Naval Reactors
Program Mission

Naval Reactors is responsible for all naval nuclear propulsion work, beginning with technology development, 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 national defense demands.

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 or 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 102 operating Naval reactor plants. Most of the work within the Naval Reactors Program is directed to ensuring the safe reliable operation of these plants. Naval Reactors also is continuing shipboard acceptance testing on the next-generation reactor for the Navy's new VIRGINIA-class attack submarines and is developing the reactor for the Navy's new CVNX-class aircraft carrier. 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.

The VIRGINIA-class will provide needed capability for the 21st century at an affordable price. This plant encompasses advanced component and system technology—including the first true life-of-the-ship core, which will make future refuelings unnecessary, and a simplified plant arrangement with fewer components (compared to previous designs). Reactor plant testing is well underway and will be complete in 2003. The lead submarine incorporating this plant should go to sea in 2004.

Naval Reactors is designing and developing an overall new reactor for the new CVNX-class aircraft carriers. This new design 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 approximately 25 percent more energy than the reactors in NIMITZ-class ships and will have more than triple the electric power available, but will require just half the number of Sailors to operate and will be easier to maintain. By contrast, the reactors used in the current NIMITZ class are a 1960's design, and have no more margin for growth in power output; this means Naval Reactors can no longer incorporate all the technical advances that would provide substantial life cycle cost savings, improved survivability, greater operational availability, better offensive capability, and more strategic flexibility.

The CVNX lead ship is expected to be authorized by 2007 and to go to sea by 2014. The time to develop the reactor is constrained and development, therefore, is a challenge. The constraint results from the time span needed by the Navy to have vendors fabricate the large and complex propulsion plant components to demanding quality standards, and to have the shipbuilder incorporate these components into the ship. The location of the propulsion plant in the ship means the shipbuilder needs the components early in construction.

Program Goal

Facilitate U.S. National security through the application of nuclear energy for propulsion of warships.

Strategic Objective

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

Program Strategic Performance Goals

NS3-1 Ensure the safety, performance reliability, and service-life of operating reactors for uninterrupted support of Fleet demands, which includes 126 million miles steamed for nuclear-powered ships, and maintaining a utilization factor of at least 90 percent for operation of test reactor plants.

NS3-2 Develop new technologies, methods and materials to support reactor plant design, including the next generation submarine reactor, which will be 99 percent complete by the end of FY 2003, and conduct detailed design on a reactor plant for the next generation aircraft carrier, CVNX.

NS3-3 Maintain outstanding environmental performance—ensure no personnel exceed Federal limits for radiation exposure and operations have no adverse effect on human health or the quality of the environment.

Performance Standards for each Program Strategic Performance Goal:

<u>Blue/Green</u>: Complete S9G and CVNX design milestones within schedule and estimated cost to support National defense requirements, support Navy operational requirements for nuclear-powered ships with no reactor accidents, meet regulatory commitments at all Naval Reactors sites, complete planned core and reactor component/system design and technology development efforts to support future national security demands, continue to maintain outstanding record of environmental safety and occupational radiation exposure performance.

<u>Yellow/Red</u>: Performance at these levels is unacceptable.

Performance Indicators

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 benefit such things as endurance, acoustic measures, lower cost, and improved maintenance, or environmental performance. 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 the ongoing NATO peace-building effort in Bosnia, and maintaining a powerful U.S. Navy presence in 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.

  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 removed fuel cells at 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 102 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 they continue to perform safely and reliably. 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 122 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.

- 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 following is the principal activity for this strategy:

- 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, and 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 conducting testing under actual operating conditions that can not 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 also are 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 life, a servicing activity must remove the core from a reactor plant. This is an extremely critical operation given the radioactivity inherent 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 they continue to operate safely and efficiently, and develop equipment and procedures to provide for safe and efficient servicing of nuclear reactor plants.

- Operate and service the ATR to provide for materials irradiations testing.

▪ **Safely and responsibly inactivate shutdown land-based reactor plants in support of the Program's and Department's environmental clean-up goals.**

Naval Reactors has shutdown six prototype plants no longer required for testing. These six plants are located at three sites. Based on the projected future use of each site, different degrees of inactivation were chosen as goals for the various facilities at the start of this effort.

Major inactivation work is nearly finished. To date, Naval Reactors has made good progress—defueled all seven reactors (one plant has two reactors) with work well underway on the other aspects of inactivation. Inactivation and cleanup work at the Windsor Site in Connecticut is complete, and regulatory approval for unrestricted release has been requested.

At the NRF site in Idaho, Naval Reactors has shutdown all three plants; however, the Expended Core Facility will continue to operate at that site for the long term. As a result, and in recognition of the other shutdown reactor plants at the INEEL, the inactivation plan for NRF includes defueling the shutdown plants, placing them in an environmentally benign lay-up condition, and remediating various facilities and supporting systems.

The two shutdown prototype plants at the Kesselring Site in New York have been inactivated and defueled, and major dismantlement work will be completed in FY 2002. Naval Reactors is still operating two prototype plants at that site. Thus, the intent has been to dismantle the shutdown plants, but leave the supporting buildings for potential future use.

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 clean up 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 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.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Targets	FY 2003 Targets
Naval Reactors has ensured the safety, performance, reliability, and service-life of operating reactors for uninterrupted support of the Fleet. We have exceeded 90 percent utilization for test reactor plants, and nuclear-powered ships have steamed over 122 million miles. (NS5-1) (EXCEEDED GOAL)	Ensure the safety, performance, reliability, and service-life of operating reactors for uninterrupted support of Fleet demands, including maintaining utilization factors of at least 90 percent for operation of test reactor plants, and 124 million miles steamed for nuclear powered ships. (NS5-1)	Ensure the safety, performance, reliability, and service-life of operating reactors for uninterrupted support of Fleet demands, including maintaining utilization factors of at least 90 percent for operation of test reactor plants, and 126 million miles steamed for nuclear powered ships. (NS3-1)
Naval Reactors has developed new technologies, methods, and materials to support reactor plant design, including the next generation submarine reactor, which is 93 percent complete. Detailed design was initiated on a reactor plant for the next generation aircraft carrier, which is on schedule to meet a planned ship construction start in FY 2006. (NS5-1) (EXCEEDED GOAL)	Develop new technologies, methods, and materials to support reactor plant design, including the next generation submarine reactor, which will be 96 percent complete by the end of FY 2002, and conduct detailed design efforts on a reactor plant for the next generation aircraft carrier. (NS5-1)	Develop new technologies, methods, and materials to support reactor plant design, including the next generation submarine reactor, which will be 99 percent complete by the end of FY 2003, and continue detailed design efforts on a reactor plant for the next generation aircraft carrier in support of reactor plant construction plans and on-going component procurement. (NS3-2)
Naval Reactors had no significant findings from State and Federal regulatory inspections, nor any radiation exposure to employees exceeding Federal limits. (NS5-1) (MET GOAL)	Maintain outstanding environmental performance—ensure no personnel exceed Federal limits for radiation exposure and no significant findings result from environmental inspections by State and Federal regulators. (NS5-1)	Maintain outstanding environmental performance—ensure no personnel exceed Federal limits for radiation exposure and operations have no adverse effect on human health or the quality of the environment. (NS3-3)

Performance Area Funding Matrix
FY 2003

Budget Categories
(dollars in thousands)

Naval Reactors Performance Areas	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………………………………………….	63,800			
Core manufacturing processes and inspection techniques…………………………..	28,800			
Removed fuel cell and irradiated test specimen examination………………………….				28,190
Fuel, core and reactor structural material development & testing………………………….			48,800	
Plant materials development and testing…….			32,100	
Irradiations testing and examination…………			55,300	
Ensure safety and reliability of reactor plants, through:				
Reactor equipment design & testing………..	42,000			
Physics testing and analysis…………………..	21,100			
Safety and shielding analyses………………...	13,800			
Steam generator, energy conversion, and chemistry technologies improvements……….		21,100		
Instrumentation and control equipment development…………………………………….		46,200		
Reactor plant components development & testing……………………………………………		35,100		
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…				40,500
Servicing of land-based test reactor plants….				12,100
Operation and servicing of the advanced test reactor……………………………………………				18,000
Inactivate shutdown prototype plants, through:				
Inactivation efforts in Connecticut…………….				--
Inactivation efforts in New York……………….				12,700
Inactivation efforts in Idaho……………………				1,800
Maintain outstanding environmental performance, through:				
Radiological, environmental and safety operations……………………………………..	43,000			
Cleanup of test facilities………………………..				31,100

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 2001	FY 2002	FY 2003
Next Generation Reactor plant development and testing………………………………………………………………………..	30,000	17,000	14,900
Development of CVNX reactor plant……………………………………	117,000	141,000	128,600

In FY 2002, Naval Reactors implemented a fellowship program for students enrolled in nuclear science and engineering programs. This program is intended to attract qualified nuclear engineering graduates to Naval Reactors' laboratories. 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. Declining enrollments in nuclear engineering departments across the United States and the declining number of university departments offering degrees in nuclear engineering have limited the employment candidate pool of nuclear engineering graduates. In addition, only a fraction of the available graduates are suitable for employment in the Naval Reactors program due to considerations of citizenship, geographical location, areas of specialty and academic standards.

Fellowships will be provided to Masters and Doctoral degree candidates. Naval Reactors is pursuing 9 fellowships to be awarded in FY 2002 for the 2001/2002 school year. For the subsequent years, FY 2003 through FY 2005, the numbers of fellowship awards to be pursued are 12, 13, and 15 respectively. In FY 2005, the fellowship program will have reached maturity and should continue with 15 awards per year in the future.

Significant Accomplishments and Program Shifts

The primary emphasis of Naval Reactors' effort, as always, will continue to be operating reactor safety and reliability. For new reactor development, CVNX reactor effort will continue, while work on the next generation reactor for the VIRGINIA-class submarine declines. The prototype reactor plant inactivation effort will decline as efforts come to fruition.

- Extend warship operational lifetime: Naval Reactors continues to develop improved manufacturing processes and analytical methods for reactor core design. Irradiation testing of core and plant materials and examining fuel cells removed from reactors is enabling extended operation by improving understanding of material performance and enhancing predictive capabilities. These new models are used to calculate reactor performance for late-in-life operations and support the lifetime extensions for submarines and aircraft carriers. Irradiation tests of fuel elements are continuing in the Advanced Test Reactor to gain a better understanding of the corrosion process in a reactor core to support further long life operations.

  Service lifetimes for aircraft carriers and for LOS ANGELES-class submarines are significantly longer than originally planned. The USS ENTERPRISE, the first nuclear powered aircraft carrier, is a vivid example of a warship meeting Navy goals of extended operation. This ship was commissioned in 1961, and is now scheduled to retire around 2015 and to be replaced by the first CVNX class aircraft carrier. Originally designed for 20 years, ENTERPRISE, upon retirement, will have served 52 years, longer than any other Navy steel-hulled warship. The Navy is extending the lives of selected LOS ANGELES-class submarines to 33 years; most of these ships will not require a refueling. Extending the lives of nuclear powered warships beyond original design life provides a distinct economic advantage while improving projected force levels for the national defense. New reactors are being designed initially for longer life spans. For example, the VIRGINIA-class submarines will have a design life of at least 33 years without a core refueling.

- Ensure safety and reliability of reactor plants in the Navy's warships: The Safety Analysis Report for the VIRGINIA-class submarine was provided to the Nuclear Regulatory Commission. This report demonstrates the VIRGINIA-class reactor will operate safely and reliably for all anticipated normal operations and for casualty situations that might occur. The report also demonstrates that operation of the VIRGINIA-class poses no risk to the health and safety of the general public.

  Naval Reactors continues to maintain its record of no nuclear accident or significant release of radioactivity to the environment from the Program's facilities or the Navy's nuclear powered warships. This environmental and safety record has endured over 50 years and has been essential to nuclear powered warships safely steaming over 122 million miles. In the process, they have accumulated over 5,200 years of reactor operation compared to the U.S. commercial nuclear power industry's 2,500 and 7,000 for the rest of the world's commercial reactors.

  Because of this safety and reliability record, the Navy daily is obtaining the benefit of these warships, and nations around the world allow them to enter their harbors and territorial waters. Other countries have suffered casualties because of risks and inadequacies the U.S. would not tolerate.

  Critical factors in achieving the extended operational lifetimes and superlative safety and reliability record are the initial careful, conservative engineering approach in developing new reactors, and subsequent extensive and ongoing testing, verification and equipment/systems updating work. While extended operational lifetime is of great benefit, this increases the technical demands of continuing the safety and reliability record, and requires emphasis on testing and evaluation work to detect and resolve problems with or affirm designs, materials, and standards.

- Develop the next generation reactor for the VIRGINIA-class attack submarines: Detailed analyses support the objective that the next generation reactor is the first true life of the ship core—designed to provide full-power, unrestricted operation throughout the design life of a new class of ships without a refueling. The life of the ship core objective has resulted in significant design, materials, and manufacturing development challenges for which technical resolution has been achieved.

  Reactor and reactor plant test procedures are being completed on schedule to support the shipboard test program which is underway. Vendor component development work on reactor plant components will be complete by the end of FY 2001. Materials qualification testing to confirm the improved corrosion performance of the New Concept Steam Generator will extend into FY 2002.

- Develop a reactor for the Navy's new CVNX-class aircraft carriers: Design, development, and manufacture of the CVNX propulsion plant proceeds on schedule. Initial reactor manufacturing development began at the core vendor during 2000 and is proceeding according to schedule. The first set of developmental elements was fabricated successfully. As planned, lessons learned from the initial manufacturing development are being factored into the manufacturing process and the fabrication of the second set of elements. The CVNX heavy equipment reference work was completed to enable fabrication of forgings to begin on schedule.

  Plant arrangements continue to progress on schedule. System descriptions that define the basic design were completed in 2001. System diagrams are being developed from the system descriptions and this effort will continue through 2002. Three-dimensional product modeling of the detailed reactor plant arrangements will continue based on the system diagram and system description work in 2003.

  Naval Reactors will develop this reactor without the need for a prototype power unit (nuclear core and related equipment). This major cost avoidance (well over $300M) is made possible by the Program's progress in computer modeling and the extensive data obtained from the prototype test reactors coupled with the planned characteristics of the new reactor.

- Support Navy acoustic requirements: Stealth is inherent in submarines, making them very advantageous and versatile warships for the Navy. Stealth means submarines can go places other warships cannot and also operate without military support. This gives the Navy an excellent surveillance and intelligence gathering capability, and an economical means of deterrence. As a practical example, at the start of the Falklands War, a British submarine sank one Argentine warship. Subsequent to the sinking, the threat that a single British submarine might be present caused the Argentines to keep their entire fleet in port for the duration of the war.

  Unfortunately, the technologies involved in attempting to detect submarines, particularly computerized data processing, are constantly advancing requiring corresponding work to preserve stealth. The reactor and associated equipment are potential major sources of noise. Naval Reactors has been able, through an aggressive analytical and component/systems development effort, to help the Navy maintain submarine stealth for both existing and new design submarine classes. Examples of this are the VIRGINIA-class new concept steam generator that will greatly reduce corrosion concerns, while also improving plant quietness.

- Conduct test reactor plant operations: The two remaining prototype test reactors and the Advanced Test Reactor (ATR) have a key role in achieving Naval Reactors' objective. The two prototypes are the only means of testing components and systems in a full plant under typical operating conditions (without disrupting Fleet operations). The ATR is the primary facility available for irradiation testing—an important consideration given Naval Reactors' dependence on such data. The intent, which the Program has been able to achieve for the two prototypes, is to maximize operational time. ATR is expected to achieve an acceptable operational rate for FY 2002, and also to perform some test modifications that will expand the breadth and variety of irradiation tests that are conducted there.

- Inactivate shutdown test reactor plants: As a cost-saving initiative, Naval Reactors previously shut down six of eight land-based prototype plants. Good progress is being made in inactivating these shutdown plants. To date:

  - All seven shutdown reactors (one plant has two reactors) are defueled. The seventh, and final, defueling was completed in 1999.

  - S1C Site Confirmatory Sampling and Analysis Report and Radiological Release Reports were issued to the Environmental Protection Agency and the State of Connecticut.

  - Shipout of the S3G pressure vessel for disposal, and limited dismantlement and dispositioning of the S3G prototype reactor compartment internals has been accomplished. In parallel with remaining S3G work, D1G pressure vessel removal will proceed through 2002, followed by completion of the remaining work covered by the Environmental Impact Statement Record of Decision, after which remaining plant structures (which also do not present a hazard, but require monitoring and upkeep) will be remediated as additional resources are available.

- Maintain outstanding environmental performance: Naval Reactors has had no significant findings from state and Federal regulatory inspections, nor any radiation exposure to employees exceeding Federal limits. In fact, during 2002, average occupational radiation exposure for Program personnel is again expected to be a small fraction (one-sixth) of the 300 millirem of radiation exposure received by an average American in one year due to radiation naturally present in the environment.

  The Naval Reactors program has a long-standing history of pollution prevention and continues to pursue new initiatives to minimize or recycle waste. Governor Ridge, who presented the Pennsylvania Governor's Award for Environmental Excellence to the Bettis Atomic Power Laboratory in recognition of outstanding pollution prevention, recognized some of these efforts during 2001.

Funding Profile

(dollars in thousands)

	FY 2001 Comparable [a] Appropriation	FY 2002 Original [a] Appropriation	FY 2002 Adjustments	FY 2002 Comparable [a] Appropriation	FY 2003 Request
Naval Reactors					
Naval Reactors Development (NRD)					
Plant Technology………………………...	118,068	116,000	N/A	N/A	112,100
Reactor Technology & Analysis………...	216,097	226,000	N/A	N/A	228,600
Materials Development & Verification….	124,329	130,904	N/A	N/A	136,200
Evaluation & Servicing…………………..	149,560	132,341	N/A	N/A	144,390
Facility Operations………………………	41,929	47,000	N/A	N/A	50,000
Construction………………………………	17,262	13,200	N/A	N/A	11,300
Subtotal, NRD……………………………….	667,245	665,445	N/A	N/A	682,590
Program Direction……………………………..	21,516 [b]	22,600	1,228 [b]	23,828 [b]	25,430 [b]
Subtotal, Naval Reactors……………………..	688,761	688,045	1,228	689,273	708,020
Adjustments					
Use of prior year balances……………….	0	0	N/A	N/A	0
Subtotal, adjustments………………………….	0	0	N/A	N/A	0
Total, Naval Reactors………………………….	688,761	688,045	1,228	689,273	708,020

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"

Funding by Site

(dollars in thousands)

[a] The "comparable" and request columns do not account for the effect of inflation. Naval Reactors' FY 2002 and FY2003 requests represent a reduction of about $18M from FY 2001 funding in real terms.

[b] Naval Reactors did not develop this requirement and does not know the basis for the amounts included, and therefore can neither validate nor endorse the accuracy of these calculations. The FY 2001 and FY 2002 column of the FY 2003 Congressional Request includes funding in the amount of $1.201M and $1.228M, respectively, for the Government's share of increased costs associated with pension and annuitant health care benefits. These funds are comparable to the FY 2003 funding of $1.23M. (Note: The data is presented on a comparable basis as if the legislation had been enacted and implemented in FY 2001.)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Pittsburgh Naval Reactors Office					
Bettis Atomic Power Laboratory………	348,224	357,540	360,928	3,388	0.9%
Pittsburgh Naval Reactors Office……..	6,554	7,440	7,755	315	4.2%
Total, Pittsburgh Naval Reactors Office……	354,778	364,980	368,683	3,703	1.0%
Idaho Operations Office					
Idaho National Engineering & Environmental Laboratory……………...	52,078	51,951	56,000	4,049	7.8%
Idaho Operations Office………………...	0	0	0	0	0%
Total, Idaho Operations Office………………	52,078	51,951	56,000	4,049	7.8%
Schenectady Naval Reactors Office					
Knolls Atomic Power Laboratory………	265,427	254,004	263,822	9,818	3.9%
Schenectady Naval Reactors Office….	5,600	6,000	6,330	330	5.5%
Total, Schenectady Naval Reactors Office...	271,027	260,004	270,152	10,148	3.9%
Washington Headquarters…………………...	9,362	10,388	11,345	957	9.2%
All Other Sites…………………………………	1,516	1,950	1,840	-110	-5.6%
Subtotal, Naval Reactors Development…….	688,761	689,273	708,020	18,747	2.7%
Use of prior year balances……………...	0	0	0	0	0%
Total, Naval Reactors Development………..	688,761	689,273	708,020	18,747	2.7%

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 INEEL Advanced Test Reactor.
Idaho National Engineering & Environmental Laboratory
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 facility in the Nation capable of performing irradiation testing of materials. The facility is the 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 also 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. 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.

Reactor Technology & Analysis
Mission Supporting Goals and Objectives

Reactor Technology and Analysis 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. Efforts support the performance measures required to extend Navy nuclear powered warship operation while ensuring the operational safety and reliability of operating reactors, supporting Navy acoustic requirements, and preserving a level of excellence in radiological and environmental control.

Continued improvement of reactor design and analytical techniques provides a more accurate forecast of reactor performance, thereby yielding more advanced Next Generation designs. New tests and analyses will also lead to the production of reactors with greater endurance and a resulting reduced cost and waste product benefit. Emphasis is on thermal/hydraulics, structural/fluid mechanics, vibration analyses, and nuclear core design/analysis work. Improved core manufacturing processes and inspection techniques also are being pursued to support extended life requirements.

Development and qualification of core and reactor component thermal/hydraulic designs are directed to optimizing reactor power while reducing coolant flow, thus facilitating improved acoustic performance. Radiological and environmental monitoring and controls ensure operations are conducted without adverse impact on employees or the environment.

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. 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.

Funding Schedule

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Total, Reactor Technology and Analysis	216,097	226,000	228,600	2,600	1.15%

	(dollars in thousands)	
FY 2001	FY 2002	FY 2003

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 2001	FY 2002	FY 2003
A. Improve nuclear reactor core design and analysis methods and develop improved designs to satisfy service life requirements……	**54,100**	**57,400**	**63,800**

To extend core service life and achieve greater core flexibility, we must gain a more extensive understanding of the reactor core environment. As testing provides more comprehensive data, new analytical models can be developed which establish new, or revise existing, core performance 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. Operating guidelines are developed with these revised assumptions.

New designs and less restrictive operating limits derived from improved design codes will enable new reactors to meet service life and performance requirements, such as the next generation reactor for VIRGINIA Class submarines and the reactor being developed for the new CVNX class aircraft carriers. The core for the VIRGINIA Class is the first designed from inception to last the life of the ship. The core for CVNX will have 50 percent more energy than the Nimitz class cores. 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 2001 Perform mechanical performance testing on newly manufactured next generation reactor plant components to expand mechanical, structural, thermal-hydraulic, and flow-induced vibration performance. Results will be applied to future reactor design methods to reduce the need for testing.

Continue evaluation and develop models to predict long term performance of reactors with high temperature capability.

Continue development of advanced computational capabilities to speed exploration of structural design alternatives and ultimately achieve more reliable, cost-effective designs.

Perform thermal-hydraulic and reactor protection analyses required to make preliminary fuel loading decisions for the advanced CVNX carrier core design.

FY 2002 Develop, execute, and report key mechanical design qualification, reactor safety, and hydraulic/flow design qualification tests for the CVNX reactor test program.

Continue 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.

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

Finalize and issue CVNX core design recommendation.

FY 2003 Continue CVNX reactor hydraulic design qualification tests and initiate flow and shock/ vibration test programs for CVNX fuel cell that validate and improve hydraulic and structural design methods.

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 CVNX core manufacturing.

	FY 2001	FY 2002	FY 2003
B. Evaluate and test improved core-manufacturing processes and inspection techniques to support extended life of reactors……………………………………….	**23,397**	**30,000**	**28,800**

The requirement for higher performance, longer lasting fuel and the drive for cost savings necessitate manufacturing process improvements. These improvements are dependent on technological advancements. Manufacturing process limitations in previously designed naval reactor cores develop unique attributes during ship operation. Consequently, compensatory margins are built into core designs and operating limits that constrain the power density and life expectancy. Modifying the fuel manufacturing process allows cores to operate with longer and greater output capability. In addition, the modified manufacturing process will minimize waste. This process is technically challenging, but necessary to improve the fuel to produce greater power cores at a lower cost for new core designs.

(dollars in thousands)		
FY 2001	FY 2002	FY 2003

Verifiable Supporting Activities:

FY 2001 Establish manufacturing processes for high temperature fuel and alternate cladding. Fabricate test hardware to select preferred materials, processes and designs for cores using high temperature materials.

Fabricate model elements to qualify new reactor materials, designs, and manufacturing technologies.

Apply process improvements to S8G's core performance, and evaluate results of other manufacturing technology developments.

FY 2002 Continue manufacturing process development for high temperature fuel and alternate clad using new materials and advanced technologies to reduce costs.

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

Fabricate manufacturing prototypes to demonstrate and qualify the fuel systems and new assembly processes required for CVNX cores.

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

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.

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

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

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 2001	FY 2002	FY 2003
A. Design and test improved reactor equipment, including advanced control drive mechanisms……………………………	**49,300**	**49,300**	**42,000**

Reactor safety/reliability demands that the mechanisms that drive the 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 CVNX reactor, 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 the new core designs. Work is focused on extending the technologies developed for the next generation reactor equipment to design the much larger equipment needed for CVNX and supporting longer carrier service lives. As part of this effort, three-dimensional structural analyses will be developed and applied.

Verifiable Supporting Activities:

FY 2001 Issue reference design report and commence design for CVNX heavy equipment including a reactor vessel, closure head, closure studs, and a core basket.

Initiate development of qualification tests to support reactor design for CVNX.

Continue design, analysis, and validation of next generation reactor heavy equipment components and auxiliary equipment for the first S9G application.

Carry out design of the head area arrangement components and confirm the design using a full-scale mockup.

Develop prototype control drive mechanism for CVNX.

FY 2002 Conduct CVNX reactor heavy equipment structural analyses and design reviews to support the final design phase.

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

Deliver, airstand, and autoclave test the CVNX control drive mechanism development unit.

Finalize reactor vessel and closure head design and initiate reactor vessel and closure head fabrication process.

FY 2003 Continue CVNX reactor heavy equipment structural analyses and design reviews and complete core barrel 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.

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

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

	FY 2001	FY 2002	FY 2003
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. Therefore, Naval Reactors is working to identify and perform experimental programs that would lead to improvements in this area.

Verifiable Supporting Activities:

FY 2001 Initiate detail design for the advanced core of CVNX.

Test new cross-section data derived from Linear Accelerator experiments to improve understanding of core reactivity.

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

Continue to reduce the reactivity bias by applying improved physics methods, modeling procedures, and cross section data.

Continue to analyze physics data from the S8G and NIMITZ prototype expended core examinations to validate physics methods.

FY 2002 Finalize CVNX core design specifications for production core manufacturing.

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

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

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

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

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.

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

	FY 2001	FY 2002	FY 2003
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. New shield materials are sought to improve shield effectiveness, while improving reactor plant affordability and eliminating the use of hazardous materials such as lead. Shielding method improvement permits 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. The goal of this work is to enable a reduction in weight and resultant cost of installed shielding without impacting radiation exposure to personnel.

Verifiable Supporting Activities:

FY 2001 Submit the next generation reactor SAR and PSA to the NRC and Advisory Committee on Reactor Safeguards (ACRS).

Establish preferred codes to permit large 3D shielding problems to be calculated quickly on parallel computer architectures.

Complete selected testing to validate and qualify portions of the advanced safety code.

Develop and qualify improved shield design methods.

Complete initial shield design for CVNX reactor compartment.

FY 2002 Resolve technical issues that arise from the NRC/ACRS review of the next generation reactor safety documents.

Evaluate and qualify improved parallelized transport code.

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

FY 2003 Provide technical support for the presentation of next generation safety documents to the NRC/ACRS.

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

Complete radiation analyses for final design of CVNX reactor equipment.

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

	FY 2001	FY 2002	FY 2003
A. Develop and qualify improved core and reactor component thermal and hydraulic designs……………………..	**16,100**	**16,100**	**16,100**

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.

Verifiable Supporting Activities:

FY 2001 Initiate fundamental testing to gain enhanced understanding of the fluid dynamics of interactions.

Initiate extension of advanced computer codes for use in transient flow analysis.

Perform tests on advanced reactor plant components utilizing results of testing for possible development of improved reactor plant components.

FY 2002 Develop and qualify advanced codes for steady state and transient flow analyses.

Extend advanced safety analysis code to calculations.

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

FY 2003 Extend 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.

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

	FY 2001	FY 2002	FY 2003
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**	**38,300**	**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 requirements. The principal focus of this environmental work is to prevent the creation of environmental hazards by minimizing wastes and preventing pollution. 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 monitoring confirms operations do not impact the surrounding community.

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.

Audit compliance to all regulations to ensure effectiveness of controls.

	FY 2001	FY 2002	FY 2003
Total, Reactor Technology & Analysis.	**216,097**	**226,000**	**228,600**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2002 vs. FY 2003 ($000)
I.A Funding level reflects requirements for the CVNX test program……………..	+6,400
I.B Funding level reflects reduced work on development of high temperature materials ……………………………………………………..……………..	-1,200
II.A Funding level reflects completion of NRG CDM and reactor heavy equipment design work ……………………………………………………….	-7,300
IV.A Funding level reflects increased radioactive shipping and disposal costs…….	+4,700
Total Funding Change, Reactor Technology & Analysis: ………………………….	+2,600

Plant Technology
Mission Supporting Goals and Objectives

Plant Technology focuses on developing, testing and analyzing components and systems in the ship's power plant which transfer, convert, control and measure power created by the nuclear reactor. Understanding component performance and system condition throughout a ship's life is key to preventing a loss of reactor plant integrity. Also new components and systems are needed to replace obsolete or degraded equipment/systems and for new applications. 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 Class and CVNX will be more reliable, improve operating efficiency and reduce life cycle costs.

Reactor plants require constant monitoring and analysis due to exposure to the severe combination of high temperature and pressure. 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 to deal with this continuing issue.

Operating reactor plant machinery, such as pumps with constantly rotating parts, requires exacting maintenance. Further wear and tear on operating reactor machinery limit system and component life. Plant Technology fund programs to combat wear through the application of better materials and lubricants, as well as more resilient designs, creating longer-lived and more reliable components and systems with reduced maintenance requirements. These programs include 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.

Considerable 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.

Funding Schedule

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Total, Plant Technology	118,068	116,000	112,100	-3,900	-3.4%

Detailed Program Justification

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 2001	FY 2002	FY 2003
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……………………………………………..	**26,050**	**23,062**	**21,100**

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 a secondary water cycle surrounds these tubes. The secondary water cycle is at a lower pressure and boils to 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 particularly 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 testing is underway on alternative energy transfer methods and testing of creviceless steam generators. 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.

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

Verifiable Supporting Activities:

FY 2001 Develop laboratory test techniques and analysis methods for accelerated testing of steam generator tubing using alternative boiler water chemistries to facilitate selection of new chemistries for possible future use.

Monitor and evaluate chemistry tests in steam generators.

Perform in-plant corrosion monitoring and complete upgrades to the predictive model.

Fabricate mockups and demonstration hardware to support development and implementation of manufacturing process improvements for advanced steam generator concepts.

Design steam generator and develop test units to confirm design basis for CVNX.

FY 2002 Conduct special transient testing of the SEAWOLF class steam generator scale model to provide test for analysis qualification to reduce frequency of inspection and cleaning.

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

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

Develop, model and improve performance of energy conversion systems. Incorporate latest technology and engineered improvements into advanced efficient and power dense power conversion systems. Investigate alternative power conversion systems.

FY 2003 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 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 conversion systems.

	(dollars in thousands)	
FY 2001	FY 2002	FY 2003

	FY 2001	FY 2002	FY 2003
B. Develop instrumentation and control equipment to replace obsolete equipment and improve reliability and performance……………………………………………......	**48,150**	**44,938**	**46,200**

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. Development of advanced power conversion equipment, which is highly reliable and efficient, 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 rapid obsolescence because industry does not maintain the parts or capability to support older 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.

Verifiable Supporting Activities:

FY 2001 Continue to design and fabricate pre-production generic instrumentation and control equipment for the NIMITZ and LOS ANGELES classes.

Continue qualification testing of advanced pressure and flow sensors to ensure compatibility with standardized instrumentation and control.

Develop equipment specifications and systems details for CVNX reactor plant instrumentation.

FY 2002 Complete NIMITZ class pre-production equipment fabrication and initiate composite testing. Commence initial issue of OHIO system functional requirements.

Complete proof-of-concept testing of existing pressure and flow sensors and begin fabrication of engineering models of advanced detectors.

Build and initiate test of modular medium voltage power conversion technology and selected solid state motor drives with advanced control techniques for proof-of-concept testing.

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

FY 2003 Complete LOS ANGELES Class generic instrumentation and control production equipment fabrication and NIMITZ Class production equipment design and fabrication.

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.

	FY 2001	FY 2002	FY 2003
C. Develop and test reactor plant components and applicable technologies which address known limitations and improve performance and reliability of components……………………………………………………	**34,868**	**39,400**	**35,100**

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 back-fit on CVN77 to incorporate current technologies addressing problems related to wear, improving performance and reliability over the pump's operating life.

Work on CVNX is also focused on optimizing reactor plant arrangements to achieve simplicity, through the use of fewer components and improve maintenance by simplifying system design and reducing the number of components. The results are cost savings, enhanced reliability, greater ease of operation and more power available for other uses in 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 has an effect on flow through the core. Deviations from nominal flow can cause a heat level imbalance within the core. Therefore, tight tolerances are necessary to ensure the entire plant operates safely and efficiently. 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 2001 Carry out next generation reactor plant integration design and testing for the VIRGINIA class.

Conduct final stage of qualification testing for the redesigned NIMITZ class main coolant pump and expand flow testing.

Continue preliminary design and arrangement for CVNX reactor plant equipment, including the main coolant pump and pressurizer, and establish basic functional requirements/equipment performance standards.

FY 2002 Resolve next generation reactor plant construction design issues.

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

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

Finalize detailed design effort of CVNX main coolant pump and procure long lead material.

FY 2003 Continue to resolve next generation reactor plant construction design issues.

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

Complete 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.

	FY 2001	FY 2002	FY 2003
D. Perform reactor plant analyses to assure safe operation and improve reactor plant chemistry controls to reduce corrosion and plant radiation levels………	**9,000**	**8,600**	**9,700**

Under pressure, the reactor core heats water in the primary system that flows through the steam generator. The steam generator absorbs the transferred heat in the secondary system to produce steam to power the turbine. 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, 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 reduce radiation levels. A key factor in the development process is a continuous flow of data from test facilities and operating plants.

Detailed reactor system performance analyses are also performed to ensure naval reactor plants are safe during normal, transient and casualty conditions. The performance analyses establish operating limits and automatic protection systems set points ensuring the plant will operate safely and reliably during all aspects 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 kept radiation levels well below regulatory requirements while enhancing reliability and reducing maintenance costs.

Verifiable Supporting Activities:

FY 2001 Evaluate progress/results of advanced primary coolant chemistry control analysis methods on the S8G prototype.

Conclude whether to implement use of alternate chemistries for reactor water treatment on several plant types.

Perform next generation reactor performance analysis to support abnormal operational limits.

Prepare reactor protection analyses to support the development of CVNX reactor plant design.

FY 2002 Assess S8G reactor coolant additive effectiveness at reducing radiation levels and qualify additive zinc for OHIO class fleet-wide application.

Continue to monitor results of additive treatment in LOS ANGELES class primary chemistries.

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

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

FY 2003 Continue to monitor results of additive treatment in reducing radiation levels in LOS ANGELES class ships.

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

	(dollars in thousands)	
FY 2001	FY 2002	FY 2003

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

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

	FY 2001	FY 2002	FY 2003
Total, Plant Technology	**118,068**	**116,000**	**112,100**

Explanation of Funding Changes from FY 2002 to FY 2003

		FY 2003 vs. FY 2002 ($000)
I.A.	Requirements decrease due to completion of the New Concept Steam Generator (NCSG) test program…………………………………………	-1,962
I.B.	Requirements reflect scaled up effort to support advanced I&C development and power electronics activities for VIRGINIA Variant, NR-2, and advanced submarine development……………………………………………….	+1,262
I.C.	Requirements decrease due to completion of development of CVNX reactor fluid system components…………………………………..…	-4,300
I.D.	Requirements reflect scaled up effort to implement fleet wide use of improved primary chemistry analysis technique on OHIO and NIMITZ class reactor plant…………………………..……………………………….	+1,100
Total Funding Change, Plant Technology:		-3,900

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 ship maneuvers and changes 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 essential 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 assure they can 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 continue to maintain that integrity over thousands of years when eventually placed in 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 at the Advanced Test Reactor (ATR) located at the Idaho National Engineering and Environmental Laboratory (INEEL) and subsequent examination at Naval Reactors' Expended Core Facility in Idaho and the Radioactive Materials Laboratory (RML) at the Knolls Atomic Power Laboratory are used to support both core and plant material 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 2001	FY 2002	FY 2003	$ Change	% Change
Total, Materials Develop & Verification	124,329	130,904	136,200	+5,296	4.0%

	(dollars in thousands)	
FY 2001	FY 2002	FY 2003

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 2001	FY 2002	FY 2003
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……………………………	**44,900**	**49,500**	**48,800**

Materials used in a reactor core 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 less cumbersome 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.

FY 2003 requirements reflect a planned delay in the testing of high temperature structural materials to support increased testing of high temperature, high depletion fuel systems.

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 materials data generated each year thus representing outcomes within the continuing general scope of work.

FY 2001 Develop a fuel processing system to support alternate methods of fuel material development.

Test model fuel elements of fleet cores to refine operating limits.

Conduct examination of S3G-ATC (Advanced Test Core) to assess performance of fuel system similar to performance in most recent core designs.

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

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

Conduct 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.

Continue expended core examinations, including initiating comparative examination of a particular core to evaluate effect on corrosion.

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

FY 2003 Prepare for qualification 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 2001	FY 2002	FY 2003
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…………………………..	**33,529**	**31,100**	**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.

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 future high performance components and plants with life of the ship reliability. 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. The increase in FY 2003 requirements reflects an increase in stress corrosion cracking and welds testing to evaluate possible long-term failures of plant components, the development of data models necessary to predict in-service lifetimes, and development of new materials with improved capability.

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 2001 Conduct testing to define the effect of irradiation on the behavior of fasteners.

Conduct testing to evaluate irradiation effects to reduce reactor vessel damage rate conservatism and establish a basis for service life extension.

Continue development of special alloys and evaluate their application to CVNX.

FY 2002 Test fasteners and weld metals to verify hypotheses of mechanisms for use in predictive modeling and application to CVNX and VIRGINIA Class development.

Continue materials testing to reduce design conservatism as appropriate and extend operating fleet, VIRGINIA Class, and CVNX service life.

Conduct engineering testing and qualification of particular hard surfacing alloys and evaluate their application to CVNX.

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

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

Perform welding studies to identify manufacturing parameters that affect residual stress to develop an increased understanding of residual stress and techniques to minimize it. Conduct corrosion testing of new, potentially more robust reactor plant materials using corrosion potential monitoring.

Conduct corrosion testing of autogenous welds to support a welded manifold concept for CVNX.

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

	FY 2001	FY 2002	FY 2003
C. Conduct irradiation testing and perform detailed examinations to provide data for material performance characterization and prediction………………………….	**45,900**	**50,304**	**55,300**

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 ATR in as short as one-tenth the time. Subsequent evaluations 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. The increase in funding reflects increasing the multiple irradiation capsule experiment (MICE) work scope, designing an additional test train, developing advanced monitoring techniques, and expediting removal of RML in-cell waste allowing for increased evaluation capability.

	(dollars in thousands)	
FY 2001	FY 2002	FY 2003

Verifiable Supporting Activities:

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

FY 2001 Irradiate fuel specimens made by alternate element fabrication techniques to determine performance benefits.

Continue irradiation of advanced fuel samples using varied sample temperatures.

FY 2002 Conduct transient testing on alternate model fuel elements.

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

Employ multiple irradiation capsule 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.

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.

Total, Materials Development & Verification……………………….	**124,329**	**130,904**	**136,200**

Explanation of Funding Changes from FY 2002 to FY 2003

		FY 2002 vs. FY 2003 ($000)
I.A.	Requirements reflect a decrease in high temperature structural materials work.…………………………………………………………………….	-700
I.B.	Funding level reflects increased corrosion and welds testing ………………………………………………………..	+1,000
I.C.	Reflects increasing the MICE work scope, designing an additional test train, developing advanced monitoring techniques, and removal of RML in-cell waste ………………………………………………………………	+4,996
Total Funding Change, Materials Development & Verification:…..……………….		+5,296

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, the initiation of a dry spent fuel 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 the preservation of environmental quality 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, supporting Navy goals for extended warship operation, and maintaining excellence in radiological and environmental control.

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 inactivating and laying up the shutdown plants to place them in an environmentally benign state.

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.

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 2001	FY 2002	FY 2003	$ Change	% Change
Total, Evaluation & Servicing	149,563	132,341	144,390	+12,049	+9.1%

	(dollars in thousands)	
FY 2001	FY 2002	FY 2003

I. Maintain a utilization factor of at least 90% for the operation of 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 2001	FY 2002	FY 2003
A. Operate land-based test reactor plants to provide for prototypical testing, core depletion analysis, and reactor plant operator training……………………………………	**33,100**	**33,100**	**40,500**

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 next generation submarine reactor core as well as the CVNX aircraft carrier reactor.

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 replacements and 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 2001 Meet depletion objectives for MARF and S8G cores.

Conduct a MARF low power physics test and S8G high power physics test and issue report.

Gather thermal/hydraulic, reactor physics and other prototype plant performance characteristics to confirm/revise operating assumptions in the fleet.

Inspect pressurizer heater wells in MARF.

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

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

Perform thermal analysis on the MARF core and revise the operations manuals to incorporate emergent technical issues.

Operational testing of advanced instrumentation and control equipment to verify its operability and serviceability prior to fleet implementation.

FY2003 Meet depletion objectives for MARF and S8G cores.

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

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

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

	FY 2001	FY 2002	FY 2003
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……………..……………….	**5,606**	**6,100**	**12,100**

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 take place in FY03 and will include inspection of key primary loop components, welds, and joints. These types of inspections prevent leaks or other structural problems and help to maintain the highest safety and operational efficiency standards. Numerous other major work evolutions are planned in conjunction with these prototype servicings. These efforts include the overhaul of the main seawater valves and replacement of Main Coolant Check Valve internals.

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 FY03 will focus on the next generation submarine reactor and evaluation of CVNX core and reactor equipment designs to enhance reactor fueling, maintenance and defueling capability. Specifically, Naval Reactors is progressing well on the next generation reactor servicing design, a design whose serviceability should decrease 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 FY03.

Verifiable Supporting Activities:

FY 2001 Develop next generation submarine reactor maintenance software.

Review finalized concepts for CVNX aircraft carrier reactor to ensure servicing capability and begin detailed design of servicing equipment.

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

Continue development of detailed designs for CVNX reactor servicing equipment.

Fabricate and test S9G main omega seal cutting machine.

Perform a resin discharge of the S8G prototype.

FY 2003 Complete development work on next generation submarine reactor maintenance software and hardware.

Begin a major non-refueling overhaul of the S8G prototype, including overhaul of the S8G Main Seawater Valves, replacement of Main Coolant Check Valve internals, and execution of component/weld inspections of the S8G plant.

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

	FY 2001	FY 2002	FY 2003
C. Operate and service the Advanced Test Reactor to provide for materials irradiations testing……………………..	**18,000**	**18,000**	**18,000**

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 2001	FY 2002	FY 2003
A. Continue efforts at the Windsor site in Connecticut to release applicable areas for unrestricted use………………….	**3,000**	**1,800**	**0**

The S1C plant is defueled. Inactivation is complete. All facilities have been removed from the site. Completion of process to satisfy EPA and the State that the site may be released for unrestricted future use is expected in FY02. Resources decrease as documentation work supporting the inactivation work is finalized and site is released for unrestricted future use.

Verifiable Supporting Activities:

FY 2001 Conduct site closeout and release process.

FY 2002 Complete site closeout and release process.

FY 2003 Transfer land for unrestricted future use.

	FY 2001	FY 2002	FY 2003
B. Continue inactivation efforts at the Kesselring site in New York to eliminate surplus facilities, remediate and dismantle plant facilities, and release applicable areas……….	**34,700**	**22,300**	**12,700**

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 site / reactor plant-related remediation work is planned for FY02 and future years. This work would reduce radiological and environmental hazard liabilities associated with historic prototype operations, but is limited by funding constraints. Resources decrease to reflect completion of substantial inactivation milestones, resource constraints and plant layup.

Verifiable Supporting Activities:

FY 2001 Conduct limited dismantlement and dispositioning of prototype reactor compartment internals, which supports placing the S3G and D1G plants in a stable layup state.

	(dollars in thousands)	
FY 2001	FY 2002	FY 2003

Shipout S3G pressure vessel for disposal.

Conduct D1G pressure vessel removal and reactor compartment disassembly.

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

FY 2003 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 2001	FY 2002	FY 2003
C. Continue inactivation efforts in Idaho to eliminate surplus facilities, remediate and dismantle plant facilities and release applicable areas…………………………	**9,957**	**6,741**	**1,800**

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 FY03 and future years, with additional work to be performed as funding becomes available.

Verifiable Supporting Activities:

FY 2001 Sample, characterize and remediate plant support buildings and facilities/utilities.

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

FY 2003 Complete the characterization and demolition of historically contaminated NRF railcars.

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

	FY 2001	FY 2002	FY 2003
A. Conduct ongoing clean up of test facilities to reduce hazards to personnel, and reduce potential liabilities due to changing conditions or accidental releases…………….	**26,600**	**25,700**	**31,100**

Operation of test, examination, and manufacturing facilities has involved the use of hazardous materials. Decontamination and unconditional release of previously contaminated facilities minimizes the environmental, health and safety impact of contaminated facilities, with the benefit of making previous radiological facilities available for non-radiological use. 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 decontamination and remediation work, environmental monitoring and control efforts are in place at the prototype sites to ensure compliance with all regulations at all Naval Reactors' sites.

Decontamination and remediation are achieved through a deliberate multi-step process which may involve facility structures and equipment being wiped, chemically treated, physically abraded, or removed according to strict engineering controls which are protective of personnel and the environment, and are designed to minimize the amount of waste generated. Resultant wastes are packaged and disposed of 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. The activities identified are, however, representative. Requirements reflect remediation efforts planned for FY03.

Verifiable Supporting Activities:

FY 2001 Continue remediation of obsolete fuel processing facility at the Bettis Pittsburgh site.

Remove friable asbestos pipe insulation and friable asbestos thermal ventilation insulation in support of facilities upgrade and remediation plans at the Knolls site.

Remove and dispose of facilities, buried radioactive piping and contaminated soil at NRF in accordance with the Record of Decision on CERCLA actions and other regulatory requirements.

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

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

Continue selected CERCLA remediation activities at NRF site.

Disposition ECF radiological systems and areas no longer in use.

FY 2003 Remediate and dispose of equipment from obsolete fuel facility at Bettis site.

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 site L-Building, while decontaminating other inactive radiological areas on site.

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

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

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.

	FY 2001	FY 2002	FY 2003
A. Examine removed fuel cells at end-of-life and perform non-destructive examinations of irradiated test specimens to confirm predicted performance and validate design methods……………………………………………	**18,600**	**18,600**	**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 dry spent fuel 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 2001 Ship radioactive and hazardous waste generated in support of ongoing work.

Design and develop specialized tooling to complete selected prototype fuel and core component examinations.

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

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003

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

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

Develop 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.

Total, Evaluation and Servicing.	**149,563**	**132,341**	**144,390**

Explanation of Funding Changes from FY 2002 to FY 2003

		FY 2002 vs. FY 2003 ($000)
I.A	Funding level reflects increased operation and maintenance costs associated with aging prototype facilities ……………………………………………..….	+7,400
I.B	Increase due to a major non-refueling overhaul and associated work evolutions in FY03……..……………………………..…………………	+6,000
II.A	Resources decrease to zero as the site is released for unrestricted future use..	-1,800
II.B.	Reflects completion of major inactivation milestones in FY02…………..	-9,600
II.C.	Requirements decrease based on progress to date, Program priorities, and budget constraints …………………….………………………….……….	-4,941
III.A	Requirements reflect increased remediation efforts planned for FY03…….	+5,400
IV.A	Reflects support required to bring spent fuel dry storage facility online….	+9,590
Total Funding Change, Evaluation and Servicing………………………….		**+12,049**

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 2003 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 2001	FY 2002	FY 2003	$ Change	% Change
Headquarters					
Salary and Benefits………………………	8,251	9,168	9,755	+587[a]	+6.4%[a]
Travel………………………………………	510	520	530	+10	+1.9%
Support Services…………………………	0	0	0	0	0%
Other Related Expenses…………………	601	700	1060	+360	+51.4%
Total, Headquarters………………………	9,362	10,388	11,345	+957	+9.2%
Full Time Equivalents……………………	56	56	57	1	1.8%
Pittsburgh Naval Reactors					
Salary and Benefits………………………	5,840	6,365	6,655	+290	+4.6%
Travel ……………………………………	125	125	130	+5	+4.0%
Support Services…………………………	0	0	0	0	0%
Other Related Expenses…………………	589	950	970	+20	+2.1%
Total, Pittsburgh Naval Reactors……….	6,554	7,440	7,755	+315	+4.2%
Full Time Equivalents……………………	71	71	70	-1	-1.4%

[a] Naval Reactors did not develop this requirement and does not know the basis for the amounts included, and therefore can neither validate nor endorse the accuracy of these calculations. The FY 2001 and FY 2002 column of the FY 2003 Congressional Request includes funding in the amount of $1.201M and $1.228M, respectively, for the Government's share of increased costs associated with pension and annuitant health care benefits. These funds are comparable to the FY 2003 funding of $1.23M. (Note: The data is presented on a comparable basis as if the legislation had been enacted and implemented in FY 2001.)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Schenectady Naval Reactors					
Salary and Benefits……………………….	5,005	5,310	5,625	+315	+5.9%
Travel………………………………………	90	95	95	0	0%
Support Services………………………….	0	0	0	0	0%
Other Related Expenses…………………	505	595	610	+15	+2.5%
Total, Schenectady Naval Reactors……	5,600	6,000	6,330	+330	+5.5%
Full Time Equivalents …………………	64	64	64	0	0%
Total Naval Reactors Program					
Salary and Benefits……………………….	19,096	20,843	22,035	+1,192[a]	+5.7%[a]
Travel………………………………………	725	740	755	+15	+2.0%
Support Services………………………….	0	0	0	0	0%
Other Related Expenses…………………	1,695	2,245	2,640	+395	+17.6%
Total, Program Direction…………………	21,516	23,828	25,430	+1,602	+6.7%
Full Time Equivalents……………………	191	191	191	0	0%

[a] Naval Reactors did not develop this requirement and does not know the basis for the amounts included, and therefore can neither validate nor endorse the accuracy of these calculations. The FY 2001 and FY 2002 column of the FY 2003 Congressional Request includes funding in the amount of $1.201M and $1.228M, respectively, for the Government's share of increased costs associated with pension and annuitant health care benefits. These funds are comparable to the FY 2003 funding of $1.23M. (Note: The data is presented on a comparable basis as if the legislation had been enacted and implemented in FY 2001.)

Detailed Program Justification

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Salaries and Benefits………………………………………………	**19,096**	**20,843**	**22,035**[a]

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 the employment ceiling established in the Department's Workforce 21 Plan. The change is due to projected salary adjustments in accordance with allowable inflation.

Travel…………………………………………………………………	**725**	**740**	**755**

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 2002 travel funding supports trips required to provide management and oversight of the Naval Reactors Program. FY03 requested funding represent on real growth compared to FY02.

Support Services………………………………………………	**0**	**0**	**0**

Naval Reactors does not use Support Services contractors.

Other Related Expenses…………………………………………	**1,695**	**2,245**	**2,640**

Include 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. FY02 and FY03 include labor costs for Bettis contractor services and ADP requirements or NR Headquarter's internal classified local area network.

Total, Program Direction…………………………………………	**21,516**	**23,828**	**25,430**[a]

Explanation of Funding Changes FY 2002 to FY 2003

[a] Naval Reactors did not develop this requirement and does not know the basis for the amounts included, and therefore can neither validate nor endorse the accuracy of these calculations. The FY 2001 and FY 2002 column of the FY 2003 Congressional Request includes funding in the amount of $1.201M and $1.228M, respectively, for the Government's share of increased costs associated with pension and annuitant health care benefits. These funds are comparable to the FY 2003 funding of $1.23M. (Note: The data is presented on a comparable basis as if the legislation had been enacted and implemented in FY 2001.)

	FY03 vs. FY02 ($000)
Salaries and Benefits…………………………………………………………………	**+1,192**[a]

The change is due to salary adjustments in accordance with allowable inflation.

Travel…………………………………………………………………………….…	**+15**

The change is due to adjustments in accordance with allowable inflation.

Other Related Expenses………………………………………………………….…	**+395**

The change is due to inclusion of labor for Bettis contractor services and ADP Requirements for NR Headquarters' internal classified local area network.

Total Funding Change, Naval Reactors Program Direction……………………….	**+1,602**

Other Related Expenses

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Training……………………………………………	117	127	137	+10	+7.9%
Working Capital Fund …………………………	500	350	560	+210	+60.0%
Software Procurement/Maintenance Activities/ Capital Acquisitions………………………………	440	750	860	+110	+14.7%
Other………………………………………………	638	1,018	1,083	+65	+6.4%
Total, Budget Authority…………………………	1,695	2,245	2,640	+395	+17.6%

[a] Naval Reactors did not develop this requirement and does not know the basis for the amounts included, and therefore can neither validate nor endorse the accuracy of these calculations. The FY 2001 and FY 2002 column of the FY 2003 Congressional Request includes funding in the amount of $1.201M and $1.228M, respectively, for the Government's share of increased costs associated with pension and annuitant health care benefits. These funds are comparable to the FY 2003 funding of $1.23M. (Note: The data is presented on a comparable basis as if the legislation had been enacted and implemented in FY 2001.)

Capital Operating Expenses & Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 2001	FY2002	FY 2003	$ Change	% Change
General Plant Projects……………………….	11,325	14,100	16,200	+2,100	+14.9%
Capital Equipment…………………………….	30,604	32,900	33,800	+900	+2.7%
Total, Capital Operating Expense	**41,929**	**47,000**	**50,000**	**+3,000**	**+6.4%**

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior Year Approp-riations	FY 2001	FY2002	FY 2003	Unapprop-riated Balance
90-N-102 Expended Core Facility Dry Cell………..……….	109,500	68,046	15,965	4,200	2,000	19,289
01-D-200 Major Office Replacement Building………….	12,397	0	1,297	9,000	2,100	0
03-D-200 CleanroomTechnology Facility	7,500	0	0	0	7,200	300
Total, Construction		**68,046**	**17,262**	**13,200**	**11,300**	**300**

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

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior Year Appropriations	FY 2001	FY 2002	FY 2003	Acceptance Date
Thermal-Hydraulic Test Equipment	2,900	2,600	300	0	0	FY 2001
Local Area Network Replacement	4,900	2,400	900	1,600	0	FY 2002
Metal Processing Equipment	4,200	4,000	200	0	0	FY 2000
Post-Irradiations Evaluation Laboratory	8,300	7,800	500	0	0	FY 2001
Scalable Computer Modification/Upgrade	10,000	0	6,000	4,000	0	FY 2002
Scalable Parallel Supercomputer	12,000	0	0	0	12,000	FY 2003
Total, Major Items of Equipment		16,800	7,900	5,600	12,000	

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

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	2Q 2002	3Q 2002	2Q 2003	2Q 2004	7,500	8,600

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
2003	7,200	6,500	6,000
2004	300	1,000	1,500

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, approximately 12,000 square feet (SF) (120' x 102') in size and approximately 36' in height. At the center of this facility is a Class 100, International Standards Organization (ISO) Level 5, Cleanroom. 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. The electrical power distribution equipment will be located in the adjoining Electrical Room. Recirculating and makeup air handling units will be located on the air handling unit deck above the cleanroom, with access available through the Mechanical Room. A Gas Storage Shed is provided for gas bottles that can be stored outdoors. A Class 100,000, ISO Level 8, Optics Laboratory (including an integral Laser Laboratory) and an Electrical Characterization Laboratory are also 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, a design room, and a janitorial/storage room. A vestibule area will be provided through which all personnel will enter and exit the facility. Finally, an approximately 3,000 SF office area will be constructed as part of the facility to accommodate personnel who routinely use the laboratory areas of the facility.

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 new roadway improvements to direct traffic around the new facility, installation of parking areas to replace those areas impacted by construction of the new building and installation of the new roadway, and 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 continue its leadership role in the development of thermophotovoltaic (TPV) technology by creating a facility with environmental controls consistent with the processing of high performance, semi-conductor 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, the security aspects of such work 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 provide the additional flexibility to pursue 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 March 2004.

4. Details of Cost Estimate

(dollars in thousands)

	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs	600	-
Total, Engineering design	600	-
Construction Phase		
Improvements to Land	230	-
Buildings	5,445	-
Utilities	160	-
Standard Equipment	100	-
Inspection, design and project liaison, testing, checkout and acceptance	285	-
Project Management (0.5% of TEC)	40	-
Total, Construction Costs	6,260	-
Contingencies		
Construction Phase (16.5% of TEC)	1,240	-
Total, Contingencies (16.5% of TEC)	1,240	-
Total, Line Item Costs (TEC)	8,100	-

Total estimate is based upon the conceptual design of the Cleanroom Technology Facility completed to date and conceptual estimates prepared for additional office and laboratory space to be included as part of the construction project.

5. Method of Performance

Contracting arrangements are as follows:

- Construction design will be performed under the Bettis Engineering Services Subcontract.
- Construction and procurement will be accomplished by fixed price contracts awarded on the basis of competitive bidding.

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	7,200	300	7,500
Total Line Item TEC/Facility Costs	0	0	7,200	300	7,500
Other Project Costs					

(dollars in thousands)

	Prior	FY 2002	FY 2003	FY 2004	Total
Conceptual design costs……….	440	0	0	0	440
NEPA Documentation Costs…...	50	10	0	0	60
Other Project Related Costs[a] …	0	600	0	0	600
Total, Other Project Costs……..	490	610	0	0	1,100
Total Project Cost (TPC)……….	490	610	7,200	300	8,600

7. Related Annual Funding Requirements

	(FY 2004 dollars in thousands) Current Estimate	Previous Estimate
Annual Facility Maintenance/Repair Costs[b]…………………………………………..	130	NA
Utility Costs (estimate based on FY 2002 projected rate structure)[c]……………….	88	NA
Total Related Annual Funding………………………………………………………..	218	NA
Total Operating Costs (operating from FY 2004 through FY 2028)………………..	5,450	NA

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.

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

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

Significant Changes

Completion changed from Fourth Quarter 2003 to First Quarter 2004

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

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design/Construction			
2001	1,297	1,297	900
2002	9,000	9,000	3,350
2003	2,100	2,100	7,850
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 will be 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	120
Design Management costs (0.3% of TEC)………………………………………………	35	70
Project Management costs (0.2% of TEC)………………………………………………	25	10
Total, Engineering design inspection and administration of construction costs (1.6% of TEC)	200	200
Construction Phase		
Buildings……………………………………………………………………………………...	8,097	8,460
Other Structures……………………………………………………………………………..	0	250
Utilities (Electrical/Civil)…………………………………………………………………….	800	0
Standard Equipment (Modular Furniture/Office Equipment)…………………………..	1,600	2,150
Removal less salvage…………………………………………………………………………	250	200
Inspection, design and project liaison, testing, checkout and acceptance……………	550	120
Construction Management (3.2% of TEC)………………………………………………	400	320
Project Management (0.8% of TEC)……………………………………………………	100	100
Total, Construction Costs	11,797	11,600
Contingencies		
Design Phase……………………………………………………………………………..	0	40
Construction Phase (3.2% of TEC)…………………………………………………….	400	560
Total, Contingencies (3.2% of TEC)……………………………………………………..	400	600
Total, Line Item Cost (TEC)………………………………………………………………..	12,397	12,400

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

4. Method of Performance

Contracting arrangements are as follows:

Building design/construction will be accomplished via one fixed price (design/build) contract 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 price contracts awarded on the basis of competitive bidding.

6. Schedule of Project Funding

	(dollars in thousands)					
	Prior	FY 2001	FY 2002	FY2003	Outyears	Total
Project cost						
Facility Cost						
Design………………………………………...	0	200	0	0	0	200
Construction…………………………………	0	1,097	9,000	2,100	0	12,197
Total Facility Cost, Line Item TEC………..	0	1,297	9,000	2,100	0	12,397
Other Project Costs						
Conceptual design cost……………………..	120	150	0	0	0	270
Decontamination & Decommissioning………………………….	0	900	150	0	0	1,050
Total Other Project costs……………………	120	1,050	150	0	0	1,320
Total Project Cost (TPC)……………………	120	2,347	9,150	2,100	0	13,717

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

Significant Changes

Fiscal Years 2000 through FY 2006 costs in the Financial Schedule (Section 2) have been updated to reflect actual costs through FY 2001 and current estimates for FY 2002 through FY 2006. The Details of Cost Estimate (Section 4) were revised to show the Design Phase, Construction Phase, and Contingency estimates based on the latest estimate for the remaining work. The remaining scope of work has been modified to address radiological contamination control and facility throughput issues.

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

2. Financial Schedule

[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] The revised cost estimate reflects work scope changes necessary to address radiological contamination control and facility throughput issues.

(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	2,076
2003	2,000	2,000	7,616
2004	18,300	18,300	14,011
2005	989	989	11,652
2006	0	0	2,597

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 96 percent 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 10 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 2002, 67% of the project is expected to be completed.

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	14,215
Design Management costs (2.8 % of TEC)	3,059	2,632
Project Management costs (2.6 % of TEC)	2,850	2,329
Total, Engineering design, inspection, and administration of construction costs (19.4% of TEC)	21,296	19,176
Construction Phase		
Buildings	43,014	41,221
Special Equipment	19,926	9,697
Standard Equipment	5,727	5,727
Inspection, design and project liaison, testing, checkout and acceptance	9,232	8,650
Project Management (2.6 % of TEC)	2,850	2,329
Total, Construction Costs	80,749	67,624
Contingencies		
Design Phase (1.4 % of TEC)	1,491	150
Construction Phase (5.4 % of TEC)	5,964	3,261
Total, Contingencies (6.8 % of TEC)	7,455	3,411
Total, Line Item Costs (TEC)	109,500	90,211

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 operating contractor.

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 2.8%, 2.8%, 2.9% and 2.9%, respectively.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	Total
Project cost							
Facility Cost							
Design	19,162	1,923	1,923	427	0	0	23,435
Construction	52,386	153	5,693	13,584	11,652	2,597	86,065
Total, Line item TEC	71,548	2,076	7,616	14,011	11,652	2,597	109,500
Operating expense funded equipment[a]	4,252	66	0	130	9	0	4,457
Total Facility Costs	75,800	2,142	7,616	14,141	11,661	2,597	113,957
Other project costs							
Conceptual design cost	1,601	0	0	0	0	0	1,601
Decontamination & Decommissioning[b]	1,184	0	0	5	0	0	1,189
NEPA Documentation Costs	2,500	0	0	0	0	0	2,500
Other project-related costs[c]	1,286	0	50	100	100	100	1,636
Total, Other project costs	6,571	0	50	105	100	100	6,926
Total project cost	82,371	2,142	7,666	14,246	11,761	2,697	120,883

[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. FY 1998 and FY 2000 include costs of $50,000 and $100,000 respectively for the design and fabrication of the temporary west shield wall.

[b] Includes costs for removal of the spray pond in FY 1998 and FY 1999. Costs for removal of Butler Buildings 10 and 10A are in FY 2001. FY 2004 includes cost for removal of the temporary west shield wall.

[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.

[c] Previous estimate is stated in FY 02 dollars.