage Shed, the roadway upgrade, and parking lot expansion from the scope of the project. Most of the cost will be incurred in Fiscal 2004 due to the need to obtain the services of a new Engineering Services Subcontractor (EES) to perform the final design—the original EES experienced financial difficulties and went into receivership.

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 2003 Budget Request[1]	2Q 2002	3Q 2002	2Q 2003	2Q 2004	7,500	8,600
FY 2004 Budget Request	3Q 2002	1Q 2003	2Q 2003	2Q 2004	7,500	8,647

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
2003	7,200	6,950	950
2004	300	550	6,550

3. Project Description, Justification and Scope

The Cleanroom Technology Facility (CTF) will be constructed outside of the existing perimeter fence in the ball field area at the Bettis Atomic Power Laboratory, West Mifflin, Pennsylvania. The construction effort will include the erection of a new, two-story building. At the center of this facility is a Class 100, International Standards Organization (ISO) Level 5, which is included in the Cleanroom Complex, approximately 13,200 square feet (SF) in size. This micro-particulate-controlled laboratory has been designed with three independent bays to provide exceptional versatility. Process and facility mechanical equipment will be located in the first floor Mechanical Room. A 3,600 square foot office area will be constructed for those personnel who normally operate the facility. The electrical power distribution equipment will be located in the adjoining Electrical Room. The second floor air handling unit deck on which will be placed the ventilation equipment for the facility will be approximately 6,900 square feet in size. Recirculating and makeup air handling units will be located on the air handling unit deck above the

[1] Naval Reactors' FY 2002 budget request included approximately $0.6 million for preliminary design of the Cleanroom Technology Facility for Bettis Atomic Power Laboratory.

cleanroom, with access available through the Mechanical Room. The installation of a Molecular Beam Epitaxy (MBE) deposition system and Electrical Characterization Laboratory has also been designed as part of the building to support performance characterization.

There will also be non-laboratory spaces constructed in the facility. These spaces will include restroom facilities, maintenance areas, a room for installation of computer cabinets to provide the computer network to the facility, and a storage room. A vestibule area will be provided through which all personnel will enter and exit the facility. The overall building height is approximately 40 feet.

The new facility will be typical of standard commercial/industrial construction; the cleanroom areas will reflect current construction practices for this type of facility. Normal building utilities including lighting, electric power, building steam, conditioned air, potable water, and storm and sanitary drainage will be provided. The construction of this facility will also include the extension of the existing perimeter fence once the construction of the new facility is completed.

The objective of this construction project is to enable the Naval Reactors Program to lead and to continue development of thermophotovoltaic (TPV) technology by creating a facility with environmental controls consistent with the processing of high performance, semiconductor devices. The current inability to control temperature, humidity, and particle count in a reliable manner significantly hinders progress toward a high efficiency energy conversion concept.

In the near term, the CTF will be utilized for Advanced Concepts to process and characterize TPV energy conversion devices. A cleanroom facility is considered to be the only method to control particulates, temperature, and humidity to the degree necessary to fabricate high performance TPV devices. In the longer term, this facility can support other technology development initiatives, such as alkali metal-based power conversion systems or other solid-state electronics research. This new facility represents an enabling infrastructure investment, significantly broadening and improving the scope of research that can be completed in-house for the Naval Reactors Program. This facility also will reduce costs and time expenditures associated with repetitious experiments, and eliminate the material damage that is attributed to the currently, poorly controlled environmental conditions. The failure to construct this facility as planned will result in the continued production of TPV devices with defects. It is clear that the challenging device technology goals of the Naval Reactors TPV development program can better be achieved by establishing more stringent control of environmental factors during device processing.

There is insufficient available space at the Bettis Atomic Power Laboratory to support current Naval Reactor Programs Advanced Concepts directives. Decontamination of existing space is not a viable option to support the Advanced Concepts program in a timely manner. Use of off-site space creates logistical problems and increases overhead costs while decreasing efficiency. Of greater concern, should continued progress in one or more Advanced Concepts Technologies result in a reclassification of this work, are the security aspects of such work which could become prohibitive. The only viable option at this time to support on-going and future developmental efforts is the construction of a new facility. Since this is a new construction project in a relatively pristine area, the typical problems associated with construction will be minimal. As a result, it is considered that the project will be completed within the schedular constraints and cost identified above.

The construction of the CTF will create within the Naval Reactors Program an improved platform for technology development. Immediately, the CTF will enable the aggressive pursuit of promising power conversion technologies such as TPV. In the longer term, this far-sighted infrastructure investment will underwrite a myriad of developments yet to be identified, and will help to ensure that our current nuclear propulsion technology remains unparalleled among the world's navies and is optimally suited to changing national needs.

This project is scheduled to be completed in September 2004.

4. Details of Cost Estimate

	(dollars in thousands)	
	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design Costs	0	600[1]
Total, Engineering Design	0	600
Construction Phase		
Improvements to Land	173	230
Buildings	6,409	5,445
Utilities	138	160
Standard Equipment	24	100
Inspection, design and project liaison, testing, checkout and acceptance	237	285
Project Management (0.5% of TEC)	40	40
Total, Construction Costs	7,021	6,260
Contingencies		
Construction Phase (6.4% of TEC)	479	1,240
Total, Contingencies (6.4% of TEC)	479	1,240
Total, Line Item Costs (TEC)	7,500	8,100

Total estimate is based upon the current estimate for the final design of of the Cleanroom Technology Facility completed to date.

[1]Naval Reactors' FY 2002 budget request included approximately $0.6 million for preliminary and final design of the Cleanroom Technology Facility for Bettis Atomic Power Laboratory.

5. Method of Performance

Contracting arrangements are as follows:

a. Construction design will be performed under the Bettis Engineering Services Subcontract.

b. Construction and procurement will be accomplished by fixed price contracts awarded on the basis of competitive bidding.

c. Title III Inspection: By the operating contractor with support by the Bettis Engineering Services Subcontractor.

6. Schedule of Project Funding

(dollars in thousands)

	Prior	FY 2002	FY 2003	FY 2004	Total
Project Cost					
Facility Cost					
Construction	0	0	950	6,550	7,500
Total Line Item TEC/Facility Costs	0	0	950	6,550	7,500
Other Project Costs					
Conceptual design costs……….	440	10	0	0	450
NEPA Documentation Costs…...	50	10	0	0	60
Other Project Related Costs[1]	0	600	0	37	637
Total, Other Project Costs……..	490	620	0	37	1,147
Total Project Cost (TPC)……….	490	620	950	6,587	8,647

7. Related Annual Funding Requirements

	(FY 2004 dollars in thousands) Current Estimate	Previous Estimate
Annual Facility Maintenance/Repair Costs[2]………………………………………...	146	130
Utility Costs (estimate based on FY 2002 rate structure)[3]……………….	108	88
Total Related Annual Funding………………………………………………………..	254	218
Total Operating Costs (operating from FY 2004 through FY 2028)………………...	6,350	5,450

[1] Includes preliminary and final design funds that will be charged to operating/expense funds.
[2] Includes personnel and material costs for maintenance and repair.
[3] Based on current usage projection; includes electrical power and natural gas use.

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.

The project will be located in an area not subject to flooding, determined in accordance with Executive Order 11988.

Bettis has reviewed various other existing cleanrooms in the Pittsburgh area and has found that the alternatives do not meet the technical requirements and have not been found to be satisfactory.

01-D-200, Major Office Replacement Building, Schenectady, New York

(Changes from FY2003 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 2001 Budget Request (Preliminary Estimate)	1Q2001	4Q2001	4Q2001	4Q2003	$12,400	$13,720
FY 2003 Budget Request	1Q2001	4Q2001	4Q2001	1Q2004	$12,397	$13,717
FY 2004 Budget Request	1Q2001	4Q2001	4Q2001	1Q2004	$12,397	$13,927

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design/Construction			
2001	1,297	1,297	534
2002	9,000	9,000	3,950
2003	2,100	2,100	7,616
2004	0	0	297

3. Project Description, Justification and Scope

A replacement building is needed at Knolls Atomic Power Laboratory (KAPL) to provide office and storage space. The project will replace two existing buildings and six temporary structures and trailers. KAPL will demolish both existing buildings and the temporary structures, and dispose of the trailers. A detailed study found constructing a new building would be more cost effective (25% life cycle savings) than renovation and expansion of the existing buildings which date back to the 1950's.

A new three-story building will be located on the site of one of the buildings to be demolished. The building will be constructed to the latest energy efficiency and safety standards and make use of low maintenance materials to minimize future cost. The building will utilize an open office layout to create approximately 500 flexible, efficient office spaces. Along with the open office layout the building will have an integral fiber optic network for utilization with desktop computing, as well as open storage areas to facilitate future rearrangements. Heating, ventilation, and air conditioning will be provided by central station air handling units incorporating filters, chilled water cooling coil, hot water heating coil, supply and return fans, and air side economizer. As part of the project, KAPL will procure modular furniture to outfit the building as existing furniture dates to construction of the existing buildings/structures.

KAPL has evaluated several alternatives including construction of multiple smaller office facilities, renovation of existing facilities, and relocation of personnel to alternate sites. All of these alternatives have higher life cycle costs and do not meet laboratory needs.

FY 2001 construction funds were used for site preparation work, including demolition of existing facilities, installation of a security fence, and modifications to existing on site utilities.

FY 2002 construction funds were used to place a design-build contract for the new office building.

FY 2003 construction funds will be used to complete outfitting the building.

This new facility will provide sufficient office space to return employees from temporary locations, and greatly improve the organizational grouping of personnel, thus improving workforce efficiencies.

4. Details of Cost Estimate[a]

	(Dollars in thousands)	
	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design drawings and Specifications)	140	140
Design Management costs (0.3% of TEC)	35	35
Project Management costs (0.2% of TEC)	25	25
Total, Engineering design inspection and administration of construction costs (1.6% of TEC)	200	200
Construction Phase		
Buildings	8,097	8,097
Other Structures	0	0
Utilities (Electrical/Civil)	900	800
Standard Equipment (Modular Furniture/Office Equipment)	1,650	1,600
Removal less salvage	200	250
Inspection, design and project liaison, testing, checkout and acceptance	470	550
Construction Management (3.2% of TEC)	400	400
Project Management (0.7% of TEC)	80	100
Total, Construction Costs	11,797	11,797
Contingencies		
Design Phase	0	0
Construction Phase (3.2% of TEC)	400	400
Total, Contingencies (3.2% of TEC)	400	400
Total, Line Item Cost (TEC)	12,397	12,397

[a] The cost estimate is based on detailed design estimates.

5. Method of Performance

Contracting arrangements are as follows:

Building design/construction will be accomplished via one fixed price (design/build) awarded on the basis of competitive best design. Furniture, computer networking and security system procurement/installation will also be accomplished under the design-build contract. Site preparation work will be accomplished by fixed contracts awarded on the basis of competitive bidding.

6. Schedule of Project Funding

	(dollars in thousands)				
	Prior	FY 2002	FY 2003	FY2004	Total
Project cost					
Facility Cost					
Design	200	0	0	0	200
Construction	1,097	9,000	2,100	0	12,197
Total Facility Cost, Line Item TEC	1,297	9,000	2,100	0	12,397
Other Project Costs	0	141	50	0	191
Conceptual design cost	270	25	0	0	295
Decontamination & Decommissioning	825	219	0	0	1,044
Total Other Project costs	1,095	385	50	0	1,530
Total Project Cost (TPC)	2,392	9,385	2,150	0	13,927

7. Related Annual Funding Requirements

	(FY 2003 dollars in thousands)	
	Current Estimate	Previous Estimate
Annual facility operating costs [a]	235	235
Utility costs (estimate based on FY 1997 rate structure)[b]	190	190
Total related annual funding	425	425
Total operating costs (operating from FY 2004 through FY 2034)	12,750	12,750

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 provision 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 CRF 101-19.6.)

This project will be located in an area not subject to flooding determined in accordance with Executive Order 11988.

This project provides replacement office space for personnel currently working at the KAPL facility. Laboratories and test facilities require this office space be provided at the KAPL-Knolls Site.

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[a] Includes personnel and M&R cost (exclusive of utility cost) for operation, maintenance, and repair of the MORB

[b] Including utility cost for operation of the MORB which will begin in FY 2004.

90-N-102, Expended Core Facility Dry Cell, Naval Reactors Facility, Idaho

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

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 1990 Budget Request (Preliminary Estimate)	1Q 1990	3Q 1991	3Q 1991	4Q 1995	48,800	49,936
FY 1996 Budget Request[a]	1Q 1990	4Q 1991	2Q 1993	4Q 1998	48,646	51,027
FY 1998 Budget Request[b]	1Q 1990	2Q 1999	2Q 1993	4Q 2001	62,046	79,604
FY 1999 Budget Request[c]	1Q 1990	2Q 2000	2Q 1993	4Q 2002	84,946	96,117
FY 2000 Budget Request[d]	1Q 1990	2Q 2000	2Q 1993	4Q 2002	86,846	98,694
FY 2002 Budget Request[e]	1Q 1990	2Q 2000	2Q 1993	4Q 2002	88,246	99,907
FY 2003 Budget Request[f]	1Q 1990	2Q 2000	2Q 1993	2Q 2006	109,500	120,883
FY 2004 Budget Request	1Q 1990	2Q 2000	2Q 1993	2Q 2006	109,500	120,947

[a] Reflects changes due to a June 1993 Court Injunction which placed the Dry Cell Project on hold, until an agreement was reached between the Department of Energy and State of Idaho in October, 1995.

[b] Added the East End Modification to accommodate Dry Fuel Storage.

[c] Added the West End Modification to accommodate return of spent fuel from the Idaho Nuclear Technology and Engineering Center (INTEC) to the Expended Core Facility.

[d] Included additional funding to perform design and facility modifications to accommodate the potential use of a larger fuel module within the Dry Cell.

[e] Realigned contingency based on 45% completion of the West End Modification Title II Design. In addition, the TEC and schedule reflect completion of the West End Modification Title I Design.

[f] Reflects work scope changes necessary to address radiological contamination control and facility throughput issues.

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
1990	3,546	3,546	1,564
1991	4,000	4,000	3,129
1992	15,000	15,000	4,238
1993	13,600	13,600	10,078
1994	0	0	2,410
1995	0	0	555
1996	3,000	3,000	7,557
1997	8,000	8,000	13,908
1998	3,100	3,100	5,559
1999	5,800	5,800	2,825
2000	12,000	12,000	11,661
2001	15,965	15,965	8,064
2002	4,200	4,200	942
2003	2,000	2,000	7,600
2004	18,300	18,300	13,965
2005	989	989	12,193
2006	0	0	3,252

3. Project Description, Justification and Scope

When all phases are completed, the Expended Core Facility (ECF) Dry Cell Project will consist of shielded fuel handling, dry storage loading facilities, an area for overpack assembly, an interim storage pad, and two dry storage container loading stations.

Two independent basket-loading areas will be installed in the ECF water pits. Features of the loading facility include the water pit to dry cell delivery system, a shielded basket transfer system, two basket loading stations and two prepared fuel loading stations. The revised systems will use proven fuel handling practices that are consistent with those used throughout the Naval Reactors Program. The complete facility will have a design life of at least 40 years.

The Dry Cell Project consists of three separate tasks: the Dry Cell, the East End Modification, and the West End Modification. The Dry Cell task provides work areas and equipment needed to more efficiently handle expended nuclear cores. This task is being modified due to concerns for the ability to repair the highly radiologically contaminated in-cell equipment, lack of redundancy in the process and the resulting impact on throughput. Spent Naval Nuclear Fuel will be loaded into Spent Fuel Canister (SFC) baskets in the ECF water pits. Two basket-loading areas will be installed in the ECF water pits. Loaded baskets will be transferred in a shielded basket transfer container to one of two prepared fuel loading stations and loaded into a SFC.

The East End Modification task provides facilities and equipment for loading dry storage containers. An interim storage pad will be provided for in-process handling, staging, and interim storage of naval spent nuclear fuel. An area for assembly of overpacks will be constructed adjacent to the interim storage pad. The overpack assembly area and interim storage pad will add an additional 35,000 square foot structure separate from the existing ECF building. This task is approximately 61 percent[a] complete.

The West End Modification task is for the design and fabrication of the equipment and facilities for the second prepared fuel-loading station, and for receiving fuel returned from INTEC that will also be loaded into SFCs. The West End Modification will provide sufficient crane capacity and rail shipping capability to allow future loading of the SFC Shipping Cask for shipment to a permanent repository. The West End Modification task in combination with the Dry Cell Task and East End Modification Task, will result in an approximately 28,835 square foot addition to the existing ECF building. This task is approximately 24 percent complete.

A two loading station arrangement will allow processing fuel returned from INTEC in the West End Loading Station while concurrently processing spent fuel received directly from the fleet for dry storage in the east loading station. The increased capacity of the overall Dry Cell will facilitate a more rapid return of spent fuel from INTEC. In addition, the arrangement allows future packaging of special case waste through one of the loading stations without interruption of dry storage container loading.

An independent review of the final design identified potential adverse fuel handling and throughput issues. The review team found that while the planned process which included dry processing and dry storage lines is viable, concerns arose regarding sustaining the long-term spent fuel throughput needed to meet the court-enforceable obligation to move all spent fuel from wet storage to dry storage by 2023. This throughput concern is driven by potential single point failures and radiological vulnerabilities that would be extremely difficult to overcome. The project is being modified to incorporate shielded fuel handling and a new dry storage overpack loading station. These improvements will increase fuel handling capability, facility accessibility from a radiological viewpoint, equipment maintenance, and will ensure the Program can meet the required throughput over the next two decades.

The project is scheduled to complete in September 2006. Through FY 2003, 73% of the project is expected to be completed.

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[a] Adjusted from 96 percent based additional funds received in FY03 to accommodate work scope changes indicated in section 1.

4. Details of Cost Estimate[a]

	(dollars in thousands)	
	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design cost ($5,663,000 for Design Drawings and Specification)	15,387	15,387
Design Management costs (2.8 % of TEC)	3,059	3,059
Project Management costs (2.6 % of TEC)	2,850	2,850
Total, Engineering design, inspection, and administration of construction costs (19.4% of TEC)	21,296	21,296
Construction Phase		
Buildings	43,014	43,014
Special Equipment	19,926	19,926
Standard Equipment	5,727	5,727
Inspection, design and project liaison, testing, checkout and acceptance	9,232	9,232
Project Management (2.6 % of TEC)	2,850	2,850
Total, Construction Costs	80,749	80,749
Contingencies		
Design Phase (1.4 % of TEC)	1,491	1,491
Construction Phase (5.4 % of TEC)	5,964	5,964
Total, Contingencies (6.8 % of TEC)	7,455	7,455
Total, Line Item Costs (TEC)	109,500	109,500

The cost estimate is based on the Dry Cell task being complete, the East End Modification task Title II design being complete and the West End Modification task Title II design being complete.

5. Method of Performance

Contracting arrangements are as follows:

a. Construction design will be performed under an Engineering Services Subcontract. Equipment will be designed by the prime contractors.

b. Construction and procurement will be accomplished by fixed price contracts awarded on the basis of competitive bidding.

c. Title III Support: By Engineering Services Subcontractor under operating contractor surveillance.

[a] The annual escalation rates assumed for FY 2003, FY 2004, FY 2005 and FY 2006 are 2.1%, 2.5%, 2.9% and 2.8%, respectively.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 2003	FY 2004	FY 2005	FY 2006	Total
Project cost						
Facility Cost						
Design	19,196	1,923	1,923	427	0	23,469
Construction	53,294	5,677	12,042	11,766	3,252	86,031
Total, Line item TEC	72,490	7,600	13,965	12,193	3,252	109,500
Operating expense funded equipment[a]	4,351	0	0	0	0	4,351
Total Facility Costs	76,841	7,600	13,965	12,193	3,252	113,851
Other project costs						
Conceptual design cost	1,601	175	0	0	0	1,776
Decontamination & Decommissioning[b]	1,184	0	0	0	0	1,184
NEPA Documentation Costs	2,500	0	0	0	0	2,500
Other project-related costs[c]	1,286	50	100	100	100	1,636
Total, Other project costs	6,571	225	100	100	100	7,096
Total project cost	83,412	7,825	14,065	12,239	3,352	120,947

[a] Includes costs for adaptation of existing storage overpacks for the selected Naval Spent Fuel Canisters (NSFCs); development of container welding systems; and procurement of weld mockups and two sets of NSFCs and overpacks for facility and system testing and checkout. Prior Years figures include costs of $50,000 and $100,000 respectively for the design and fabrication of the temporary west shield wall.

[b] Prior Years figures include costs for removal of the spray pond and Butler Buildings 10 and 10A.

[c] Includes costs for procurement of several prototype items to support equipment design and confirm system operations, for facility startup, and for operator training.

7. Related Annual Funding Requirements

	(FY 2006 dollars in thousands)	
	Current Estimate	Previous Estimate
Facility operating costs[a]	4,506	4,506
Utility costs[b]	574	574
Total related annual funding	5,080	5,080
Total operating costs[c] (operating from FY 2002 through FY 2042)	203,200	203,200

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.

The project location in an area subject to flooding has been evaluated and the findings, determined in accordance with Executive Order 11988, are that the project can be designed and constructed to withstand the probable maximum flood.

The Dry Cell and dry loading stations are unique facilities and similar systems and space are not available at other Federal Scientific Laboratories.

[a] Includes personnel, materials, and capital equipment costs for operation, maintenance, and repair.

[b] Includes electrical power, steam heat, and maintenance items such as utility lines, valves, and pumps.