

(dollars in thousands)

FY

2010 Actual Approp	FY 2011 Request	FY 2012 Request
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- Perform examinations on core and plant components after ship service including preparation of technical work documents, development of hardware and instrumentation, engineering support and skilled technician labor.

**Core and Reactor Materials Development:** This work involves verifying acceptable performance for current cores through end of life, pursuing potential cost reductions, and improving materials and processes through long-term irradiation tests and evaluations. Funding has been identified in the estimated amount of \$41,000,000 to support this work in FY 2012, including the following:

- Utilize test data and increased fundamental understanding to improve models and revise current design bases for more capable and cost efficient Pressurized Water Reactor designs.
- Continue to develop, test, and examine high performance fuel system constituent materials for advanced applications.
- Develop and deploy new high accuracy measurement techniques to cost-effectively measure the thermal conductivity of prototypic oxide films from expended cores with the goal of providing thermal performance margin to operating cores.
- Apply core material modeling capabilities to guide testing programs, improved understanding of manufacturing processes, and better predict in-core performance.
- Perform corrosion testing to support core design needs, model development and improved understanding of the corrosion process for particular metals and metal alloys.
- Examine expended cores from prototypes and ships to determine any unexpected effects of reactor operation and use the results to modify design methods and ensure safe operation of the fleet.
- Select and characterize candidate fuel, poison, cladding, moderator, reflector and structural materials, for a cost effective high performance reactor system.
- Evaluate additional expended core corrosion examination data. Develop revised corrosion design factors and design code re-correlations where appropriate.
- Develop new models and correlations for in-pile and out-of-pile material performance where there is a demonstrated need, or significant performance benefit that can be achieved.
- Improve current system fundamental understanding and perform in-reactor and autoclave tests to support qualification and implementation of advanced materials whose capabilities exceed those of current zirconium alloys. Perform irradiation tests of advanced fuel designs with improved capabilities.
- Evaluate currently available and advanced fuel systems for application in Virginia Forward Fit applications.
- Assess starting material, fuel and core manufacturing along with inspection processes to recommend changes for cost reduction while maintaining performance.

**Major Outyear Priorities and Assumptions**

**OHIO-class Replacement Submarine:** To recapitalize the most survivable leg of the nuclear triad, NR is developing a life-of-ship reactor plant for the OHIO-class Replacement submarine that will serve in excess of 40 years. Lead times associated with designing, building, testing, and deploying new nuclear warships, specifically submarines, are particularly long with exacting deadlines for delivery of components to shipyards for timely construction making full funding for this program crucial.

Work to support the OHIO-class replacement submarine is tightly synchronized with Navy-funded propulsion plant work. This DOE-funded design work includes reactor plant component design and development, core arrangement, instrumentation and control design and development, reactor plant configuration, systems development and integration, and reactor performance analysis and validation. Completion of this work drives the overall design maturity of the reactor and propulsion plant thereby significantly minimizing risk during component procurement (beginning in FY 2017) and ship construction (beginning in FY 2019).

**OHIO-class Replacement Submarine**  
(dollars in thousands)

	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
Operations and Maintenance	121,300	149,700	169,800	205,000	150,300

**S8G Prototype Refueling:** The S8G Prototype reactor plant provides a cost-effective test and evaluation platform for new technologies, materials, and components before they are introduced to the Fleet, and provides a vital training platform for reactor plant operators. The S8G Prototype has been integral to the development of technologies including the current VIRGINIA-class and SEAWOLF-class fuel systems, which have resulted in improved performance and reliability while reducing life-cycle costs. This approach will significantly mitigate technical, cost, and schedule risk to the ship construction program by testing and proving the manufacturability of the fuel system prior to full-scale construction.

Refueling for the land-based S8G Prototype will allow the insertion of the new cladding and fuel system technology for the OHIO-class Replacement with the prototype refueling core. This will enable the testing and demonstration of core manufacturability necessary for production and delivery of the OHIO-class Replacement submarine reactor. One of the most significant requirements for the OHIO-class Replacement submarine is the life-of-the-ship (40+ years) core, which is impossible with the current conventional cladding. Alternate clad manufacturing development will enable the development of mature production processes for the OHIO-class Replacement submarine core prior to full-scale production and procurement.

### **OHIO-Class Ballistic Missile Submarine Replacement**

The OHIO-class ballistic missile submarines (SSBNs) have been the backbone of the Nation's Sea-Based Strategic Deterrent since the early-1980s. The Navy intends to replace the OHIO-class SSBNs at a reduced force structure beginning in FY 2027 when the first of 14 is retired. In order to have a replacement available in FY 2027 and consistent with the Navy's 30-year shipbuilding plan, the Navy would need to procure this ship in FY 2019. Research, development, and design for the OHIO-class SSBN began in FY 2010. Design of a new reactor plant is required to meet required capabilities, maximize operational availability, and reduce acquisition and life-cycle costs. This new design will leverage VIRGINIA-class technology, as well as manufacturing development and demonstration efforts to be performed as part of the Land-Based Prototype Refueling program. Central to this work and to enabling a reduced SSBN force structure is the development of a reactor plant core that operates for the life of the ship without refueling. The DOE reactor plant design and development work for the OHIO-class replacement will continue in FY 2012 and beyond to ensure sufficient maturity of detailed design to support initial fabrication and procurement of long-lead nuclear components in FY 2017 and ship construction in FY 2019. Funding has been identified within Naval Reactors Operations and Maintenance in the estimated amount of \$121,300,000 to fund this effort in FY 2012.

### **S8G Prototype Refueling**

The S8G Prototype (located in upstate New York), which serves as a critical operating reactor platform to demonstrate technology advancements for fleet application, will be depleted and will require refueling beginning in FY 2017. Originally built as a prototype for the OHIO-class submarine propulsion plant [S8G], this testing platform has been integral to the development of technologies including the VIRGINIA-class and SEAWOLF-class fuel systems, which have resulted in improved performance and reliability while reducing life-cycle costs. Continued operation of this land-based prototype and development of advanced core technology will enable extended core lifetimes, more efficient use of nuclear fuel, greater compactness, and cross-platform adaptability. Integral to development of a life of the ship core for the OHIO-class replacement, core manufacturing and demonstration will be performed as part of this refueling effort. By constructing the replacement core for the prototype with technologies and capabilities planned for the OHIO-class replacement, technical, cost, and schedule risk to the ship construction program will be significantly mitigated. This manufacturing development and demonstration work, as well as development of new core technologies, began in FY 2010. To preserve this critical research and development asset for the long term and to achieve a life-of-the ship core for the OHIO-class replacement submarine, core development and refueling overhaul work must continue in FY 2012 and beyond. Funding has been identified within Naval Reactors Operations and Maintenance in the estimated amount of \$99,500,000 to fund this effort in FY 2012.

### **Recapitalization of Spent Nuclear Fuel Infrastructure**

All spent naval nuclear fuel from Navy shipyards is shipped to the Naval Reactors Facility (NRF), located at the Idaho National Laboratory, for examination and disposal per the 1995 agreement signed by Department of Navy, DOE, and the State of Idaho. Compliance with this agreement and Naval Reactors' resultant ability to continue work in Idaho is dependant upon a viable, efficient fuel-handling infrastructure. However, major portions of the existing infrastructure (i.e., water pools and related support facilities) and equipment (i.e., examination equipment, cranes, etc.) are 50+ years old. Consequently, the magnitude of required sustainment efforts and incremental infrastructure upgrades pose substantial risk to operations and production workflow. An interruption to refueling and defueling schedules for nuclear-powered vessels, as required by existing maintenance schedules, would adversely