Naval Reactors

Proposed Appropriation Language

For Department of Energy expenses necessary for naval reactors activities to carry out the Department of Energy Organization Act (42 U.S.C. 7101 et seq.), including the acquisition (by purchase, condemnation, construction, or otherwise) of real property, plant, and capital equipment, facilities, and facility expansion, [$690,163,000,] *$688,045,000*, to remain available until expended. *(Energy and Water Development Appropriations Act, 2001 as enacted by section 1(a)(2) of P.L. 106-377.)*

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's efforts have ensured, and continue to ensure, the safe operation of the many reactor plants in operating nuclear powered submarines and aircraft carriers, and have fulfilled the Navy's requirements for new reactors to meet evolving national defense demands.

Naval Reactors is principally a technology program in the business of power generation for military application. The Program's long term development work ensures nuclear propulsion technology provides options to maintain and upgrade current capabilities, as well as meet 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, evolving 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.

With 97 operating Naval reactor plants in warships comprising 40% of the Navy's major combatants, primary emphasis and most effort is placed on ensuring the safety and reliability of these plants. Naval Reactors is developing the next generation reactor for the Navy's new VIRGINIA class attack submarines and a reactor for the Navy's new CVNX class of aircraft carriers.

The VIRGINIA class will provide needed capability for the Navy at a more affordable price. This plant encompasses advanced component and system technology -- including the first true life-of-the-ship core, which will obviate the need for expensive refuelings, and a simplified plant arrangement with fewer components compared to previous designs. Development of the next generation reactor is well along and proceeding on schedule. The lead submarine incorporating this plant is expected to 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% more energy than the reactors used in NIMITZ class ships. This energy can support a higher operating tempo, and future electrical load growth in the CVNX class. 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 technical advances which 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 in 2006 and to go to sea in 2013. The time to develop the reactor is constrained and development, therefore, 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.

Program Objective

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

Performance Goals

- 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% for test reactor plants, and 124 million miles steamed for nuclear-powered ships.
- NS5-2 Develop new technologies, methods and materials to support reactor plant design, including the next generation submarine reactor, which will be 96% complete by the end of FY 2002, and conduct detailed design on a reactor plant for the next generation aircraft carrier, CVNX.
- NS5-3 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.

Strategies

Due to the integrated nature of nuclear propulsion work, efforts overlap between strategies and across performance goals. For example, the strategies for meeting Navy goals for extended warship operation, ensuring the safety and reliability of reactor plants in Navy warships, and ensuring no personnel exceed Federal radiation exposure limits are closely related. Efforts within each strategy can impact safety as well as endurance. In a similar manner, development of the new concept steam generator is aimed at improving safety and performance, but also benefits endurance and acoustic measures. 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 effort in Bosnia and U.S. presence in Iraq. 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 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. Naval nuclear reactors power 40% of the Navy's major combatants. This number is comparable to the entire U.S. commercial nuclear power generating industry and represents nearly as many reactors as the next two largest nuclear power generating nations combined (France and Japan).

These 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. Nuclear powered warships have steamed more than 120 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.
- 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% for 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, which 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 accumulated the equivalent of 18 years of equivalent fleet operation in the S8G prototype plant. The prototypes also are used to train Navy nuclear plant operators. In 2000, Naval Reactors celebrated the milestone of 100,000 Navy nuclear power plant operators trained in the Program=s rigorous pipeline.

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.

With the shutdown of the S1C plant, there is no future need for the Windsor Site in Connecticut. As such, Naval Reactors has demolished all structures, remediated the area, recycled/disposed of waste material, and is releasing the site for unrestricted use.

While the S3G and D1G prototype plants at the Kesselring Site in New York are shutdown, 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 original intent was to complete the overall inactivation effort by 2002. 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.

At the NRF site in Idaho, Naval Reactors has shutdown all three plants -- S5G, S1W, and A1W; 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.

Public opinion supports prompt inactivation, as related in numerous newspaper articles published during and after the Environmental Impact Statement public comment period for the New York and Connecticut prototype plants. 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 efforts at the Kesselring Site in New York to eliminate surplus facilities, remediate and dismantle plant facilities and release applicable areas.
- Continue inactivation 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.

Performance Measure Funding Matrix

FY 2002

Budget Categories (dollars in thousands)

Performance Measures	Reactor Technology & Analysis	Plant Technology	Materials Development & Verification	Evaluation and Servicing
Meet Navy goals for extended warship operation, through:				
Nuclear heat source design and analysis methods	57,400			
Core manufacturing processes and inspection techniques	30,000			
Removed fuel cell and irradiated test specimen examination				18,600
Fuel, core and reactor structural material development & testing			49,500	
Plant materials development and testing			31,100	
Irradiations testing and examination			50,304	
Ensure safety and reliability of reactor plants, through:				
Reactor equipment design & testing	49,300			
Physics testing and analysis	21,100			
Safety and shielding analyses	13,800			
Steam generator, energy conversion, and chemistry technologies improvements		23,062		
Instrumentation and control equipment development		44,938		
Reactor plant components development & testing		39,400		
Reactor plant performance analyses and chemistry control		8,600		
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				33,100
Servicing of land-based test reactor plants				6,100
Operation and servicing of the advanced test reactor				18,000
Inactivate shutdown prototype plants, through:				
Inactivation efforts in Connecticut				1,800
Inactivation efforts in New York				22,300
Inactivation efforts in Idaho				6,741
Maintain outstanding environmental performance, through:				
Radiological, environmental and safety operations	38,300			
Cleanup of test facilities				25,700

The following funding profiles for the development of the next generation reactor for the VIRGINIA class of submarines and 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 benefitting the next generation and CVNX reactor developments.

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
Next Generation Reactor plant development and testing	40,000	30,000	17,000
Development of CVNX reactor plant	80,000	117,000	141,000

In FY 2002, Naval Reactors will implement 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 will pursue 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 to increase, while work on the next generation reactor for the Virginia class submarines declines. The prototype reactor plant inactivation effort will decline as efforts come to fruition or are cut back due to funding constraints.

- <u>Extend warship operational lifetime</u>: Naval Reactors continues to develop improved manufacturing processes and analytical methods for reactor core design. Irradiation testing of core and plant materials is enabling extended operation by demonstrating the acceptability of fuel manufacturing process improvements and enhancing predictive capabilities. Older classes of nuclear powered warships are and will operate beyond original design life. A vivid example is the USS ENTERPRISE, the first nuclear powered aircraft carrier. This ship was commissioned in 1961, and is now scheduled to retire in 2013 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 continued use of this ship and the other nuclear powered warships beyond original design life (the Navy recently announced after exhaustive engineering analysis that selected LOS ANGELES class submarine lives could be extended by 10 percent) provides a distinct economic advantage while improving projected force levels for the national defense. Moreover, new reactors are being designed initially for longer life spans. For example, VIRGINIA class submarines will have a design life of 33 years without a core refueling.

Ensure safety and reliability of reactor plants in the Navy=s warships: 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 120 million miles. In the process, they have accumulated nearly 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. The former Soviet Navy's nuclear propulsion safety record offers a stark contrast -- they 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. Continued examination of fuel cells removed during refueling or defueling of reactor plants will lend important refinements to current assumptions. As an example of the value of such studies, when examinations of the expended cores from the first NIMITZ class refueling began in early FY 2000, the data showed that the relationship between temperature and corrosion in the aircraft carrier reactor is significantly different than assumed. This finding will require further study, but may ultimately affect operating procedures for fleet carriers as necessary to maintain safe operation and preserve core life.

Develop the next generation reactor for the Virginia class attack submarines: Naval Reactors expects to exceed the 90% completion goal for this plant during FY 2000. DOE-cognizant development work is mostly complete, but some confirmatory testing is still necessary. Naval Reactors continues to support the Navy=s schedule for construction of the lead ship. Navy vendors are fabricating all major components for the lead ship reactor plant. By the end of 2001, confirmatory life testing of control drive mechanisms (the first completely new design for these components in 25 years) will have been completed.

Develop a reactor for the Navy=s new CVNX class aircraft carriers: Following scoping and sizing assessments made to support the Navy=s studies of carrier alternatives, development started during 1999. Initial reactor manufacturing development began at the core vendor during 2000 and is proceeding according to schedule. Plant arrangements continue to progress on schedule in 2000. System definition for the new reactor plant will be completed during 2000, and development of system diagrams will continue through 2001. Naval Reactors will develop this reactor without the need for a prototype power unit (nuclear core and related equipment). This major cost avoidance (at least $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. An example of this applicable to the Virginia class, is the new concept steam generator. This component 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 2000, and also to perform some test modifications which will expand the breadth and variety of irradiation tests which 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.

Dismantlement of the S1C reactor compartment, as well as decontamination and demolition of all facilities at the Windsor site in Connecticut, was completed in 1999.

S3G pressure vessel removal was completed in 2000, and the remaining plant structures (which do not present a hazard in their current state, but require resources for continued upkeep and monitoring) will be remediated as resources are available.

In parallel with remaining S3G work, D1G is undergoing preparations for pressure vessel removal. D1G pressure vessel removal will proceed through 2002, 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 2000, average occupational radiation exposure for Program personnel was 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.

Funding Profile

(dollars in thousands)

	FY 2000 Comparable* Appropriation	FY 2001 Original Appropriation	Adjustments	FY 2001 Comparable* Appropriation	FY 2002 Budget Request
Naval Reactors					
Naval Reactors Development (NRD)					
Plant Technology	111,025	118,200	0	118,200	116,000
Reactor Technology & Analysis	196,000	216,900	0	216,900	226,000
Materials Development & Verification	121,400	127,600	-3,000	124,600	130,904
Evaluation & Servicing	160,497	151,000	-1,437	149,563	132,341
Facility Operations	46,200	42,200	0	42,200	47,000
Construction	15,000	17,300	-38	17,262	13,200
Omnibus .22% rescission	0	0	-1,480	-1,480	0
Subtotal, NRD	650,122	673,200	-5,955	667,245	665,445
Program Direction	19,515	21,400	-1,085	20,315	22,600
Subtotal, Naval Reactors	669,637	694,600	-7,040	687,560	688,045
Adjustments					
General Reduction, S&S	0	-4,437	+4,437	0	0
Use of prior year balances	0	0	0	0	0
Subtotal, adjustments	0	-4,437	+4,437	0	0
Total, Naval Reactors	669,637	690,163	-2,603	687,560	688,045

Public Law Authorization:

Pub. L. 83-703, AAtomic Energy Act of 1954"
Executive Order 12344 (42 U.S.C. 7158), ANaval Nuclear Propulsion Program@
Pub. L. 106-65, ANational Defense Authorization Act of 2000", Title 32, ANational Nuclear Security Administration"

Naval Reactors' FY 2002 budget request includes approximately $0.6M for preliminary design of a cleanroom technology facility for Bettis Atomic Power Laboratory, to improve material design and testing efficiency and help eliminate waste caused by introduction of impurities during testing. Construction funds for the facility will be requested for FY 2003.

* "Comparable" columns do not account for the effect of inflation. Naval Reactors' FY 2002 request represents a reduction of about $20M from FY 2001 funding in real terms.

Funding by Site

	(dollars in thousands)				
	FY 2000	FY 2001	FY 2002	$ Change	% Change
Pittsburgh Naval Reactors Office					
Bettis Atomic Power Laboratory	335,500	349,018	357,540	8,522	2.4%
Pittsburgh Naval Reactors Office	7,800	6,200	7,600	1,400	22.6%
Total, Pittsburgh Naval Reactors Office	343,300	355,218	365,140	9,922	1.8%
Idaho Operations Office					
Idaho National Engineering & Environmental Laboratory	51,100	52,147	51,951	-196	3.8%
Idaho Operations Office	1,000	0	0	0	0%
Total, Idaho Operations Office	52,100	52,147	51,951	-196	3.8%
Schenectady Naval Reactors Office					
Knolls Atomic Power Laboratory	261,000	266,079	254,004	-12,075	-4.5%
Schenectady Naval Reactors Office	6,000	5,600	5,900	300	5.4%
Total, Schenectady Naval Reactors Office	267,000	271,679	259,904	-11,775	-4.3%
Washington Headquarters	11,100	8,515	9,150	635	7.5%
All Other Sites	1,625	1,519	1,900	381	25.0%
Omnibus .22% rescission	0	-1,518	0	1,518	100.0%
Subtotal, Naval Reactors Development	675,125	687,560	688,045	485	0.1%
Use of prior year balances	0	0	0	0	0%
Total, Naval Reactors Development	675,125	687,560	688,045	485	0.1%

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 Arlington, Virginia, which administers the Naval Nuclear Propulsion Program.

Plant Technology

Mission Supporting Goals and Objectives

Plant Technology focuses on the of development, testing and analysis of components and systems which transfer, convert, control and measure power created by the reactor. Understanding how components degrade through operation 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 is 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 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 simpler, more reliable, more capable, and less costly to inspect and maintain.

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. To deal with this continuing issue, Naval Reactors is pursuing technologies to greatly reduce corrosion through fundamental design changes.

Reactor machinery, such as pumps with constantly rotating or operating parts, wear and require lubrication and maintenance. Plant Technology funds 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 of their own.

Considerable development work is devoted to applying advances in electronics to instrumentation and control equipment and systems. Due to rapid degradation and obsolescence, 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, accuracy and reliability of the instrumentation can affect the long term useable power obtained from the reactor.

Funding Schedule

(dollars in thousands)

	FY 2000	FY 2001	FY 2002	$ Change	% Change
Total, Plant Technology	111,025	118,200	116,000	-2200	-1.9%

Reactor Technology & Analysis

Mission Supporting Goals and Objectives

The work in this category focuses on ensuring the continued safety of operating reactors, developing a better fundamental understanding of reactor behavior, designing new reactors having longer life, improved reliability, enhanced simplicity, better efficiency, and greater energy density, improving and streamlining manufacturing and assembly processes to achieve cost savings and reduce waste, and developing new production techniques to incorporate new materials and processes. Reactor Technology and Analysis efforts support the performance measures of meeting the goals for extended Navy nuclear powered warship operation, ensuring the operational safety and reliability of operating reactors, supporting Navy acoustic requirements, and ensuring continued excellence in radiological and environmental control.

Further development of reactor design and analytical techniques will allow more accurate predictions of reactor performance, thereby providing more balanced designs. New tests and analyses will lead to improvements which allow the production of reactors with greater endurance and a resulting benefit in terms of reduced costs and fewer waste products. Emphasis in this area 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.

Likewise, work is underway to improve analysis tools to better understand basic nuclear data. The focus is to predict performance over longer core and reactor lifetimes, and thereby allow these lifetimes to be extended beyond current predictions. Other initiatives in this area are dedicated to designing and testing simpler, more reliable reactor equipment, performing analyses to ensure reactor safety, and developing improved shield designs to reduce cost and minimize weight without increasing personnel radiation exposure.

Development and qualification of core and reactor component thermal/hydraulic designs are aimed at improvements in 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.

Funding Schedule

	FY 2000	FY 2001	FY 2002	$ Change	% Change
Total, Reactor Technology and Analysis	196,000	216,900	226,000	+9,100	4.2%

Detailed Program Justification

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
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.			
A. Improve nuclear reactor core design and analysis methods and develop improved designs to satisfy service life requirements.	**50,000**	**54,100**	**57,400**

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 qualified which permit establishing new, or revising 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 and operating guidelines are developed with these revised assumptions.

New designs and less restrictive operating limits derived from improved design codes will facilitate meeting service life and performance requirements for new reactors, such as the next generation reactor for VIRGINIA Class submarines and the reactor being developed for the new CVNX class of aircraft carriers. The core for the VIRGINIA Class will be the first designed from inception to last the life of the ship. Development work for new core designs entails developing independent models and using independent 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.

Perform thermal and hydraulic design evaluations of reactor cores to determine the appropriate concepts that promote overall propulsion plant affordability and enable the simplification of all systems. Requirements reflect acceleration of the CVNX test program.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Verifiable Supporting Activities:

FY 2000 Incorporate experimental results of reactor shock and vibration test programs to update analysis methods in the next generation reactor. Review engineering designs, analyses and test work to assure the next generation reactor will perform as expected.

Evaluate technical requirements for reactors with high temperature capability.

Initiate reference design for an advanced core for use in a reactor plant intended for a new aircraft carrier.

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 alternate heat transport systems in order to maximize core operating efficiency and extend core life.

Further develop advanced computational capabilities in order 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.

	(dollars in thousands) FY 2000	FY 2001	FY 2002
B. Evaluate and test improved core manufacturing processes and inspection techniques to support extended life of reactors.	**18,000**	**24,200**	**30,000**

The requirement for better, longer lasting fuel, and the drive for cost savings necessitate manufacturing process improvements which are now feasible because of the availability of new technologies. Previously designed naval reactor cores develop certain attributes after operation because of manufacturing process limitations. Consequently, compensatory margins must be built into core designs and operating limits constraining the power density and life expectancy. Modifying the fuel manufacturing process allows cores to operate with longer and greater output capability. This process is technically challenging, but necessary to improve the fuel manufacturing process to produce greater power cores at a lower costs for new core designs. Requirements reflect acceleration of applied CVNX development work.

Verifiable Supporting Activities:

FY 2000 Begin fabrication and development work for a mechanical test cell that has the large cross section and internal geometry prototypical of CVNX.

Begin qualification of advanced element processes and core fabrication techniques.

Develop new and emergent manufacturing and inspection technologies to improve core performance, solve technical problems and reduce core cost.

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 processes 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 for the element and initiate formal process qualification of the assembly manufacturing processes to include control rod, manifold and core structural processes.

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
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.			
A. Design and test improved reactor equipment, including advanced control drive mechanisms	**44,000**	**49,300**	**49,300**

Reactor safety/reliability demand the mechanisms which 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 ensuring 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 aggressive plant-wide limitations on space and mechanism operating power. In addition to the new drive mechanism, a more accurate control rod position indicator is being developed to meet improved 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.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Verifiable Supporting Activities:

FY 2000 Continue remaining control drive mechanism lead unit testing, examination and reports for next generation reactor.

Perform any needed testing and resolve design issues arising from receipt inspection or power unit assembly for the next generation reactor.

Initiate reference designs for reactor equipment and initiate design process for an improved control drive mechanism for use on CVNX.

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 final design and intiate reactor vessel and closure head fabrication process.

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
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	**20,000**	**21,100**	**21,100**

The first cores Naval Reactors developed had expected service lives of two years. Subsequent research and development has resulted in core service lives of over twenty years, and current development will deliver a life-of-the-ship core which 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 ensure continued safe and reliable operation at stages in life which extend well beyond current operating experience.

In addition, current physics methods use approximations which limit design precision and require allowances be built into the design. Naval Reactors is developing advanced nuclear design methods and software that use fewer approximations resulting in reduced uncertainties and associated costly conservatism in advanced reactor design. This reduction in uncertainties and biases currently applied to core reactivity predictions can lead 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 requires 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 core designs and to optimize new core designs. Therefore, Naval Reactors is working to identify and perform experimental programs that would lead to improvements in this area.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Verifiable Supporting Activities:

FY 2000 Evaluate physics data from late-in-life operation of the advanced fleet reactor core and qualify model predictions against the measured data.

Incorporate improvements to major nuclear design programs.

Start reference design work for more affordable core design for an advanced aircraft carrier.

Apply improved physics methods, modeling procedures and cross section data to reduce reactivity bias for current and future core designs.

Commence analysis of physics data from the NIMITZ core and S8G prototype expended core examinations to validate physics predictions and methods.

Evaluate physics data developed from neutron cross section measurements at the RPI accelerator.

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.

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
C. Conduct reactor safety and shielding analyses for nuclear reactor plants to ensure containment of radiation and proper protection of personnel	**13,000**	**13,800**	**13,800**

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

In addition, shielding analyses are conducted to ensure effective attenuation of radiation and continued safe operation. New shield materials are sought to improve shield effectiveness, while eliminating the use of hazardous materials such as lead and improving reactor plant affordability. Shielding method improvement allows more accurate prediction of radiation shielding effectiveness and the extent of radiation received by personnel, reactor components, and materials. This allows shielding to be better optimized to reduce radiation exposure to personnel and equipment during reactor plant and servicing operations 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.

For additional explanation, please refer to classified addendum.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Verifiable Supporting Activities:

FY 2000 Complete the next generation reactor flooding casualty evaluation and continue preparation of the Safety Analysis Report (SAR) and Probabilistic Safety Assessment (PSA).

Finalize the CVN 77 shield design and develop construction drawings.

Initiate analysis necessary to establish conceptual design of engineered safeguards system for CVNX.

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.

	(dollars in thousands)	
FY 2000	FY 2001	FY 2002

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

	FY 2000	FY 2001	FY 2002
A. Develop and qualify improved core and reactor component thermal and hydraulic designs	**16,000**	**16,100**	**16,100**

Work in this area focuses on developing more advanced thermal hydraulic analytical models and codes. Improved tools will enable a more realistic approximation of flow requirements. This, in turn, will enable a more balanced design and reduction in cost, and will enable the design of reactor cores and components with reduced acoustic signatures.

For additional explanation, please refer to classified addendum.

Verifiable Supporting Activities:

FY 2000 Validate and qualify advanced computational fluid dynamics code.

Complete sufficient tests and analyses to provide qualification basis for an advanced safety code which resulted from thermal and hydraulic extended range testing.

Develop test data to benchmark simulations.

Initiate validation of advanced safety code for use in calculations.

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.

For additional explanation, please refer to classified addendum.

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
IV. Ensure no personnel exceed Federal limits for radiation exposure and no significant findings result from environmental inspections by state and federal regulators.			
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 .	**35,000**	**38,300**	**38,300**

Radiological materials must be properly controlled to protect the health and safety of workers, the public and the environment. Naval Reactors enforces strict compliance with requirements for 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 generation 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, effective enforcement of existing controls, and emergency response capabilities are in place to control or mitigate any problems. In addition, 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 2000	FY 2001	FY 2002
Total, Reactor Technology & Analysis	196,000	216,900	226,000

Explanation of Funding Changes from FY 2001 to FY 2002

	FY 2002 vs. FY 2001 ($000)
#I.A Funding level reflects acceleration of the CVNX test program	+3,300
#I.B Funding level reflects acceleration of the CVNX development contract	+5,800
Total Funding Change, Reactor Technology & Analysis:	+9,100

Detailed Program Justification

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
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.			
A. Ensure satisfactory reactor plant operation throughout life and improve steam generator, energy conversion, and steam generator water chemistry technologies to enhance performance and reduce maintenance costs	**23,000**	**26,000**	**23,062**

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 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 requires a continually updated 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.

CVNX shipbuilding schedules and goals for reduced weight, manning, and life cycle costs, require development of 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 preferred goals of cost and weight reduction while enhancing performance.

Development is also 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. FY 02 amount reflects completion of tube deposition corrosion testing, and completion of advanced steam generator feasibility testing.

	(dollars in thousands)	
FY 2000	FY 2001	FY 2002

Verifiable Supporting Activities:

FY 2000 Continue steam generator simulator testing and analysis for development of improved corrosion control and predictive models.

Continue testing of chemistry additives and corrosion inhibitors for long term use.

Continue testing several types of steam generators with advanced in-plant corrosion monitors.

Identify and incorporate improvements to the new concept steam generator technology based on lessons learned from testing the manufacturing demonstration unit.

Assess new technologies and suppliers to meet CVNX steam generator objectives.

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 LOS ANGELES class steam generator scale model to provide test for additional analysis qualification and inspection frequency reduction.

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 abate/reduce steam generator corrosion issues.

Model, develop, and characterize energy conversion modules with high efficiency, high power density.

For additional explanation, please refer to classified addendum.

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
B. Develop instrumentation and control equipment to replace obsolete equipment and improve reliability and performance	**45,000**	**48,100**	**44,938**

Naval reactor plant operators rely on instrumentation to monitor plant conditions, take corrective action, and determine position and speed of the control rods used regulate reactor output. Safe and reliable operation of the plant is dependent on the reliability and performance of this equipment. 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. FY 2002 amount reflects completion of CVNX non-generic I&C specification.

(dollars in thousands)		
FY 2000	FY 2001	FY 2002

Verifiable Supporting Activities:

FY 2000 Conduct testing of various standardized instrumentation hardware building blocks, conduct qualification testing of software building blocks, and modify as necessary.

Continue development of instrumentation for OHIO and LOS ANGELES class submarine reactor plants using standardized building blocks.

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

Begin identification of functional requirements for a new aircraft carrier reactor plant instrumentation system.

FY 2001 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 specific CVNX reactor plant instrumentation.

FY 2002 Complete NIMITZ class pre-production equipment fabrication and initiate composite testing. Commence OHIO class pre-production equipment fabrication.

Complete proof-of-concept testing of advanced 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.

For additional explanation, please refer to classified addendum.

	FY 2000	FY 2001	FY 2002
	(dollars in thousands)		
C. **Develop and test reactor plant components and applicable technologies which address known limitations and improve performance and reliability of components.**	**35,025**	**35,100**	**39,400**

Naval Reactors evaluates current technologies and applies them to develop simpler components which 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 is also focused on optimizing reactor plant arrangements to achieve simplicity, through the use of fewer components. Reducing the number of components and systems reduces maintenance, space and power needs. 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 which require less maintenance, and manning, without compromising safety or performance. Requirements reflect scaled up effort for development of CVNX reactor fluid system components.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Verifiable Supporting Activities:

FY 2000 Develop acceptance test procedures for the next generation reactor.

Continue qualification and flow testing of the redesigned NIMITZ class carrier main coolant pump.

Initiate preliminary design of components, such as the main coolant pump and pressurizer, and arrangements for the reactor plant for a new aircraft carrier.

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 of 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.

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
D. Perform reactor plant analyses to assure safe operation and improve reactor plant chemistry controls to reduce corrosion and plant radiation levels	**8,000**	**9,000**	**8,600**

Under pressure, the reactor core heats water in the primary system which flows through the steam generator. The steam generator absorbs the transferred heat in the secondary to producing 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 maintaining primary water chemistry to provide as benign an environment as possible, thus protecting the components and systems of the reactor plant. 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. FY 2002 amount reflects minor scope changes.

	(dollars in thousands)	
FY 2000	FY 2001	FY 2002

Verifiable Supporting Activities:

FY 2000 Incorporate results of isolation tests in the core performance model.

Conduct alternate chemistry treatment test and evaluation for future use in several plant types.

Perform the initial start-up test protection analysis for the next generation reactor, complete the reactor protection analysis for normal operating conditions, and develop a design basis for the reactor protection analysis under abnormal operating conditions.

Conduct end-of-life advanced fleet reactor performance analysis.

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 prototype effectiveness at reducing radiation levels and qualify OHIO class fleet-wide application.

Monitor results of zinc 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 2000	FY 2001	FY 2002
Total, Plant Technology	$111,025	$118,200	$116,000

Explanation of Funding Changes from FY 2001 to FY 2002

		FY 2002 vs. FY 2001 ($000)
# I.A	Reflects completion of tube deposition corrosion testing, and completion of advanced steam generator feasibility testing	-2,938
# I.B	Requirements decrease due to completion of CVNX non-generic instrumentation and control specification	-3,162
# I.C	Requirements reflect scaled up effort for development of CVNX reactor fluid system components	+4,300
# I.D	FY 02 amount reflects minor scope changes	-400
Total Funding Change, Plant Technology:		-2,200

Materials Development & Verification

Mission Supporting Goals and Objectives

Materials Development & Verification provides the high performance materials necessary for aval reactor plant applications. This work principally helps ensure shipboardNaval nuclear reactor plants meet Navy goals for extended warship operation by d eveloping Ensuringmaterials 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. This challenge is compounded by the difficulty in examining or replacing materials in the reactor plant once assembled.

Examining or replacing materials in a reactor plant which is assembled and operational is especially difficult because of system complexity and personnel radiation exposure concerns; thus it is essential that materials be qualified in advance of their 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 and then used to develop predictive models. The ability of these models to reliably predict material performance directly impactsis 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 continuous safe operation of naval reactors.

Work in this category is divided into three areas: core and reactor structural materials, plant materials, and irradiations testing. The first two areas concern the different challenges and demands placed on materials based on their location and function. For example, fuelthe materials used in the reactor core must maintain high integrity in retaining radioactive fission products under intense heat and irradiation during operating lifetime, and continue to maintain that integrity over thousands and thousands of years when eventually placed in a long-term spent fuel repository. at higher temperature , whereas tThe 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 is used to support both core and plant material development, but is highlighted to reflect the fundamental impact of irradiation on material performance.

Materials Development & Verification provides the high performance materials necessary for naval reactor plant applications in the most economical manner possible.

Funding Schedule

(dollars in thousands)

	FY 2000	FY 2001	FY 2002	$ Change	% Change
Total, Materials Development & Verification	124,400	124,600	130,904	+6,304	5.1%

Detailed Program Justification

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
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.			
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	**43,800**	**44,900**	**49,500**

Materials used in a reactor core must be capable of maintaining their mechanical integrity in an operating reactor environment which subjects them to the harmful effects of irradiation, pressure, corrosion, and heat. This demand is further exacerbated by their need to endure this harsh environment over increasing time periods. 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.

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 development. Where appropriate, manufacturing and other process development is qualified and processes 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.

	(dollars in thousands)	
FY 2000	FY 2001	FY 2002

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 2000 Conduct testing of prototypic X750 fasteners to provide temperature dependencies for use in a predictive cracking model.

Complete post-irradiation evaluation of initial high temperature fuel material irradiations tests to assess performance.

Develop improved method of predicting corrosion of fuel element cladding.

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

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

Initiate prototypical testing of CVNX fuel element design.

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

FY 2002 Prepare for qualification of improved, newly installed fuel fabrication process.

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. *(PM- G/N, 31.02/31.03B)*Continue evaluating prototypical irradiation testing of CVNX fuel element design in the Advanced Test Reactor.

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.

For additional explanation, please refer to classified addendum.

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
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	**37,600**	**33,800**	**31,100**

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 endurance to support increasingly longer lived nuclear cores.

Naval Reactors employs various methods to test, evaluate, and develop improved plant materials. For example, autoclave corrosion test facilities are used to create a hot, pressurized environment to approximate, under accelerated conditions, what the material would experience over a longer period of time in an operational reactor plant. Materials which have been in service are examined to provide critical operating data. In addition, testing and examination provides valuable 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. FY 2002 requirements decrease in several areas, most notably due to completion of selected alloy crack growth rate testing in support of continued-use predictive modeling. For additional explanation, please refer to classified addendum.

Verifiable Supporting Activities:

Because understanding the long term behavior of materials is an incremental learning process, the verifiable supporting activities described below represent milestones within the continuing overall effort.

FY 2000 Conduct current phase of testing of corrosion resistant materials to support model refinements.

Continue development of special alloys.

Conduct testing to evaluate long-term behavior of a reactor vessel structural material with improved fracture resistance to support safety analysis report for reactor operation.

Perform testing to extend lifetime of high strength fasteners.

Improve testing capabilities by developing advanced non-destructive testing methods and automated data acquisition techniques.

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.

Conduct fatigue cracking testing to evaluate a more affordable cladding process for pressure vessels.

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 hardsurfacing 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.

For additional explanation, please refer to classified addendum.

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
C. Conduct irradiations testing and perform detailed examinations to provide data for material performance characterization and prediction	**43,000**	**45,900**	**50,304**

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, is Naval Reactors' main source of data on the performance of reactor materials under irradiated conditions. The ATR 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.

While operation of the facility is partly funded in the Evaluation and Servicing budget category, work here 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 train's internal arrangement and location in the ATR determines exposure to specific conditions.

Naval Reactors continues to develop enhanced systems for irradiation testing with precise temperature control and environmental monitoring in the ATR. The change of $5 million in this area reflects work to apply these monitoring and control technologies, and work to combine test assemblies into an integrated test vehicle.

	(dollars in thousands)	
FY 2000	FY 2001	FY 2002

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 2000 Initiate irradiation of advanced fuel samples using enhanced facilities for control of sample temperatures during irradiation.

Irradiate vendor fuel samples to demonstrate acceptability of newly established production process.

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.

For additional explanation, please refer to classified addendum.

	FY 2000	FY 2001	FY 2002
Total, Materials Development & Verification	$124,400	$124,600	$132,700

Explanation of Funding Changes from FY 2001 to FY 2002

	FY 2002 vs. FY 2001 ($000)
# I.A. FY 01 amount reflects additional work to identify alternative methods of fuel development and emergent cyber security requirementsReflects accelerated fuel work	+ 4,600
# I.B. Decrease reflects completion of the development phase of the main omega seal ultrasonic testing system, and minor reductions in various areas such as a reduced level of non-destructive testingRequirements decrease in several areas, most notably due to completion of selected alloy fatigue testing in support of continued use predictive modeling	- 2,700
# I.C. Reflects more testing in the Advanced Test Reactor using an enhanced system for testing at high sample temperatures and a minor change due to emergent cyber security requirements.Reflects work to apply monitoring and control technologies from other sites to ATR as well as a heightened level of irradiation operations . . .	+ 4,404
Total Funding Change, Materials Development & Verification:	+ 6,304

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 testingg an and examination of reactor materials, components, and new designs under prototypical operating conditions, 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 operating ships.

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.

End-of-life fuel cell examinations and non-destructive examinations of irradiated test specimens contribute to extended warship operation by validating design predictions and providing information which 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

(dollars in thousands)

	FY 2000	FY 2001	FY 2002	$ Change	% Change
Total, Evaluation & Servicing	161,900	149,563	132,341	-17,222	-11.5%

Detailed Program Justification

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
I. Maintain a utilization factor of at least 90% for prototype plants to ensure their availability for scheduled testing, training, and servicing needs, and provide for development of servicing equipment and testing of plant components, materials and procedures.			
A. Operate land-based test reactor plants to provide for prototypical testing, core depletion analysis, and reactor plant operator training.	**32,000**	**33,100**	**33,100**

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 a unique testing environment. A major focus is to aggressively deplete the advanced fleet reactor in S8G to obtain data required to validate design methods currently in use in SEAWOLF and VIRGINIA class submarines and provide data useful in the development of the next generation submarine reactor cores 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 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 maintenance and repairs on the MARF and S8G prototypes, while also making necessary replacements and improvements, to ensure the plants remain safe operating environments and reliable test platforms. 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.

(dollars in thousands)		
FY 2000	FY 2001	FY 2002

Verifiable Supporting Activities:

FY 2000 Deplete the MARF and S8G cores according to depletion objectives.

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

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.

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.

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
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.	**18,000**	**5,606**	**6,100**

Naval Reactors performs major servicings on the prototypes to ensure continued safe and reliable operation of these crucial test beds. Major servicings between FYs 99-01 focus on inspecting key primary loop areas and inspecting and cleaning the steam generators. While these inspections must be done to ensure proper plant maintenance, they also provide invaluable information on extending the life of the system and the components which make up the system.

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 FY02 will focus on the next generation submarine reactor and development of conceptual designs for the servicing features and equipment for the CVNX reactor. 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. FY 02 adjustment based on changes in servicing work.

	(dollars in thousands)	
FY 2000	FY 2001	FY 2002

Verifiable Supporting Activities:

FY 2000 Conduct a major non-refueling overhaul of the S8G prototype, including steam generator servicing.

Complete final design of next generation submarine reactor defueling procedures.

Perform scoping studies to evaluate preliminary core and reactor servicing equipment design concepts for a new aircraft carrier reactor.

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 cutting machine.

For additional explanation, please refer to classified addendum.

	FY 2000	FY 2001	FY 2002
C. Operate and service the Advanced Test Reactor to provide for materials irradiations testing.	**16,900**	**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 five train-type experiments with various flux conditions in pressurized water 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.

(dollars in thousands)

	FY 2000	FY 2001	FY 2002
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.			
A. Continue efforts at the Windsor site in Connecticut to release applicable areas for unrestricted use.	**7,000**	**3,000**	**1,800**

The S1C plant is defueled. Inactivation is complete. All facilities have been removed from the site. Completion of documentation 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 is finalized and site is released for unrestricted future use.

For additional explanation, please refer to classified addendum.

Verifiable Supporting Activities

FY 2000 Complete building demolition and site dismantlement.

FY 2001 Conduct site closeout and release process.

FY 2002 Complete site closeout and release process.

	FY 2000	FY 2001	FY 2002
B. Continue inactivation efforts at the Kesselring site in New York to eliminate surplus facilities, remediate and dismantle plant facilities, and release applicable areas. . . .	**23,400**	**34,700**	**22,300**

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 has public, state, and local government support. The S3G engine room has been completely dismantled. Certain site and reactor plant-related remediation work is planned for FY02 and future years, including removal of the D1G pressure vessel, the final major inactivation milestone left to accomplish. Resources decrease to reflect the transition to D1G pressure vessel work and preparations for final phase of EIS plan.

Verifiable Supporting Activities:

FY 2000 Continue inactivation work, including S3G pressure vessel removal.

FY 2001 Conduct limited dismantlement and dispositioning of prototype reactor compartment internals, place S3G and D1G plants in a stable layup state. Shipout S3G pressure vessel for disposal.

FY 2002 Conduct D1G pressure vessel removal operations. Begin D1G reactor compartment disassembly and dispose of minor reactor plant components and waste.

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
C. Continue inactivation efforts in Idaho to eliminate surplus facilities, remediate and dismantle plant facilities and release applicable areas.	**21,600**	**9,957**	**6,741**

With completion of defueling of the second A1W reactor, all fuel has now been removed from the prototype plants at the Naval Reactors Facility (NRF). Requirements thus decline substantially. The plants are now in a safe layup condition, with all plants being maintained in a low-maintenance, environmentally benign state. Limited site / reactor plant-related remediation, including State mandated inactivation efforts, is planned for FY02 and future years. Funding reflects performance of State mandated remediation work.

Verifiable Supporting Activities:

FY 2000 Complete servicing equipment disposal from A1W-A defueling.

Complete the lay-up work for the A1W plant.

Complete environmental remediation work stipulated in the spent fuel agreement with the State of Idaho.

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 2000	FY 2001	FY 2002

(dollars in thousands)

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

	FY 2000	FY 2001	FY 2002
A. Conduct ongoing clean up of test facilities to reduce hazards to personnel, and reduce potential liabilities due to changing conditions or accidental releases..	**25,000**	**26,600**	**25,700**

Operation of test, examination, and manufacturing facilities has involved the use of hazardous materials. Decontamination and unconditional release of previously contaminated facilities maximizes usable space for future operations, while minimizing environmental, health and safety impact of contaminated facilities. This work reduces the potential for materials such as asbestos, heavy metals, other chemicals, or radioactivity to enter into the environment.

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.

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 completion of selected remediation activities in FY01.

(dollars in thousands)		
FY 2000	FY 2001	FY 2002

Verifiable Supporting Activities:

FY 2000 Conduct remediation of obsolete fuel processing facility at the Bettis Pittsburgh site.

Conduct remediation activities at Bettis Pittsburgh for disposition of historically contaminated facilities and equipment.

Continue the renovation of various areas at the Knolls site.

Continue remediation work at NRF in accordance with the record of decision on CERCLA actions and other regulatory requirements.

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 Pittsburg 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.

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002

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 2000	FY 2001	FY 2002
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.	**18,000**	**18,600**	**18,600**

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.

Verifiable Supporting Activities:

FY 2000 Prepare the necessary procedures and schedules for examinations, assembly, shipment, receipt, and disassembly of about fifteen irradiation tests.

Conduct data collection for highest priority D2W prototype expended core component examinations.

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.

	FY 2000	FY 2001	FY 2002
	(dollars in thousands)		

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.

	FY 2000	FY 2001	FY 2002
Total, Evaluation and Servicing	161,900	149,563	132,341

Explanation of Funding Changes from FY 2001 to FY 2002

		FY 2002 vs. FY 2001 ($000)
# I.B	Minor adjustment based on changes in servicing work	+494
# II.A	Continued decrease in funding requirements as Windsor site inactivation is completed	- 1,200
# II.B	Requirements decrease as the inactivation effort approaches its final phase	-12,400
# II.C	Reflects compliance with State mandated inactivation efforts.	-3,216
# III.A	Reflects completion of selected remediation activities in FY01	-900
Total Funding Change, Evaluation & Servicing		- 17,222

Capital Operating Expenses & Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 2000	FY2001	FY 2002	$ Change	% Change
General Plant Projects	10,300	11,400	14,100	2,700	23.7%
Capital Equipment	35,900	30,800	32,900	2,100	6.8%
Total, Capital Operating Expense	46,200	42,200	47,000	4,800	11.4%

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior Year Approp-riations	FY 2000	FY2001	FY 2002	Unapprop-riated Balance
90-N-102 Expended Core Facility Dry Cell	88,246	56,046	12,000	15,965	4,200	0
98-D-200 Site Laboratory/ Facility Upgrade	15,700	12,700	3,000	0	0	0
01-D-200 Major Office Replacement Building	12,400	0	0	1,297	9,000	2,100
Total, Construction		68,746	15,000	17,262	13,200	2,100

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

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior Year Approp-riations	FY 2000	FY 2001	FY 2002	Accept-ance Date
Thermal-Hydraulic Test Equipment	2,900	1,400	1,350	150	0	FY 2001
Local Area Network Replacement	4,900	1,500	900	900	1,600	FY 2002
Metal Processing Equipment .	4,200	2,500	1,700	0	0	FY 2000
Post-Irradiations Evaluation Laboratory	8,300	7,600	400	300	0	FY 2001
Next Generation Scalable Computer	10,000	0	10,000	0	0	FY 2000
Scalable Computer Modification/Upgrade	10,000	0	0	6,000	4,000	FY 2002
Storage Technology Upgrades	2,000	0	0	0	2,000	FY 2002
Total, Major Items of Equipment		13,000	14,500	7,400	7,600	

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

(Changes from FY 2001 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

Fiscal Years 1999 through FY 2002 costs in the Financial Schedule (Section 2) have been changed to show actual costs for FY 1999 and costs for FY 2000 and beyond based on updated estimates. 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.

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

[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] The revised cost estimate reflects realignment of 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.

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
1990	3,546	3,546	1,564
1991	4,000	4,000	3,129
1992	15,000	15,000	4,238
1993	13,600	13,600	10,078
1994	0	0	2,410
1995	0	0	555
1996	3,000	3,000	7,557
1997	8,000	8,000	13,908
1998	3,100	3,100	5,559
1999	5,800	5,800	2,825
2000	12,000	12,000	13,646
2001	15,965	15,965	12,080
2002	4,200	4,200	10,697

3. Project Description, Justification and Scope

When all phases are completed the Expended Core Facility (ECF) Dry Cell Project will consist of a dry shielded fuel handling, disassembly, examination and loading facility, a decontamination shop, a shielded repair shop, dry storage loading facilities, an area for overpack assembly, and an interim storage pad. The shielded facility and shops are located in the existing ECF building South Bay and are connected to the existing ECF water pits. Two dry storage container loading stations are being constructed, one at the east end and one at the west end of the shielded cell.

The total dry shielded facility design will incorporate high density concrete radiation shielding and highly filtered air ventilation for radiological contamination control. Shielded lead glass windows and viewing aids will be provided at the various stations. The facility will include automated equipment for fuel module disassembly, examination, and interim dry storage. Features of the production line include the water pit to dry cell delivery system, the examination system, the cutting system for separation of modules, and the prepared fuel loading station. The dry (unmoderated) environment of the shielded cell allows efficient material handling with a high degree of safety. The complete facility will have a design life of 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. Existing ECF underwater equipment is not capable of handling the larger and heavier modules now in use. The underwater fuel disposal methods are personnel intensive and have significant technical disadvantages. These technical disadvantages include extremely difficult equipment and facility maintenance; poor visibility; time-consuming shipping cask loading; and a significant burden of deliberately redundant administrative and physical controls for nuclear safety. The use of a dry cell significantly reduces these disadvantages. This task is complete.

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. Adjacent to the interim storage pad, an area for assembly of overpacks will be constructed. 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 50 percent complete.

The West End Modification task is for the design and fabrication of the equipment to handle the spent fuel and container components and design and construction of a second loading station and support systems. The West End Modification will allow significant crane capacity and height, shielded cell height, and transfer pit depth to provide the flexibility necessary to handle future spent fuel components which may be longer than those currently handled at ECF. The West End Modification task will provide an approximately 60 foot extension to the Dry Cell shielded cell, including a cask transfer pit below the west extension and a fuel receipt transfer bay which, in combination with the Dry Cell Task and East End Modification Task, will result in an approximately 23,425 square foot addition to the existing ECF building. This task is approximately 6 percent complete.

A two loading station arrangement will allow for 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 (8 versus 13 years). In addition, the arrangement allows future packaging of special case waste through one of the loading stations without interruption of dry storage container loading.

The project is scheduled to complete in September 2002. Through FY 2001, 88% 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 ($4,833,000 for Design Drawings and Specification)	13,619	13,613
Design Management costs (2.9 % of TEC)	2,497	2,320
Project Management costs (2.6 % of TEC)	2,239	2,290
Total, Engineering design, inspection, and administration of construction costs (21.1% of TEC)	18,355	18,223
Construction Phase		
Buildings	39,051	37,891
Special Equipment	10,881	10,358
Standard Equipment	5,727	5,927
Inspection, design and project liaison, testing, checkout and acceptance	7,897	8,172
Project Management (2.6 % of TEC)	2,239	2,290
Total, Construction Costs	65,795	64,638
Contingencies		
Design Phase (0.5 % of TEC)	406	300
Construction Phase (4.2 % of TEC)	3,690	3,685
Total, Contingencies (4.7 % of TEC)	4,096	3,985
Total, Line Item Costs (TEC)	88,246	86,846

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 I 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 2001 and FY 2002 are 2.5% and 2.6%, respectively.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 2000	FY 2001	FY 2002	Total
Project cost					
Facility Cost					
Design	16,168	2,360	156	77	18,761
Construction	35,655	11,286	11,924	10,620	69,485
Total, Line item TEC	51,823	13,646	12,080	10,697	88,246
Operating expense funded equipment[a]	530	2,400	1,000	200	4,130
Total Facility Costs	52,353	16,046	13,080	10,897	92,376
Other project costs					
Conceptual design cost	1,700	0	0	0	1,700
Decontamination & Decommissioning[b]	750	400	0	100	1,250
NEPA Documentation Costs	2,500	0	0	0	2,500
Other project-related costs[c]	1,681	0	200	200	2,081
Total, Other project costs	6,631	400	200	300	7,531
Total project cost	58,984	16,446	13,280	11,197	99,907

[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 2000. FY 2002 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 2002 dollars in thousands)	
	Current Estimate	Previous Estimate
Facility operating costs[a]	4,227	4,227
Utility costs[b]	539	539
Total related annual funding	4,766	4,766
Total operating costs (operating from FY 2002 through FY 2042)	190,640	190,640

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.

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

Significant Changes

None

1. Construction Schedule History

	Fiscal Quarter				Total	Total
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete	Estimated Cost ($000)	Project Cost ($000)
FY 2001 Budget Request (*Preliminary Estimate*)	1Q2001	4Q2001	4Q2001	4Q2003	$12,400	$13,720

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design/Construction			
2001	1,297	1,297	900
2002	9,000	9,000	3,650
2003	2,100	2,100	7,850

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 use with desktop computing, as well as have open storage areas to facilitate future rearrangements . Heating, ventilation, and air conditioning will be provided by a four-pipe fan coil unit system with hot water heating and chilled water cooling. 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 are required for site preparation work, including demolition of existing facilities, installation of a security fence, and modifications to existing on site utilities.

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)	120	120
Design Management costs (0.6% of TEC)	70	70
Project Management costs (0.1% of TEC)	10	10
Total, Engineering design inspection and administration of construction costs (1.6% of TEC)	200	200
Construction Phase		
Improvements to Land	0	0
Buildings	8,460	8,460
Special Equipment	0	0
Other Structures	250	250
Utilities	0	0
Standard Equipment	2,150	2,150
Major Computer Equipment	0	0
Removal less salvage	200	200
Inspection, design and project liaison, testing, checkout and acceptance	120	120
Construction Management (2.6% of TEC)	320	320
Project Management (0.8% of TEC)	100	100
Total, Construction Costs	11,600	11,600
Contingencies		
Design Phase (0.3% of TEC)	40	40
Construction Phase (4.5% of TEC)	560	560
Total, Contingencies (4.8% of TEC)	600	600
Total Line Item Cost	12,400	12,400
Less: Non-Agency Contribution	0	0
Total, Line Item Costs (TEC)	12,400	12,400

[a] The cost estimate is based on conceptual design.

5. 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 values. Furniture, computer networking, and security system procurement/installation will be accomplished by fixed price contract awarded on the basis of competitive bidding. Site preparation work will be accomplished by fixed price contract awarded on the basis of competitive bidding.

6. Schedule of Project Funding

(dollars in thousands)

	Prior	FY 2000	FY 2001	FY 2002	Outyears	Total
Project cost						
Facility Cost						
Design	0	0	240	0	0	240
Construction	0	0	1,057	9,000	2,100	12,160
Total, Line Item TEC	0	0	1,297	9,000	2,100	12,400
Plant, Engineering, and Design (PE&D)	0	0	0	0	0	0
Operating expense funded equipment	0	0	0	0	0	0
Total Facility Costs (Federal and Non-Federal)	0	0	1,297	9,000	2,100	12,400
Other Project Costs						
Conceptual design cost	0	0	120	0	0	120
NEPA Documentation Costs	0	0	0	0	0	0
Decontamination & Decommissioning	0	0	300	900	0	1,200
Total Other project-related costs	0	0	420	900	0	1,320
Total, Project Costs	0	0	1,717	9,900	2,100	13,720
Less: Non-Agency Contributions	0	0	0	0	0	0
Total Project Cost (TPC)	0	0	1,717	9,900	2,100	13,720

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, 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.

[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.

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.

Historically, ten FTEs were included in this budget for the Idaho Operations Office to oversee operation of the Advanced Test Reactor (ATR), which Naval Reactors uses for materials irradiation and testing. With the establishment of the National Nuclear Security Administration (NNSA), all federal employees at the field operations offices whose salaries are funded by NNSA programs became NNSA employees. Because the Office of Nuclear Energy, Science, and Technology (NE) owns and has the responsibility for operating ATR, these 10 FTEs were be transferred to the Office of Nuclear Energy in FY 2001. Funding to support these FTE's has been transferred from Naval Reactors' budget target to the Office of Nuclear Energy.

The FY 2002 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 2000	FY 2001	FY 2002	$ Change	% Change
Headquarters					
Salary and Benefits	7,130	7,320	7,940	+620	+8.5%
Travel	510	510	520	+10	+2.0%
Support Services	0	0	0	0	0%
Other Related Expenses	630	630	700	+70	+11.1%
Total, Headquarters	8,270	8,460	9,160	+700	+8.3%
Full Time Equivalents	57	56	56	0	0%
Pittsburgh Naval Reactors					
Salary and Benefits	5,280	5,620	6,365	+745	+13.2%
Travel	110	125	125	0	0%
Support Services	0	0	0	0	0%
Other Related Expenses	600	570	950	+380	+66.7%
Total, Pittsburgh Naval Reactors	5,990	6,315	7,440	+1,125	+17.8%
Full Time Equivalents	70	71	71	0	0%
Schenectady Naval Reactors					
Salary and Benefits	4,700	4,960	5,310	+350	+7.1%
Travel	90	90	95	+5	+5.6%
Support Services	0	0	0	0	0%
Other Related Expenses	495	490	595	+105	+21.4%
Total, Schenectady Naval Reactors	5,285	5,540	6,000	+460	0.083
Full Time Equivalents	64	64	64	0	0%
Idaho Operations Office					
Salary and Benefits	900	0	0	0	0%
Travel	20	0	0	0	0%
Support Services	0	0	0	0	0%
Other Related Expenses	135	0	0	0	0%
Total, Idaho Operations Office	1,055	0	0	0	0%
Full Time Equivalents	10	0	0	0	0%
Total Naval Reactors Program					
Salary and Benefits	18,010	17,895	19,615	+1720	+9.6%
Travel	730	725	740	+15	+2.1%
Support Services	0	0	0	0	0%
Other Related Expenses	1,860	1,695	2,245	+550	+32.4%
Total, Program Direction	20,600	20,315	22,600	+2285	+11.2%
Full Time Equivalents	201	191	191	0	0%

Detailed Program Justification

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
Salaries and Benefits	**18,010**	**17,895**	**19,615**

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 and the Advanced Test Reactor. 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	**730**	**725**	**740**

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 2001 travel funding supports trips required to provide management and oversight of the Naval Reactors Program. A small decrease is projected due to the net effect of relinquishing budget responsibility for the ten Idaho Operations Office employees and increased travel requirements within the NR Program.

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

Naval Reactors does not use Support Services contractors.

Other Related Expenses	**1,860**	**1,695**	**2,245**

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. The increase is due to inclusion of labor costs for Bettis contractor services and a shift in procurement responsibility for NR Headquarters' computer acquisitions.

Total, Program Direction	20,600	20,315	22,600

Explanation of Funding Changes FY 2001 to FY 2002

	FY02 vs. FY01 ($000)
Salaries and Benefits	**+1720**
# The change is due to salary adjustments in accordance with allowable inflatio.	
Travel	**+15**
# The small decrease is projected due to the net effect of relinquishing budget responsibility for the ten Idaho Operations Office employees and increased travel requirements within the NR Program.	
Other Related Expenses	**+550**
# The change is due to inclusion of labor for Bettis contractor services and a shift in procurement responsibility for NR Headquarters' computer acquisitions.	
Total Funding Change, Naval Reactors Program Direction	+2285

Other Related Expenses

(dollars in thousands)

	FY 2000	FY 2001	FY 2002	$ Change	% Change
Training	116	117	127	+10	+8.6%
Working Capital Fund	520	500	350	-150	-30.0%
Software Procurement/Maintenance Activities/ Capital Acquisitions	458	440	750	+310	+70.5%
Other	766	638	1,018	+380	+59.6%
Total, Budget Authority	1,860	1,695	2,245	+550	+32.4%