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 and systems, and implementing them into existing or future plant designs. Intricate engineering challenges and long lead time to fabricate the massive, complex components require many years before introduction into the fleet.

With 99 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. Under development are the next generation reactor intended for the Navy's new VIRGINIA Class attack submarines and a reactor intended 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 submarine reactor is well along and proceeding on schedule. The lead submarine incorporating this plant is expected to go to sea in 2004.

The new CVNX Class aircraft carriers are to evolve incrementally with the first ship having a new propulsion plant and electric, as opposed to steam, aircraft catapults. The reactors used in the current NIMITZ Class aircraft carriers, while quite capable for this class and kept updated to the extent feasible, are a 1960's design; this means Naval Reactors cannot incorporate many of the latest technical advancements. Therefore, an overall new reactor design for the CVNX has distinct advantages and is the critical enabler for other shipwide advances such as electromagnetic catapults. The advantages include 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 FY 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 Measures

- NS6-1 Ensure the safety, performance reliability, and service-life of operating reactors.
- NS6-2 Develop new technologies, methods and materials to support reactor plant design, including the next generation reactor, which will be 93% complete by the end of FY 2001, and initiate detailed design efforts on a reactor plant for CVNX.
- NS6-3 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 both support the ongoing NATO effort in Kosovo and deal with 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 103 reactors. Naval nuclear reactors power 40% of the Navy's major combatants. This is slightly more than the entire U.S. commercial nuclear power generating industry and 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 119 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 chemistry 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 a 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 15 years of equivalent fleet operation in the S8G prototype plant. The prototypes also are used to train Navy nuclear plant operators.

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 is demolishing all structures, remediating the area, recycling/disposing of waste material, and 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.

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.

The original intent was to complete the overall inactivation effort by 2002. To date, Naval Reactors has made good progress -- defueled six of the seven reactors (one plant has two reactors) with work well underway on defueling the remaining reactor and on the other aspects of inactivation. However, constrained resources preclude accomplishing the original goals or schedule.

The following are principal activity areas for this strategy:

< Continue inactivation efforts at the Windsor site in Connecticut to eliminate surplus facilities, remediate and dismantle plant facilities and release applicable areas.

< 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.

Over time, the harmful effects of materials previously thought safe such as asbestos and PCBs have become known. In addition, sensitivity has increased concerning the environmental quality of ground water and air. These trends have resulted in stricter government regulations on environmental quality. Despite these stricter government regulations, Naval Reactors continues to have an outstanding environmental performance record. Naval Reactors cleans up after itself in a rigorous, environmentally safe, and correct manner - including properly maintaining our facilities.

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.

Strategy Funding Matrix

FY 2001

Strategies	Budget Categories (dollars in thousands) 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	54,100			
Core manufacturing processes and inspection techniques	24,200			
Removed fuel cell and irradiated test specimen examination				18,600
Fuel, core and reactor structural material development & testing			44,900	
Plant materials development and testing			36,800	
Irradiations testing and examination			45,900	
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		26,000		
Instrumentation and control equipment development		48,100		
Reactor plant components development & testing		35,100		
Reactor plant performance analyses and chemistry control		9,000		
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				7,000
Operation and servicing of the advanced test reactor				18,000
Inactivate shutdown prototype plants, through:				
Inactivation efforts in Connecticut				3,000
Inactivation efforts in New York				25,700
Inactivation efforts in Idaho				2,000
Maintain outstanding environmental performance through:				
Radiological, environmental and safety operations	38,300			

Strategies	Reactor Technology & Analysis	Plant Technology	Materials Development & Verification	Evaluation and Servicing
	Budget Categories (dollars in thousands)			
Cleanup of test facilities				26,600

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 included as subsets of the above funding matrix, since the data was extracted without consideration to the broader applicability and benefit of the work to other reactor plant types. 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 1999	FY 2000	FY 2001
Next Generation Reactor plant development and testing	50,000	40,000	30,000
Development of CVNX reactor plant	60,000	80,000	117,000

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.

- Extend warship operational lifetime: Older classes of nuclear powered warships are operating 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 provides a distinct economic advantage while providing a force multiplier for the national defense. Moreover, new reactors are being designed initially for longer life spans. For example, the Virginia Class submarines will have a design life of 33 years without a core refueling. Along with extending life span, the intervals between overhauls have been extended or overhaul duration shortened substantially contributing to longer operational lifetime. For example, on March 25, 1999, the Navy announced selected LOS ANGELES Class submarine lives could be extended to about 33 years, a 10 percent increase. This life extension will materially aid the Navy in managing force level within cost constraints.

Ensure safety and reliability of reactor plants in the Navy's warships: Naval Reactors' superlative record in this regard continues -- 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 almost 50 years and has been essential to nuclear powered warships safely steaming over 119 million miles. In the process, they have accumulated nearly 5,100 years of reactor operation compared to the U.S. commercial nuclear power industry's 2,400 and 6,500 for the rest of the world's commercial reactors.

Because of the 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 exacerbates the difficulty of continuing the safety and reliability record. In turn, this puts more emphasis on the testing and evaluation work to detect problems with or affirm designs, materials, and standards/procedures; continuing development of improved radiation control means; and developing better, simpler components for use in new and existing designs.

Develop the next generation reactor for the Virginia Class attack submarines: Naval Reactors exceeded the 85% completion goal for this plant during FY 99. DOE cognizant development work is supporting the Navy's schedule for construction of the lead ship. Navy vendors are fabricating all major components for the lead ship reactor plant:

The first new concept steam generator unit was delivered to the shipyard in 1999. Final development and qualification testing will continue into 2001.

The pressurizer was completed in December, 1998.

The core barrel and closure head development and fabrication was completed as planned in late 1999.

Develop a reactor for the Navy's new CVNX Class aircraft carriers: Development started at the beginning of FY 99. Prior to that only scoping and sizing assessments were made to support the Navy's studies of carrier alternatives. Initial efforts indicate Naval Reactors will be able to provide a reactor plant meeting the established criteria. 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 $100M) 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. The ATR is the only available irradiation test facility -- 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, due to shutdown time required to verify conservatism in operating procedures, has been less successful in this regard during FY 99, though still achieving an acceptable operational rate.

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 major facilities at the Windsor site in Connecticut, was completed in 1999. Work to date has resulted in approximately 29 buildings/structures being demolished and disposal of over 9,600 tons of construction debris, over 1,200 tons of recycled steel, over 6,200 tons of PCB and asbestos contaminated waste, and 1,250 cubic yards of radiological waste.

Preparations continue for dismantlement of the S3G and D1G prototype plants at the Kesselring site in New York, including removing interferences to enable S3G pressure vessel removal and shipout.

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 1999, average occupational radiation exposure for Program personnel was again 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 1999 [a] Current Appropriation	FY 2000 [a] Original Appropriation	FY 2000 Adjustments [d]	FY 2000 Current Appropriation	FY 2001[b] Request
Naval Reactors Development					
Plant Technology	111,100	111,200	-175	111,025	118,200
Reactor Technology & Analysis	192,000	196,000	0	196,000	216,900
Materials Development & Verification	119,500	124,800	-400	124,400	127,600
Evaluation & Servicing	163,589	162,000	-100	161,900	134,000
Facility Operations	51,100	48,000	-1,800	46,200	42,200
Program Direction	20,100	20,600	0	20,600	21,400
Subtotal, Naval Reactors Development	657,389	662,600	-2,475	660,125	660,300
Construction	12,800	15,000	0	15,000	17,300
Subtotal, Naval Reactors Development	670,189	677,600	-2,475	675,125	677,600
Use of prior year balances	-4,049 [c]	0	0	0	0
Total, Naval Reactors Development	666,140	677,600	-2,475	675,125	677,600

Title 32 of the National Defense Authorization Act for Fiscal Year 2000 assigns the Deputy Administrator for Naval Reactors the responsibilities, authorities, and accountability for all functions of the Office of Naval Reactors under the Naval Nuclear Propulsion Executive Order. The Executive Order includes safeguards and security among these responsibilities, therefore this work (including security investigations for Naval Reactors' contractors) is funded directly from within Naval Reactors Development. No offset for Naval Reactors' contractor security investigations will appear in another organization's budget.

Public Law Authorization:

Public Law 83-703, "Atomic Energy Act of 1954"

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

Public Law 106-65, "National Defense Authorization Act of 2000", Title 32, "National Nuclear Security Administration"

[a] Amounts appropriated in these columns were appropriated under "Other Defense Activities."

[b] Amounts reflected in this column are requested under "Other Nuclear Security Activities."

[c] Share of EWD reduction for use of prior-year unobligated balances assigned to this program. The total reduction is applied at the appropriation level.

[d] Government-wide rescission of 0.38%

Funding by Site

(dollars in thousands)

	FY 1999	FY 2000	FY 2001	$ Change	% Change
Pittsburgh Naval Reactors Office					
Bettis Atomic Power Laboratory . .	324,750	335,500	344,600	9,100	2.7%
Pittsburgh Naval Reactors Office . .	7,650	7,800	8,200	400	5.1%
Total, Pittsburgh Naval Reactors Office . . .	332,400	343,300	352,800	9,500	2.8%
Idaho Operations Office					
Idaho National Engineering & Environmental Laboratory	51,200	51,100	51,500	400	.8%
Idaho Operations Office	900	1,000	1,100	100	10.0%
Total, Idaho Operations Office	52,100	52,100	52,600	500	1.0%
Schenectady Naval Reactors Office					
Knolls Atomic Power Laboratory . .	270,350	261,000	255,600	-5,400	-2.1%
Schenectady Naval Reactors Office	5,750	6,000	6,200	200	3.3%
Total, Schenectady Naval Reactors Office .	276,100	267,000	261,800	-5,200	-2.0%
Washington Headquarters	8,189	11,100	8,400	-2700	-24.3%
All Other Sites	1,400	1,625	2,000	375	23.1%
Subtotal, Naval Reactors Development . . .	670,189	675,125	677,600	2,475	0.4%
Use of prior year balances	-4,049		0	0	0%
Total, Naval Reactors Development	666,140	675,125	677,600	2,475	0.4%

Site Description

Pittsburgh Naval Reactors Office

This Office oversees the Bettis Atomic Power Laboratory.

Bettis Atomic Power Laboratory

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 is the only 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

Naval Reactors Headquarters in Arlington, Virginia which administers the Naval Nuclear Propulsion Program.

Reactor Technology & Analysis

Mission Supporting Goals and Objectives

The work in this category ensures the continued safe operation of operating reactors, and develops new reactors with improved power capabilities, endurance, reliability and efficiency, and greater simplification. 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 Naval Reactors to reduce design conservatism. New tests and analysis will allow greater assessment of the technical ability to lengthen service life. Emphasis in this area is on thermal/hydraulics, structural/fluid mechanics, vibration analyses and nuclear core design/analysis work. The work is geared toward accurately predicting reactor performance while reducing design conservatism. Improved core manufacturing processes and inspection techniques also are being pursued to support extended life requirements.

Likewise, work is underway to improve analysis tools while bettering the understanding of basic nuclear data. The focus is to enhance Naval Reactor's ability 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 1999	FY 2000	FY 2001	$ Change	% Change
Total, Reactor Technology and Analysis . .	192,000	196,000	216,900	+20,900	9.6%

Detailed Program Justification

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
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.			
The demand for extended service life and for more flexibility necessitate achieving a better 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 vibration are needed to show the acceptability and performance of the core and reactor component designs and operating guidelines 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 validating key structural, thermal-hydraulic, and nuclear calculations to provide design assurance. Key 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. FY 01 resource change reflects conducting planned mechanical testing of new designs..	52,000	50,000	54,100

	(dollars in thousands)	
FY 1999	FY 2000	FY 2001

Verifiable Supporting Activities:

FY 1999 Assess and resolve implications of shock/vibration and other reactor test programs on design margin and design bases for the next generation reactor.

Assess feasibility and potential benefits of high temperature reactor concepts.

Initiate qualification of improved reactor code and design procedures using thermal-hydraulic data.

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

FY 2000 Incorporate experimental results of reactor shock and vibration test programs to update analysis methods for 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.

	(dollars in thousands)	
FY 1999	FY 2000	FY 2001

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.

For additional information, please see classified addendum.

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
B. Evaluate and test improved core manufacturing processes and inspection techniques to support extended life reactors.			
Desirable new core design features and the drive for cost savings require manufacturing process improvements. Earlier Naval core designs develop fuel hot spots during operation because of manufacturing process limitations. Consequently, compensatory margins must be built into the fuel designs and operating limits which constrain the power level and life. The modified fuel manufacturing process allows cores to operate with higher energy density needed for longer endurance. However, this process is expensive and technically challenging. Therefore, continuing work is aimed at improving fuel manufacturing to develop a process which can deliver a high power core at lower cost. Related work includes developing more cost-effective manufacturing processes for fuel assemblies and core structural components. Test specimens are manufactured for reactor tests to qualify design and process changes. In addition, the experience gained through process development and improvement can be applied in ensuring manufacturability of new core designs. Change reflects development of reactor for CVNX . . .	15,000	18,000	24,200

(dollars in thousands)		
FY 1999	FY 2000	FY 2001

Verifiable Supporting Activities:

FY 1999 Conduct initial demonstration of the new fuel system manufacturing process.

Investigate new manufacturing and inspection technologies to reduce core cost and improve core operation.

FY 2000 Model key manufacturing processes and demonstrate advanced processing technologies on mockups. Begin fabrication and development work for a mechanical test cell that is representative of the large size cell concept for CVNX.

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. 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.

For additional information, please see classified addendum.

	(dollars in thousands)	
FY 1999	FY 2000	FY 2001

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 which eliminate gears and provide rod speed flexibility.

The control rods attenuate reactivity in the reactor. Regulation of the reactivity and reactor safety/reliability demand the mechanisms which drive the control rods perform without incident. The next generation reactor control drive mechanism is the first fundamentally new mechanism to be designed in 25 years. The design is in the final stages of qualification. The remaining testing focuses on ensuring consistent rod control and protection against potential casualties for the life of the ship. This technology will apply to the CVNX reactor, but requires considerable scale-up. The CVNX control rod will be the largest in Program history. The size of the control rod presents challenges for mechanism design. One challenge is the design and development of bearings that will operate for sixty years. While the control drive mechanism must be developed to handle an unprecedented load, the design is constrained by aggressive plant-wide limitations on space and operating power. Additionally, a new more accurate control rod position indicator is being pursued with the ultimate goal of improving plant control and safety.

	FY 1999	FY 2000	FY 2001
Naval Reactors also must develop and qualify reactor heavy equipment, including reactor vessels, closure heads, closure studs, and core baskets to accommodate new core designs. Work is focused on the next generation reactor equipment for the new aircraft carrier. Part of this effort is developing and applying three-dimensional structural analyses. Funding level reflects development of reactor equipment and control drive mechanism concepts for CVNX.	39,000	44,000	49,300

(dollars in thousands)		
FY 1999	FY 2000	FY 2001

Verifiable Supporting Activities:

FY 1999 Conduct control drive mechanism lead unit life testing and examinations.

Begin life testing of prototypical production unit control drive mechanisms.

Evaluate concepts for control drive mechanisms for a new aircraft carrier.

Assess sizing of reactor equipment for a new aircraft carrier based on analytical and experimental methods.

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.

(dollars in thousands)

FY 1999	FY 2000	FY 2001

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.

The first cores Naval Reactors developed had expected service lives of two years. Subsequent development has allowed extending service life to over twenty years, and development is underway to 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. As a consequence, Naval Reactors is developing improved methods and tools to provide continued assurance of 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 improving design methods and software to reduce the degree of conservatism. For example, advancements in computer capability are being exploited to provide more precise calculations of core performance over lifetime. This will allow a reduction in uncertainties and biases currently applied to core reactivity predictions. These reductions 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.

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
Work also focuses on improving measurements of basic nuclear data and establishing experimental programs required to obtain better data. This includes measurement of nuclear cross sections which underlie all reactor physics calculations. FY 01 amount reflects initiation of CVNX core detailed design..	20,000	20,000	21,100

Verifiable Supporting Activities:

FY 1999 Evaluate advanced fleet reactor prototype physics data for the most reactive time in life.

Develop a parallel version of the Monte Carlo program to achieve a large reduction in time required to solve the neutron transport equation and to improve accuracy for the same computational time.

Develop affordable core design concepts to support design basis for a reactor for a new aircraft carrier.

Analyze physics data from the D2W prototype expended core examination.

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.

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
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.			
For additional information, please see classified addendum.			
C. Conduct reactor safety and shielding analyses for nuclear reactor plants to ensure containment of radiation and proper protection of personnel.			
Naval Reactors conducts reactor safety analyses of all plants and new core designs to confirm the adequacy of the design and ensure public health and safety. 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. Severe accident assessments are conducted for specific reactor plant designs to evaluate containment integrity for postulated accident scenarios. 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. 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. FY 01 amount reflects inflation in prior years	13,000	13,000	13,800

	(dollars in thousands)	
FY 1999	FY 2000	FY 2001

Verifiable Supporting Activities:

FY 1999 Complete next generation reactor loss-of-electric load casualty evaluation, electrical fire evaluation, and initiate the flooding casualty evaluation.

Complete the CVN 77 shield design.

FY 2000 Develop and qualify improved shield design methods.

Establish initial design methods for CVNX.

FY 2001 Establish preferred codes to permit large problems to be calculated quickly on parallel computer architectures.

Initiate development of methodology for analyzing with advanced safety code.

Develop initial shield design the reference case CVNX reactor compartment.

Review test data to validate and qualify portions of the advanced safety code.

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

For additional information, please see classified addendum.

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
III. Accomplish planned core and reactor component/system design and technology development efforts to support the Navy's acoustic requirements.			
A. Develop and qualify improved core and reactor component thermal and hydraulic designs.			
Work in this area focuses on improving thermal hydraulic analytical models and codes. Improved tools will enable a more accurate determination of flow requirements. This, in turn, will allow increasing the margin between operating parameters and core performance limits.			
For additional information, please see classified addendum.	19,000	16,000	16,100

Verifiable Supporting Activities:

FY 1999 Develop models and perform fundamental testing for the application of the advanced computational fluid dynamics code.

Develop models and conduct testing to extend the qualified range of the thermal and hydraulic design procedures.

Develop models and conduct testing for extension of modified hydraulic design code to future core designs.

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.

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
FY 2001 Initiate fundamental multiple channel testing to gain enhanced understanding of the fluid dynamics of channel to channel interactions. Initiate qualification testing of the advanced safety code. Perform tests on advanced reactor plant components utilizing results of turbulent flow fields testing, applicability for possible development of reactor plant components that produce lower broad band noise. For additional information, please see classified addendum.			
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.			
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 safe handling and disposal of radiological material. Additional procedures are in place to ensure compliance with evolving environmental requirements. The principal focus of this environmental work is to prevent the generation of environmental hazards, by reducing wastes and preventing pollution. Training is conducted to ensure radiological, safety and environmental requirements are understood. 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, and emergency response capabilities are in place to control or mitigate any problems. FY 01 amount reflects inflation as well as radiological and environmental controls work to ensure compliance with all regulatory requirements.	34,000	35,000	38,300

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001

Verifiable Supporting Activities:

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

Improve accountability and fuel handling controls for special nuclear material inventory via improved integration and automation of systems.

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 1999	FY 2000	FY 2001
Total, Reactor Technology & Analysis	192,000	196,000	216,900

Explanation of Funding Changes from FY 2000 to FY 2001

		FY 2001 vs. FY 2000 ($000)
#I.A	Resource change reflects conducting planned mechanical testing of new designs and support for emergent cyber security requirements.	+4,100
#I.B	FY 01 amount reflects development of reactor for a new aircraft carrier.	+6,200
#II.A	Funding level reflects development of reactor equipment and control drive mechanism concepts for CVNX.	+5,300
#II.B	FY 01 amount reflects development of the detailed design for the advanced core of CVNX	+1,100
#II.C	FY 01 amount due to inflation	+800
#III. A	FY 01 amount due to emergent cyber security requirements.	+100
#IV.A	FY 01 amount reflects inflation as well as radiological and environmental controls work to ensure compliance with all regulatory requirements.	+3,300
Total Funding Change, Reactor Technology & Analysis:		+20,900

Plant Technology

Mission Supporting Goals and Objectives

Plant Technology encompasses development, testing and use of predictive tools to analyze components and systems which transfer, convert, control and measure power created by the reactor. Components sustain wear through normal operation which threatens reactor plant integrity. Also, new components and systems are needed to replace obsolete or degraded equipment in existing plants or for new reactor plants. A principal thrust is to develop and apply new analytic methods and predictive tools to identify potential problems or the effects of changing performance requirements. These advances better enable developing corrective actions, determining component replacement, or deciding on the need to develop new or modified technology. Advances in these areas have permitted safe continued operation of components beyond their original design life. Advances achieved in the various applicable areas such as manufacturing/welding processes, fluid dynamics, predictive models/analysis methods and thermal-hydraulics have enhanced operating plant performance and allowed major improvements in performance for new reactor plants. For example, the reactor plant now under development for the VIRGINIA Class and the preliminary CVNX designs are simpler, hence more reliable, and more power dense than previous plants, due largely to the continuing advances being made.

A reactor plant is a harsh environment in which to operate machinery. The constant exposure to water at high temperature and pressure is corrosive. Harmful corrosive environments exist in the steam generators due to the intense boiling inherent in the transfer of reactor heat to the turbines. Besides dealing with this continuing problem, Naval Reactors is pursuing technologies to greatly reduce such corrosion through fundamental design changes. The results are embodied in the new concept steam generator being developed. Also, machinery such as pumps with constantly rotating or operative parts wear and require lubrication. To the extent this wear can be abated through the application of better materials and lubricants, as well as more resilient designs, the longer-lived and more reliable the component and system will be. A constant concern is in improving or correcting one area, another will be made worse. To help preclude these possibilities requires extensive and comprehensive testing.

Likewise, continuing work is devoted to applying the latest advances in electronics to instrumentation and control equipment and systems. Due to rapid degradation and obsolescence, this equipment must be replaced at least once during the lifetime of an operating plant. While this presents a continuing challenge, rapid technological advances provide distinct advantages. For example, the accuracy and reliability of the instrumentation can affect the useable power obtained from the reactor.

Funding Schedule

(dollars in thousands)

	FY 1999	FY 2000	FY 2001	$ Change	% Change
Total, Plant Technology	111,100	111,025	118,200	+7,175	6.4%

Detailed Program Justification

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001

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.

Steam generators are the interface between the reactor plant and the power turbines, transferring heat from the reactor plant to produce steam to run the power turbines. To accomplish this, hot water from the reactor flows through a bundle of thin-walled tubes within the steam generator. A shell containing the secondary cycle water surrounds these tubes. The secondary cycle water is at a lower pressure and boils to steam. Consequently, integrity of steam generator components and tube bundles is extremely important to prevent radioactive contamination of the steam which is piped out of the steam generator to power the turbines.

Maintaining steam generator integrity requires continually developing an understanding of high temperature corrosion processes, assessment of potential cause and corrective actions, and development of alternative water chemistries which will inhibit or abate corrosion. Trace impurities can 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 potential corrosion mechanisms, devising methods to locate and remove deposits, minimizing input of these impurities and continually testing water chemistries and corrosion inhibitors for benefits and drawbacks to ensure they mitigate the consequences of these impurities over the life of the plant.

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
To support CVNX shipbuilding schedules and goals for reduced weight, manning, and life cycle costs, requires development of improved performance steam generation features. Development work focuses on new tubing materials, developing new corrosion controls and heat transfer methods, and utilizing steam separation predictive tools to meet preferred goals, cost and weight reduction objectives.			
Development is also underway to test other ways to transfer energy. The intent of the new concept steam generator is to minimize the propensity for concentration of impurities and eliminate low flow regions resulting in an inherently more corrosion resistant, reliable design. Growth reflects increasing work on developing the CVNX steam generator and its components.			
For additional explanation, please refer to classified addendum.	25,000	23,000	26,000

Verifiable Supporting Activities:

FY 1999 Evaluate conventional steam generator sludge/corrosion samples and compare to simulator test results to develop improved corrosion control and predictive tube corrosion models.

Continue testing necessary to support long term use of potential new chemistry additives and corrosion inhibitors in operating steam generators.

Continue design and begin testing in-plant corrosion monitors for several types of steam generators.

Carry out the manufacturing demonstration unit thermal and hydraulic testing.

	(dollars in thousands)	
FY 1999	FY 2000	FY 2001

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 such as sodium nitrate 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.

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.

For additional information, please see classified addendum.

	(dollars in thousands)	
FY 1999	FY 2000	FY 2001

B. Develop instrumentation and control equipment to replace obsolete equipment and improve reliability and performance.

Naval reactor plants rely on instrumentation to monitor plant conditions, take corrective action, and determine position and speed of the control rods used to regulate the reactor. Safe and reliable operation of the plant is dependent on the reliability and performance of this equipment. In addition, highly accurate and reliable equipment can increase actual usable power available from the reactor.

	FY 1999	FY 2000	FY 2001
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. Due to its nature -- circuit cards and numerous interconnected small electrical components -- and obsolescence, lifetimes are much more limited than for heavy reactor equipment. As a consequence, this 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 more flexible to incorporate future technological advances. FY 01 amount reflects development of equipment specifications and systems details for CVNX reactor plant instrumentation.	41,000	45,000	48,100

Verifiable Supporting Activities:

FY 1999 Continue qualification testing of standardized instrumentation and control hardware and continue design documentation of system software.

Continue engineering model development and testing of advanced pressure and flow sensors and prepare for qualification testing.

Examine potential instrumentation and control technologies for application in a reactor plant for a new aircraft carrier.

Begin development of instrumentation for OHIO and LOS ANGELES class submarine reactor plants using

(dollars in thousands)

FY 1999	FY 2000	FY 2001

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 generic instrumentation and control test equipment applicable to the for the NIMITZ Class, and finalize the LOS ANGELES and OHIO class test equipment.

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

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

For additional information, please see classified addendum.

	(dollars in thousands)	
FY 1999	FY 2000	FY 2001

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

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 backfit to incorporate current technologies which will address problems related to wear and thus improve its performance and enhance reliability over the pump's operating life.

Work is also focused on optimizing reactor plant arrangements to achieve simplicity, resulting in fewer components. The fewer the number of components and systems, the less the 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 is flow through each component and system in the reactor plant because the pressure drop associated with each component has an affect on flow through the core. Deviations from nominal flow can cause a heat level imbalance within the core, thus tight tolerances are necessary to ensure the entire plant operates safely and efficiently. The over-arching goal of plant arrangement/development and testing is to develop more affordable reactor components/systems arrangements, which requires less maintenance, less manning, and can be built in a more cost-effective manner while maintaining safety and performance. . . . .

FY 1999	FY 2000	FY 2001
36,100	35,025	35,100

Verifiable Supporting Activities:

FY 1999 Develop the next generation reactor primary fluid system design and complete coolant pump qualification testing.

Complete qualification unit fabrication and initiate qualification testing of the redesigned NIMITZ Class carrier main coolant pump including flow testing.

Continue feasibility studies and initiate conceptual definitions of a reactor plant for a new aircraft carrier.

	(dollars in thousands)	
FY 1999	FY 2000	FY 2001

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.

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
D. Perform reactor plant analyses to assure safe operation and improve reactor plant chemistry controls to reduce corrosion and plant radiation levels.			
The reactor core heats water which flows through the steam generator. The steam generator transfers the heat to the turbine cycle water by producing steam for power . Any corrosion products present in the reactor water will be carried through the plant and irradiated in the core. Additionally, excessive build-up of corrosion products in the core acts as insulation and narrows water channels, reducing flow and heat transfer.			
Chemistry controls are aimed at reducing corrosion. Development work aims at maintaining 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 which ensure the plant will operate safely and reliably during 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 been able to maintain consistently low radiation levels while enhancing reliability and correspondingly reducing maintenance costs. The FY 01 amount reflects reactor protection analysis for CVNX.	9,000	8,000	9,000

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001

Verifiable Supporting Activities:

FY 1999 Continue analysis of core performance by isolating the effects of water acidity and temperature.

Continue the alternate chemistry treatment test for possible future use in several plant types.

Perform the protection analysis for the next generation reactor.

Initiate analysis to extend advanced fleet reactor protection basis to end-of-life.

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.

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

	FY 1999	FY 2000	FY 2001
Total, Plant Technology	$111,100	$111,025	$118,200

Explanation of Funding Changes from FY 2000 to FY 2001

	FY 2001 vs. FY 2000 ($000)
# I.A FY 01 amount reflects scaled up work on design and development of the CVNX steam generator.	+ 3,000
# I.B FY 01 amount supports the development of equipment specifications and system details for CVNX reactor plant instrumentation, and emergent cyber security requirements.	+ 3,100
# I.C Minor adjustments.	+75
# I.D FY 01 amount supports performance of protection analyses for CVNX plant design.	+ 1,000
Total Funding Change, Plant Technology:	+7,175

Materials Development & Verification

Mission Supporting Goals and Objectives

Materials Development & Verification provides the high performance materials necessary for Naval reactor plant applications. This work principally supports the performance measure to ensure Naval nuclear reactor plants are able to meet Navy goals for extended warship operation. Ensuring materials will withstand the rigors of the harsh environment -- irradiation, high temperature, high pressure, and corrosion -- over a number of decades is a central element to providing longer lived reactor plants. This challenge is compounded by the difficulty in examining or replacing materials in the reactor plant once assembled. 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 prototypical specimens and materials removed from service and then used to develop predictive models. The ability of these models to reliably predict material performance is vital to operating plant safety and to qualifying materials for longer lifetimes.

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, the materials used in the reactor core must maintain high integrity in retaining radioactive fission products under intense irradiation at higher temperature, whereas the materials used in plant pressure-boundary components must maintain the high integrity of the primary coolant boundary under high stress in a corrosive environment. Irradiation testing is used to support both core and plant material development, but is highlighted to reflect the fundamental impact of irradiation on material performance.

Funding Schedule

(dollars in thousands)

	FY 1999	FY 2000	FY 2001	$ Change	% Change
Total, Materials Development & Verification	119,500	124,400	127,600	+3,200	2.6%

Detailed Program Justification

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
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.			
Materials used in a reactor core as fuel, poison, cladding, and structural pieces 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 applications is dependent upon fabrication process development, as well as testing and development of predictive models to cover design applications. Materials used in long life core designs must be qualified in advance by collecting data on their performance during tests, examining their condition after testing and at end of use, and assembling the collected data into sound predictive models.			
FY 01 reflects additional work to identify alternative methods of fuel development and reflects emergent cyber security requirements	40,500	43,800	44,900

(dollars in thousands)

FY 1999	FY 2000	FY 2001

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 1999 Verify fuel performance models by evaluation of the condition of spent cores.

Test post irradiation crack growth rate specimens to determine whether the calculated effect of neutron fluence on stress corrosion cracking resistance of X750 and A625 can be reduced.

Evaluate acceptability of fuel manufactured with a new production process that reduces cost and utilizes environmentally friendly materials.

Conduct destructive evaluation of fuel specimens which underwent performance testing and assess changes to design bases.

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

Complete interim evaluation of initial high temperature fuel material irradiations tests to assess performance.

Develop improved method of predicting corrosion of fuel element cladding.

	(dollars in thousands)	
FY 1999	FY 2000	FY 2001

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 testing of CVNX fuel element design in the Advanced Test Reactor.

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

For additional explanation, please refer to classified addendum.

		(dollars in thousands)	
	FY 1999	FY 2000	FY 2001
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.			
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 life times to support increasingly longer lived nuclear cores. An example of a plant material concern is embrittlement resulting from irradiation.			
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, destructive and non-destructive 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.			
The decrease in FY 2001 is due to a reduced level of work in a number of areas such as non-destructive testing.			
For additional explanation, please refer to classified addendum	39,000	37,600	36,800

(dollars in thousands)		
FY 1999	FY 2000	FY 2001

Verifiable Supporting Activities:

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

FY 1999 Conduct advanced testing of promising new alloys.

Complete first phase of program to evaluate effects of chemistry and material microstructure on irradiation damage in pressure vessel material.

Improve testing capabilities by developing laser spectroscopy techniques to study low level contaminants in water and monitor stability of additives.

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

Continue development of special alloys.

Conduct testing to evaluate long-term temperature and irradiation embrittlement behavior of a reactor vessel structural material.

Perform testing to extend lifetime of high strength fasteners.

Improve crack growth rate and corrosion fatigue testing capabilities by developing advanced non destructive testing methods and automated data acquisition techniques.

	(dollars in thousands)	
FY 1999	FY 2000	FY 2001

FY 2001 Conduct testing to define the effect of irradiation on 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.

For additional explanation, please refer to classified addendum.

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
C. Conduct irradiations testing and perform detailed examinations to provide data for material performance characterization and prediction.			
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 fuel, poison, and structural 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 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 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 is developing an enhanced system for irradiation testing with precise temperature control in the ATR. The change of $2.9 million in this area reflects more irradiations testing using this new system and a minor change due to emergent cyber security requirements.	40,000	43,000	45,900

	FY 1999	FY 2000	FY 2001
	(dollars in thousands)		

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 1999 Irradiate pressure vessel fracture toughness specimens.

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.

For additional explanation, please refer to classified addendum.

	FY 1999	FY 2000	FY 2001
Total, Materials Development & Verification	$119,500	$124,400	$127,600

Explanation of Funding Changes from FY 2000 to FY 2001

	FY 2001 vs. FY 2000 ($000)
# I.A. FY 01 reflects additional work to identify alternative methods of fuel development and reflects emergent cyber security requirements	+ 1,100
# I.B. Decrease reflects completion of the development phase of an ultrasonic testing system, and minor reductions in various areas such as a reduced level of non-destructive testing..	- 800
# I.C. Reflects more testing in the Advanced Test Reactor using an enhanced system for testing various sample temperatures and a minor change due to emergent cyber security requirements.	+ 2,900
Total Funding Change, Materials Development & Verification:	+ 3,200

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 and the Advanced Test Reactor, the examination of expended cores to validate end-of-life predictions, and the preservation of environmental quality at all Naval Reactors sites.

Evaluation and Servicing supports the performance measures for ensuring the 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.

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 clean up of facilities at all Naval Reactors sites to reduce hazards to personnel, and reduce potential liabilities due to changing conditions or accidental releases.

Funding Schedule

(dollars in thousands)

	FY 1999	FY 2000	FY 2001	$ Change	% Change
Total, Evaluation & Servicing	163,589	161,900	134,000	-27,900	-17.2%

Detailed Program Justification

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
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.			

	(dollars in thousands)	
FY 1999	FY 2000	FY 2001

A. Operate land-based test reactor plants to provide for prototypical testing, core depletion analysis, and reactor plant operator training.

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 quickly deplete the advanced fleet reactor in S8G since the information gained will validate the predictions for the advanced fleet reactor cores installed in SEAWOLF class submarines and provide data useful in the development of the next generation 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 on the MARF and S8G prototypes to ensure the plants remain in a safe condition and can carry out their testing mission. 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. The FY 01 amount covers inflationary growth experienced at these sites, where work is labor-intensive, and emergent cyber security requirements.

	FY 1999	FY 2000	FY 2001
For additional explanation, please refer to classified addendum.	31,000	32,000	33,100

(dollars in thousands)		
FY 1999	FY 2000	FY 2001

Verifiable Supporting Activities:

FY 1999 Meet depletion goals for MARF and S8G.

Conduct the fourth MARF low power physics test and issue report.

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

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

Inspect pressurizer heater wells in MARF.

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.

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
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.			
Naval Reactors performs major servicings on the prototypes to ensure continuing operability. Anticipated major servicings over FYs 99-01 focus on inspecting vulnerable primary loop areas and inspecting the steam generators. This must be done periodically as solid particles settle out of the boiler water in the low flow areas where steam generator tubes and support plates meet. These particles form a sludge, which, if not removed, could cause chemical corrosion in the metal tubes and supporting plates. Performing these inspections and cleanings on prototype plants not only keeps them operating efficiently and safely, but increases our knowledge of how fast sludge is accumulating and how corrosion is occurring in shipboard steam generators.			
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 this area focuses on the next generation reactor, and are starting on the servicing features and equipment for the CVNX reactor. Specifically, Naval Reactors is proceeding well on the next generation reactor servicing design to ensure proper provision for maintenance and defueling capability. Included in this work is the design of all power unit loading, maintenance, and defueling equipment, and preparation of planning documents and analyses required for shipment and installation of the next generation reactor power unit, and shipment and disposal of recoverable irradiated fuel and irradiated core components. This same work also is commencing for the CVNX reactor. Requirements decrease to reflect the completion of a major availability in FY 00 followed by demobilization and shipout of equipment.	14,000	18,000	7,000

	(dollars in thousands)	
FY 1999	FY 2000	FY 2001

Verifiable Supporting Activities:

FY 1999 Inspect the two MARF steam generators.

Perform detailed design of next generation reactor penetration seal cutting equipment.

Complete a safety analysis report for packaging for shipment of next generation reactor spent fuel in an M-140 container.

Complete development of next generation reactor defueling procedures.

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

Complete final design of next generation reactor penetration seal cutting equipment.

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

FY 2001 Develop next generation reactor maintenance software.

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

For additional explanation, please refer to classified addendum.

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
C. Operate and service the Advanced Test Reactor to provide for materials irradiations testing.			
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. Requirements change to reflect inflation and growth in contractor overhead charges.	16,000	16,900	18,000

Verifiable Supporting Activities:

All Years Meet operating efficiency goals.

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
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 inactivation efforts at the Windsor site in Connecticut to eliminate surplus facilities, remediate and dismantle plant facilities and release applicable areas.			
The S1C plant is defueled, and the reactor pressure vessel have been packaged and shipped out for disposal. Requirements decrease as this work enters final phase.			
For additional explanation, please refer to classified addendum.	22,000	7,000	3,000

Verifiable Supporting Activities

FY 1999 Complete removal and package and ship out for disposal.

Complete reactor compartment removal and disposal activities.

FY 2000 Complete building demolition and site dismantlement.

FY 2001 Conduct site closeout and release process.

For additional explanation, please refer to classified addendum.

	FY 1999	FY 2000	FY 2001
B. Continue inactivation efforts at the Kesselring site in New York to eliminate surplus facilities, remediate and dismantle plant facilities and release applicable areas.			
The S3G and D1G plants at the Kesselring site in New York are defueled. In 1997, an Environmental Impact Statement and Record of Decision recommending prompt dismantlement of the S3G and D1G reactor compartments were issued. The S3G engine room has been completely dismantled. Resources change to reflect plant layup and contractor demobilization costs, as well as removal of other major plant components as funding permits.	14,000	23,400	25,700

	(dollars in thousands)	
FY 1999	FY 2000	FY 2001

Verifiable Supporting Activities:

FY 1999 Continue dismantlement activities, including preparations for S3G pressure vessel removal.

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

FY 2001 Conduct dismantlement and dispositioning of prototype reactor compartment internals, place S3G and D1G plants in a stable layup state, and demobilize contractor.

C. Continue inactivation efforts in Idaho to eliminate surplus facilities, remediate and dismantle plant facilities and release applicable areas.

	FY 1999	FY 2000	FY 2001
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. Work at NRF will now focus principally on placing the A1W plant in a safe layup condition, maintaining all plants in a low-maintenance, environmentally benign state, and accomplishing site / plant-related remediation work.	25,589	21,600	2,000

Verifiable Supporting Activities:

FY 1999 Complete servicing equipment disposal from S5G defueling.

Complete the layup work for the S5G plant.

Defuel the A1W-A plant.

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

Decontaminate the S1W retention basin.

(dollars in thousands)		
FY 1999	FY 2000	FY 2001

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.

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

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
A. Conduct ongoing clean up of test facilities to reduce hazards to personnel, and reduce potential liabilities due to changing conditions or accidental releases.			
Operation of test, examination, and manufacturing facilities has involved the use of hazardous materials. Decontamination and remediation efforts limit the hazards to personnel, reduce the potential environmental liabilities due to changing conditions or accidental releases, and provide more usable space for future operations. This work reduces the potential for materials such as asbestos, heavy metals, chemicals, and radioactivity to present a hazard to personnel or 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.			
Facilities and equipment are characterized to determine the extent and nature of clean up 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. Resources change to acknowledge several years' inflationary growth and a minor change for emergent cyber security requirements..	25,000	25,000	26,600

	(dollars in thousands)	
FY 1999	FY 2000	FY 2001

Verifiable Supporting Activities:

FY 1999 Process for disposal historical waste from the L-Building at the Bettis Pittsburgh site.

Remove asbestos from various buildings and laboratories at the Bettis Pittsburgh site.

Continue Knolls site remediation 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.

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
IV. Conduct planned development, testing, examination and evaluation of nuclear fuel systems, materials, and manufacturing and inspection methods to ensure Naval nuclear reactors are able to meet Navy goals for extended warship operation.			
A. Examine removed fuel cells at end-of-life and perform non-destructive examinations of irradiated test specimens to confirm predicted performance and validate design methods.			
Data obtained from the examinations of in-service components and specimens provides valuable information on material and component characteristics and performance in the harsh reactor environment. 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. Resources grow to reflect inflation and a minor change for emergent cyber security requirements.	16,000	18,000	18,600

Verifiable Supporting Activities:

FY 1999 Prepare the necessary procedures and schedules for examinations, assembly, shipment, receipt, and disassembly of about fifteen irradiation tests.

Complete data collection for highest priority A4W prototype expended core component examination.

Receive fuel from the Advanced Submarine Nuclear Propulsion Plant (ASNPP) from the A1W prototype.

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 1999	FY 2000	FY 2001
FY 2001 Prepare the necessary procedures and schedules for examinations, assembly, shipment, receipt, and disassembly of about fifteen irradiation tests. 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			
Total, Evaluation and Servicing	163,589	161,900	134,000

(dollars in thousands)

Explanation of Funding Changes from FY 2000 to FY 2001

		FY 2001 vs. FY 2000 ($000)
# I.A	Changes for inflation and emergent cyber security requirements	+ 1,100
# I.B	Decrease reflects completion of FY 00 S8G prototype availability	- 11,000
# I.C	Increase for inflation.	+ 1,100
# II.A	Continued decrease as Windsor site inactivation enters final phase	- 4,000
# II.B	Resources change to reflect plant layup and contractor demobilization costs, as well as removal of other major plant components as funding permits	+2,300
# II.C	Decrease due to completion of A1W defueling, and reduction in inactivation work at Naval Reactors Facility	- 19,600
# III.A	Recognition of several years' inflation and a minor change for emergent cyber security requirements.	+ 1,600
# IV.A	Change for inflation and a minor change for emergent cyber security requirements.	+ 600
Total Funding Change, Evaluation & Servicing		- 27,900

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.

Ten FTEs are currently included for the Idaho Operations Office to oversee operation of the Advanced Test Reactor, 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 will become NNSA employees. Because the Office of Nuclear Energy, Science, and Technology has and will continue to have the responsibility for operating the Advanced Test Reactor, these 10 FTEs will be transferred to the Office of Nuclear Energy beginning in FY 2001, but Naval Reactors will continue to fund the FTEs in FY 2001. For FY 2002 through FY 2005 funding will be transferred from Naval Reactors' budget target to the Office of Nuclear Energy.

The FY 2001 request includes Working Capital Fund resources to cover the costs of goods and services at Naval Reactors' Headquarters including building occupancy (rent), payroll processing and telephone services.

Funding Schedule

(dollars in thousands, whole FTEs)

	FY 1999	FY 2000	FY 2001	$ Change	% Change
Headquarters					
Salary and Benefits	7,010	7,130	7,320	+190	+2.7%
Travel	500	510	510	0	0%
Support Services	0	0	0	0	0%
Other Related Expenses	650	630	630	0	0%
Total, Headquarters	8,160	8,270	8,460	+190	+2.3%
Full Time Equivalents	57	57	57	0	0%
Pittsburgh Naval Reactors					
Salary and Benefits	5,160	5,280	5,620	+340	+6.4%
Travel	150	110	125	+15	+13.6%
Support Services	0	0	0	0	0%
Other Related Expenses	515	600	570	-30	-5.0%
Total, Pittsburgh Naval Reactors	5,825	5,990	6,315	+325	+5.4%
Full Time Equivalents	72	70	70	0	0%

	(dollars in thousands, whole FTEs)				
	FY 1999	FY 2000	FY 2001	$ Change	% Change
Schenectady Naval Reactors					
Salary and Benefits	4,595	4,700	4,960	+260	+5.5%
Travel	85	90	90	0	0%
Support Services	0	0	0	0	0%
Other Related Expenses	510	495	490	-5	-1%
Total, Schenectady Naval Reactors	5,190	5,285	5,540	+255	+4.8%
Full Time Equivalents	65	64	64	0	0%
Idaho Operations Office					
Salary and Benefits	820	900	930	+30	+3.3%
Travel	30	20	20	0	0%
Support Services	0	0	0	0	0%
Other Related Expenses	75	135	135	0	0%
Total, Idaho Operations Office	925	1,055	1,085	+30	+2.8%
Full Time Equivalents	10	10	10	0	0%
Total Naval Reactors Program					
Salary and Benefits	17,585	18,010	18,825	+815	+4.5%
Travel	765	730	745	+15	+2.0%
Support Services	0	0	0	0	0%
Other Related Expenses	1,750	1,860	1,830	-30	-1.6%
Total, Program Direction	20,100	20,600	21,400	+800	+3.9%
Full Time Equivalents	204	201	201	0	0%

Detailed Program Justification

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
Salaries and Benefits			
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.	17,585	18,010	18,825

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
Travel			
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 change is projected to support increasing travel requirements for Pittsburgh Naval Reactors personnel due to off-site security responsibilities and required training not offered locally.	765	730	745
Support Services			
Naval Reactors does not use Support Services contractors.	0	0	0
Other Related Expenses			
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 decrease is primarily due to a reduction in Working Capital Fund estimates.	1,750	1,860	1,830
Total, Program Direction	20,100	20,600	21,400

Explanation of Funding Changes FY 2000 to FY 2001

	FY01 vs. FY00 ($000)
Salaries and Benefits	
# The change is due to salary adjustments in accordance with allowable inflation	+815
Travel	
# The funding change is to support increasing travel requirements for Pittsburgh Naval Reactors personnel due to off-site security responsibilities and required training not offered locally.	+15
Other Related Expenses	
# The decrease is primarily due to a reduction in Working Capital Fund estimates..	-30
Total Funding Change, Naval Reactors Program Direction	+800

Other Related Expenses

(dollars in thousands)

	FY 1999	FY 2000	FY 2001	$ Change	% Change
Training	115	116	117	+1	+0.9%
Working Capital Fund	484	542	525	-17	-3.1%
Printing and Reproduction	11	11	15	+4	+36.3%
Rental Space	0	0	0	0	0%
Software Procurement/Maintenance Activities/					
Capital Acquisitions	382	458	440	-18	-3.9%
Other	758	733	733	+0	0%
Total, Budget Authority	1,750	1,860	1,830	-30	-1.6%

Capital Operating Expenses & Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 1999	FY 2000	FY 2001	$ Change	% Change
General Plant Projects	9,000	10,300	11,400	1,100	+10.7%
Capital Equipment	42,100	35,900	30,800	-5,100	-14.2%
Total, Capital Operating Expense	51,100	46,200	42,200	-4,000	-8.7%

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior Year Approp-riations	FY 1999	FY 2000	FY 2001	Unapprop-iated Balance
90-N-102 Expended Core Facility Dry Cell	86,846	47,146	5,800	12,000	16,000	2,800
98-D-200 Site Laboratory/Facility Upgrade .	15,700	5,700	7,000	3,000	0	0
01-D-200 Major Office Replacement Building	12,700	0	0	0	1,300	11,100
Total, Construction		52,846	12,800	15,000	17,300	13,900

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

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior Year Approp-riations	FY 1999	FY 2000	FY 2001	Accept-ance Date
ATR-ECF Transfer Casks . . .	9,100	8,100	1,000	0	0	FY 2000
Thermal-Hydraulic Test Equipment	2,900	300	1,100	1,500	0	FY 2001
Test Facility Upgrades	5,700	5,000	700	0	0	FY 1999
Local Area Network Replacement	4,900	500	1,000	900	900	FY 2002
Scalable Parallel Upgrade . .	12,000	0	12,000	0	0	FY 1999
Metal Processing Equipment	4,200	0	2,500	1,700	0	FY 2001
Post-Irradiations Evaluation Laboratory	8,300	4,400	3,200	400	300	FY 2002
Next Generation Scalable Computer	10,000	0	0	10,000	0	FY 2000
Scalable Computer Modification/Upgrade		0	0	0	6,000	FY 2002
Total, Major Items of Equipment		18,300	21,500	14,500	7,200	

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

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
2001	1,300	1,300	800
2002	9,000	9,000	4,700
2003	2,100	2,100	6,900

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 100,000 square feet 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 about 570 flexible, efficient office spaces. Along with the open office layout the building will have an integral fiber optic network for utilization with desktop computing, as well as 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 construction of a new storage facility.

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

The cost estimate is based on conceptual design.

[a]The annual escalation rates assumed for FY 2001 through FY 2002 are 2.5 and 2.6 respectively.

5. Method of Performance

Contracting arrangements are as follows:

a. Building design/construction will be accomplished by one fixed price contract awarded on on the basis of competitive best value.

b. Site preparation work will be accomplished by fixed price contract awarded on the basis of competitive bidding.

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

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	Prior Year	Current Year	Budget Year	Outyears	Total
Project cost						
Facility Cost						
Design	0	0	0	240	0	240
Construction	0	0	0	1,060	11,100	12,160
Total, Line Item TEC	0	0	0	1,300	11,100	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	0	1,300	11,100	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	1,200	0	0	1,200
Other project-related costs	0	0	0	0	0	0
Total, Project Costs	0	0	1,320	1,300	11,100	13,720
Total Project Cost (TPC)	0	0	1,320	1,300	11,100	13,720

7. Related Annual Funding Requirements

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

[a] Including personnel and M&S cost (exclusive of utility cost) for operation, maintenance, and repair of the Major Office Replacement Building.

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

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

(Changes from FY 2000 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

Fiscal Years 1998 through FY 2002 costs in the Financial Schedule (Section 2) have been changed to show actual costs for FY 1998 and costs for FY 1999 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. Section 8 was added to comply with the latest Construction Project Data Sheet Preparation Guidance.

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	48,000	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 2001 Budget Request	1Q 1990	2Q 2000	2Q 1993	4Q 2002	86,846	98,694

| [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.

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	2,436
2000	12,000	12,000	14,209
2001	16,000	16,000	12,886
2002	2,800	2,800	8,317

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 approximately 99 percent 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 15 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, a fuel receipt transfer bay, spares storage, control room, and a mockup training area in an approximately 22,300 square foot addition to the existing ECF building.

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, 87% of the project is expected to be completed.

4. Details of Cost Estimate[a]

	(dollars in thousands) Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design cost ($5,024,000 for Design Drawings and Specification)	13,613	12,830
Design Management costs (2.7 % of TEC)	2,320	2,415
Project Management costs (2.6 % of TEC)	2,290	2,290
Total, Engineering design, inspection, and administration of construction costs (20.9% of TEC)	18,223	17,535
Construction Phase		
Buildings	37,891	35,540
Special Equipment	10,358	11,080
Standard Equipment	5,927	5,927
Inspection, design and project liaison, testing, checkout and acceptance	8,172	9,474
Project Management (2.6 % of TEC)	2,290	2,290
Total, Construction Costs	64,638	64,311
Contingencies		
Design Phase (0.3 % of TEC)	300	500
Construction Phase (4.2 % of TEC)	3,685	4,500
Total, Contingencies (4.6 % of TEC)	3,985	5,000
Total Line Item Cost	86,846	86,846
Less: Non-Agency Contribution	0	0
Total, Line Item Costs (TEC)	86,846	86,846

The cost estimate is based on the Dry Cell task being 99 percent complete, the East End Modification task Title II design being 90 % completed and the West End Modification task conceptual design completed.

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 Inspection: By Engineering Services Subcontractor under operating contractor surveillance.

---

[a] The annual escalation rates assumed for FY 1997 through FY 2002 are 2.8, 2.0, 1.6, 2.1, 2.0, and 2.0 percent respectively.

6. Schedule of Project Funding

	(dollars in thousands)					
	Prior Years	FY 1999	FY 2000	FY 2001	Outyears	Total
Project cost						
Facility Cost						
Design	13,343	2,949	2,025	145	61	18,523
Construction	35,655	0	11,671	13,341	7,656	68,323
Total, Line item TEC	48,998	2,949	13,696	13,486	7,717	86,846
Operating expense funded equipment[a]	430	100	3,475	300	162	4,467
Total Facility Costs (Federal and Non-Federal)	49,428	3,049	17,171	13,786	7,879	91,313
Other project costs						
Conceptual design cost	1,700	0	0	0	0	1,700
Decontamination & Decommissioning[b]	250	500	250	100	0	1,100
NEPA Documentation Costs	2,500	0	0	0	0	2,500
Other project-related costs[c]	1,681	0	0	200	200	2,081
Total, Other project costs	6,131	500	250	300	200	7,381
Total project cost	55,559	3,549	17,421	14,086	8,079	98,694

[a] Includes costs for adaptation of existing storage overpacks and transportation casks for the selected Dual Purpose Canisters (DPCs); development of container welding systems; and procurement of weld mockups and two sets of DPCs 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 2001 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

[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.