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Report to Congress

Requirements and Plans for University National

Oceanographic Laboratory System (UNOLS) Fleet Renewal

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Executive Summary

This report is the second in a series on University National Oceanographic Laboratory System (UNOLS) Fleet Renewal. In the February 2003 Report to Congress, Navy outlined the need to maintain a technologically-advanced oceanographic research fleet and stated twelve of the 17 largest ships in the UNOLS fleet would reach the end of their expected service life by 2015. In support of the 2001 Federal Oceanographic Facilities Committee (FOFC) report, Navy recommended an orderly, phased approach to renewal of the fleet over the next ten years with the construction of four new Ocean Class ships. Navy reported it was unable to fund Ocean Class vessels in the Fiscal Year 2004 President's Budget request due to higher priorities but planned to select a single hull form during Fiscal Year 2004. Navy said it would address Ocean Class ship construction beginning in Fiscal Year 2006, depending on overall Navy program priorities and in conjunction with NSF as the other major partner in the UNOLS fleet program.

Since the 2003 Report to Congress, progress has been made by the federal agencies on UNOLS fleet renewal. Science mission requirements (including Navy specific criteria) for the Ocean Class ships were developed and reviewed. Working with UNOLS and the oceanographic community, Navy conducted studies of multiple ship hull form options and selected the monohull in 2005 as the preferred hull form for the new Ocean Class vessels. Navy has updated current estimates of the total cost of a new Ocean Class research vessel places it between $80M – $100M under the Shipbuilding and Conversion account (SCN). Navy also continued development of new technology areas such as Unmanned Underwater Vehicles (UUV) and has seen particular promise in the capabilities of underwater gliders as potential alternatives for the use of ships for survey missions and selected R&D projects.

In order to better evaluate Navy equities in the UNOLS partnership, given current fiscal constraints, a Naval Research Advisory Committee Panel examined the rational for construction of a new generation of research vessels within the national context of federal plans for infrastructure support, the role of UNOLS in providing efficient utilization of federal assets, Navy's past and projected utilization of the Navy owned vessels and their importance to naval programs, and current planning for the Ocean Class research vessels.

The Panel found Ocean Class research ships are a critical part of the effort to support Navy's need for research on networked naval operations in the complex littoral operating areas of the 21st Century. The Panel determined the UNOLS-Navy-NSF-Academia partnership is very successful and the UNOLS ships provide important knowledge to Navy programs, but found the expected Navy contribution of four new Ocean Class ships to implement the FOFC Fleet Renewal Plan to be out of balance when compared to its use of the fleet. Navy owns six large ships in the fleet and annually uses approximately 800 of the 5350 total available UNOLS ship days or about 15%. Of this

DRAFT

amount, directed Navy programs such as the SSBN Security Program account for about 35% with the remainder used by the Office of Naval Research (ONR) Science and Technology (S&T) programs. The FOFC Plan anticipates a Navy future capital investment of $300M - $400M during the period 2008-2015, which represents about 35% - 50% of the total UNOLS (NSF + Navy) investment. The Panel proposed Navy consider the purchase of two, vice four, Ocean Class ships by 2017 to maintain the advantages of its partnership with UNOLS and its commitment to the national fleet but at a reduced capital investment level more consistent with its current and projected yearly fleet usage.

Navy recognizes the need to renew the UNOLS fleet and notes the direction of Congress with regards to the use of SCN funds, however, recapitalization and transformation of the Navy operational fleet has placed severe pressures on the SCN account. As a result, the Chief of Naval Operations (CNO) has determined any diversion of SCN funds will jeopardize the successful execution of the Annual Long-Range Plan for Construction of Naval Vessels as reported to Congress. Navy will therefore propose pursuing an incremental funding strategy using S&T funds to acquire two Ocean Class research ships by 2017 to support Navy equities in UNOLS fleet renewal.

Background

Since the late 1950's, and through the height of the Cold War, Navy has been a primary participant in national oceanographic research and has supported the oceanographic research fleet, including the purchase of eleven research ships designated AGOR's (Auxiliary General Oceanographic Research). These ships have been operated by academic institutions through a lease charter agreement signed by past equivalent offices of ASN RD&A. Navy's requirement has been to support vessels of the size and capability which allows them to cross oceans and conduct research or survey for extended periods. With the formation of the University National Oceanographic Laboratory System (UNOLS) consortium in 1972, the federal agencies and academic institutions began cooperating to achieve the most efficient and effective operation of the research fleet.

The fleet is composed of a range of vessel sizes and capabilities categorized from largest to smallest as Global Class, Ocean Class (with a subset of Intermediate Class), Regional Class and Local Class. The majority of the ships in the Global, Ocean-Intermediate, and Regional Classes are owned by the federal government, principally, Navy, the National Science Foundation (NSF), and the National Oceanic and Atmospheric Administration (NOAA). Navy and the NSF have jointly contributed to the large ship infrastructure and operational costs of the academic research fleet. Navy owns six of the largest ships (five Global and one Ocean Class) which support critical naval research in forward deployed areas of the world's oceans, as well as the needs of other federal agencies. A major segment of the research fleet is now approaching end of service life and is in need of replacement.

The Federal Oceanographic Facilities Committee (FOFC) Fleet Plan of December 2001 detailed the aging of the fleet and outlined the renewal of the Regional Class and

the transition of the fleet from the Intermediate Class to the highly advanced Ocean Class ships. To implement this Plan, Navy and NSF leadership announced at the September 2002 UNOLS meeting the intention to pursue renewal of the UNOLS fleet. NSF declared a commitment to build three Regional Class ships and several other infrastructure initiatives. The Chief of Naval Research (CNR) announced the Navy would like to be able to support construction of four Ocean Class Research Vessels to transition the fleet from the Intermediate Class. In February 2003, in response to House Report 107-436, the Secretary of the Navy stated in his Report to Congress: "Although the Department of the Navy was unable to fund the Ocean Class vessels in the President's FY04 budget request due to higher priorities, the current plan is to select a single hull form in FY04 and address Ocean Class ship construction… starting in FY06 at the $63M to $80M funding level depending on final hull form selection and overall Navy program priorities." This update of the February 2003 report discusses recent fleet renewal activities, Navy's review of participation in the UNOLS partnership, and revised plans for support of fleet renewal based on current and projected Navy equities.

Fleet Renewal Activities

Several significant actions related to fleet renewal have been completed since the last report. Extensive collaboration between the federal agencies and the oceanographic community has resulted in the development and review of detailed science mission requirement listings for both the new Regional Class and the new Ocean Class research vessels. This has included Navy specific requirements for the Ocean Class ships to ensure support of Navy unique research needs. Working with UNOLS and the other federal agencies, Navy conducted studies to evaluate a wide range of hull form options for the new Ocean Class ships. In 2005, UNOLS and CNR agreed upon a monohull as the preferred option for the prospective Ocean Class ship. These studies also offered a rough order of magnitude cost estimate. Recently, Navy has revised these estimates based on past oceanographic research ship acquisition programs and projected cost increases in labor and material. The revised estimate put the cost of the new Ocean Class Research Vessel between $80M - $100M. Navy also continued extensive research and development efforts on Autonomous Underwater Vehicles (AUVs) as potential alternatives for the use of ships in support of both research and operational missions. AUVs and buoyancy driven underwater gliders have shown very significant promise to providing new capabilities in conducting survey and research operations, but research vessels will still be needed to conduct investigations which require the intervention of scientists and instruments not capable of being housed on AUV's.

The full fleet renewal actions provided by NSF include: an improved fleet seismic capability with the acquisition and conversion of the Research Vessel Marcus Langseth (Figure 1); an initial installment of appropriated funds for conversion of the Ocean Drilling Program Drill Ship with the final installment included in the FY07 President's Budget request; an Alaska Region Research Vessel (ARRV) in the FY07 President's Budget request; and initial development of the Alvin Replacement Deep Submersible. NSF has also identified agency funding and signed a Memorandum of Agreement with the Navy Program Executive Officer Ships (PEO Ships) for program management

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support and contract authority for the acquisition of three new Regional Class ships resulting in two contracts awarded in May 2006 for design of the new ships.
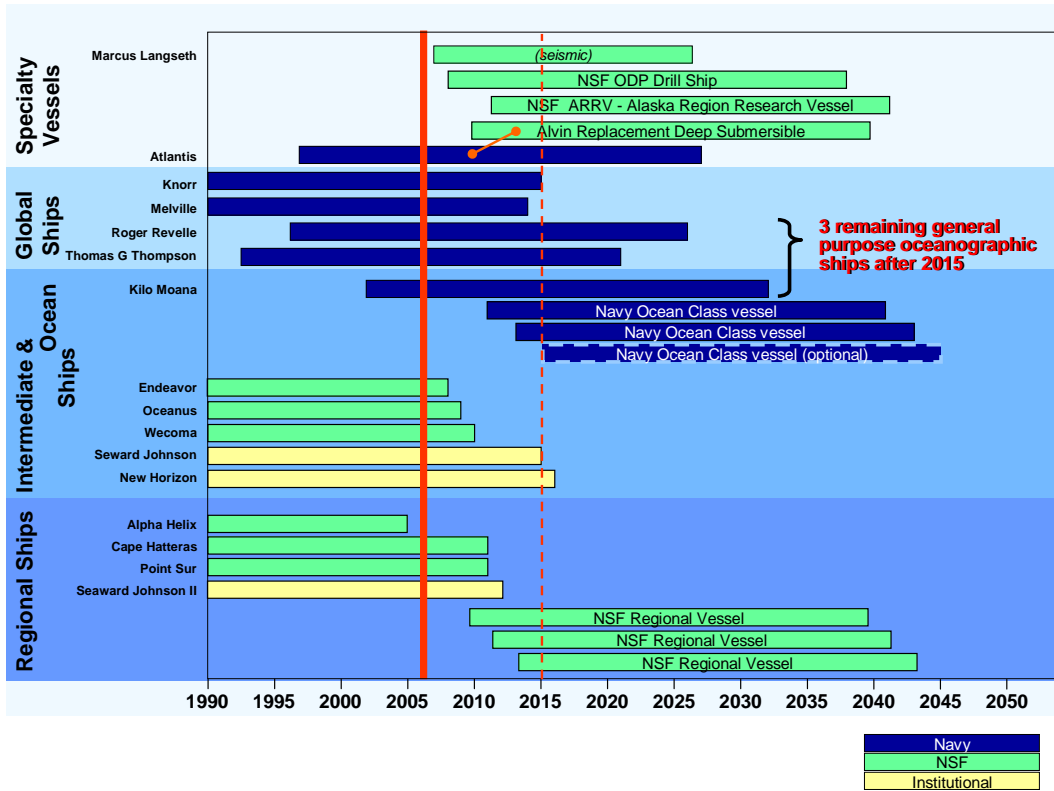
UNOLS Fleet Renewal, including Navy Options

Figure 1

UNOLS Oceanographic Research Fleet Renewal, including Navy options. The red line calls attention to the present; the dotted red line refers to a period which will have seen the retirement of most general purpose vessels having the capability of extended operations most useful to Navy.

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NRAC Study

In order to better evaluate Navy's equities in the FOFC UNOLS Fleet Renewal Plan, a Naval Research Advisory Committee (NRAC) Panel examined the rationale for construction of a new generation of research vessels. The NRAC Panel specifically considered:
- The current infrastructure support (research vessels) for academic oceanography by the Office of Naval Research (ONR)
- The role of UNOLS in providing efficient utilization of federal assets for global oceanographic studies
- The national context of federal plans for continuation of research vessel infrastructure supporting academic ocean sciences
- The recent historical, present and future utilization of the Navy owned vessels and their importance to naval programs, particularly S&T
- The current planning for the Ocean Class Research Vessel including science mission requirements, hull form selection and cost estimation.

Navy Research Requirements

The Chief of Naval Operations is transforming the Navy to meet both national security and recapitalization challenges and to find better ways of doing business overall. Under the Seapower 21 tenets of FORCEnet, Sea Strike, Sea Shield, Sea Basing and Sea Shaping, naval fleet capabilities will be widely deployed through the Distributed and Networked Operations (DNO) concept to improve crisis response and position the U.S. to win wars decisively. The DNO concept employs a flexible networked force structure with groups of ships able to operate independently or as Expeditionary Strike Forces. The NRAC Panel recognized the close linkage of naval operations to the complex littoral maritime environments in which these forces will be expected to operate, especially where submarines and mines will be potential threats. The Panel pointed out that the commitment to a netted force, particularly undersea, requires more extensive knowledge of the environment in regions unlike the Cold War.

Future networked naval undersea operations and sea basing will likely be focused in highly dynamic littoral regions such as the Western Pacific and the Indian Ocean (Figure 2) where recent ONR investigations have shown acoustic variability of 30 fold (15db) over time scales of minutes. These littoral environments have large geographic extent, vary greatly in physical characteristics from one region to another, have extremely complex oceanographic structure, and can significantly impact the success of naval operations. The Panel noted data collection and research is required to understand the detailed physical processes occurring in these areas and to identify the spatial and temporal variability needed to support development of new oceanographic prediction systems and tactical decision aids for the fleet commanders. High-resolution, three-dimensional, and time based information is essential for conducting fleet networked operations of the future. This data collection and research must be conducted on-scene using a variety of tools optimized to sample the environment at the appropriate scales and resolutions. The Panel found Ocean Class research ships are a critical part of this effort.
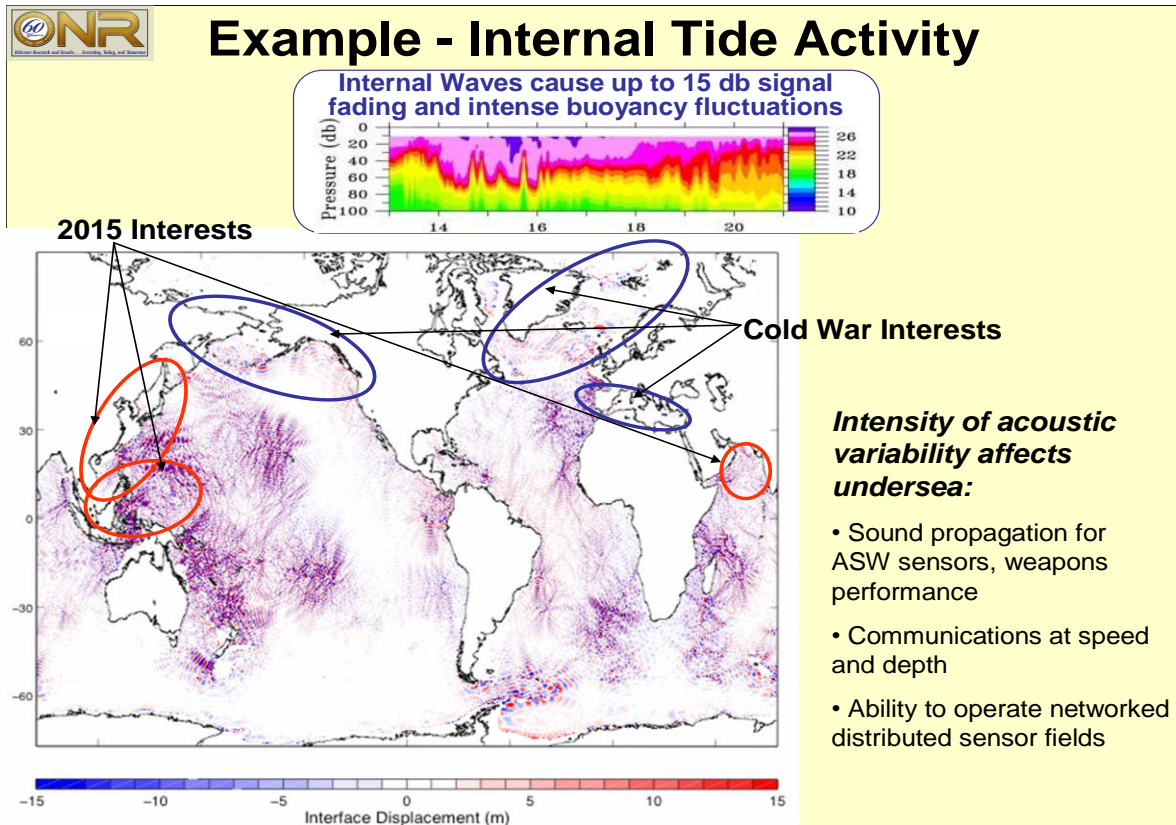
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Figure 2
Shift of Navy Interest Areas from the Cold War to 2015. Internal waves are propagating changes to ocean density and are caused by water flowing over submerged sills because of tides.

UNOLS Partnership

The NRAC Panel noted the long and successful history of Navy's participation in the UNOLS partnership which provides all the participating federal agencies with access to the entire range of fleet assets, allowing selection of the right size of vessel for the size of the science and technology mission. For Navy, the availability of a mix of vessel types and capabilities is particularly important in that it provides larger ships for global reach missions but also makes smaller ships available for missions in U.S waters and near shore without incurring the high costs of short term ship rentals on the commercial spot market. According to the UNOLS funding model, operational ship support is provided from federal research grants or contracts. Ship operations costs come from the same accounts as the research costs. Estimates show the cost of a typical 30 day Navy mission using a commercially leased ship would be twice as much as using the UNOLS fleet due to

higher base ship operating costs and the need to install specific mission support equipment. Directed Navy programs such as the SSBN Security Program, the Space and Naval Warfare Command, and the Naval Post Graduate School, as well as ONR, take maximum advantage of these efficiencies to conduct dedicated experiments and support education and research initiatives. On average, from ONR data over the past six years, Navy would expend an additional $7.7M per year if all of its experiments had to be conducted on the six Navy ships.

Partnering with NSF and other federal agencies also helps minimize costs through shared funding of transits and maintenance and mission equipment upgrades. Annual transit savings to Navy through UNOLS cooperative scheduling, particularly for trans-Pacific missions, is estimated at $1M. In addition, maintenance costs of Navy owned ships assumed by non-Navy users through the UNOLS process is estimated at $4.4M per year. Overall, ONR analysis estimates partnering with NSF through UNOLS saves Navy S&T on the order of $13.2M per year. These savings are critical to allowing research funds to be used as effectively as possible since any additional costs would be borne by the S&T programs.

Fleet Renewal Investment Balance

The NRAC Panel noted Navy annually has used approximately 800 of the 5350 total available UNOLS fleet ship days or about 15% (Figure 3). Of this total, ONR represents about 65% with the remainder used by a broad range of applied (both classified and unclassified) Navy programs. The interagency FOFC Renewal Plan calls for a Navy capital investment of $300M - $400M for construction of four new Ocean Class research ships during the period 2008 – 2015, which represents 35% – 50% of the total UNOLS (Navy + NSF) investment. The Panel found this investment by Navy to be out of balance when compared to the fleet usage percentage of 15% and proposed Navy budget for the purchase of two Ocean Class ships by 2017. This would require $150M - $200M over the next ten years, which is more in line with the yearly usage, and would maintain commitment to the national fleet while also retaining access to the smaller ships to take advantage of the projected yearly cost savings. The Panel recognized the need for Navy to begin a dialogue with the other UNOLS partners to discuss infrastructure investments and the impacts of reduced fleet availability.

As previously mentioned, autonomous underwater vehicle technology shows significant promise for providing new survey and research capabilities. Autonomous platforms include surface drifters, neutrally buoyant and profiling floats, highly controllable self-propelled AUV's and underwater gliders. Currently available large AUV's have the capability to conduct detailed bathymetric and water chemistry surveys at depths to 5,000 meters and also have the internal intelligence to alter the survey pattern in response to data collected. Smaller AUV's can be optimized to carry out a variety of survey operations in deep water and shallow water. Larger AUV's under development will have the capability to carry multiple sensor suites and remain at sea for long periods of time. Underwater gliders have already been developed to the point where they can

remain deployed for weeks to months collecting data and periodically surfacing to call home, transfer collected data, and receive new instructions.

Figure 3, based on UNOLS data, shows fleet projections for the total number of general purpose ships expected to be in service. The uncertainty in the projected utilization beyond 2006 is depicted by using the seven year average of 2000 – 2006 for all years out to 2020. Estimates of the number of ships and operating days available includes all ship classes from Global to Local resulting in an average of 200 operating days per year per ship. By 2015, based on the planned construction of 3 Regional Class, the ARRV and 2 Ocean Class research vessels, the total available ships and operating days is projected to be reduced. However, as depicted in Figure 3, Navy believes that by the 2009 – 2010 time frame, new AUV technology, currently under development, will allow greater sampling rates and increase the total amount of data being returned from the oceans. Although the total extent is uncertain, Navy projects a steady increase in AUV utilization in the out-years. Driven by advances in automation and their ability to provide affordable access to the ocean, up to ten percent of the total ocean survey and research work currently being done on ships could be accomplished by AUV's by 2020.
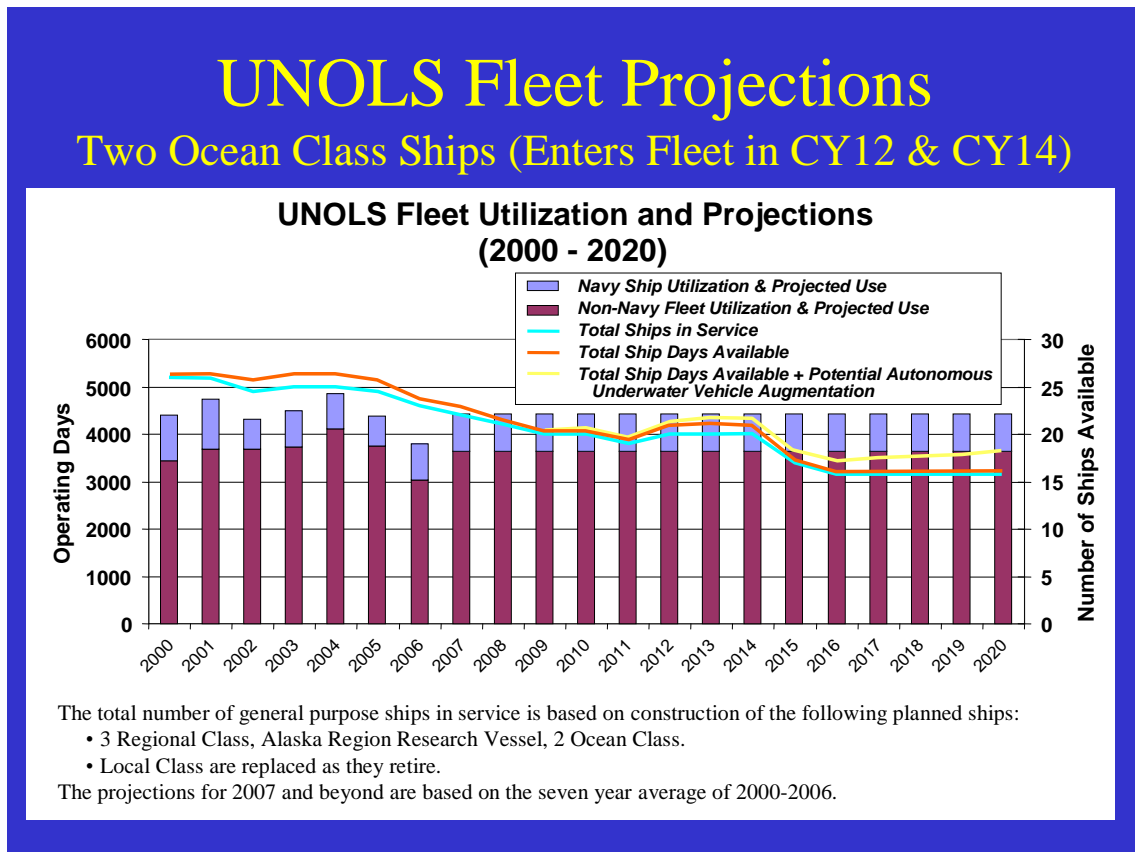

Figure 3
Availability of general purpose ships versus requirements.

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Conclusion

Navy recognizes the importance of the UNOLS academic research fleet renewal and notes significant progress has been made in the last three years toward defining the Ocean and Regional classes as elements of that renewal. Navy has found its participation in the UNOLS partnership to be valuable as shown by the NRAC study. Navy intends to support UNOLS fleet renewal by constructing new monohull Ocean Class vessels. Further, Navy understands Congressional desires to support the recapitalization of the UNOLS research vessels from SCN. However, Navy has a strict prioritization for the SCN account and this science and technology infrastructure has not reached the minimum priority allowable for inclusion. Navy will instead, propose building Ocean Class vessels at a reduced level commensurate with Navy overall usage of the fleet. Navy will plan to acquire two Ocean Class research ships by 2017 under an acquisition strategy using incremental S&T funding within RDT&E (Table 1). Concept refinement and design studies would be conducted in FY08 using PE 0603564N as directed in H.R. 1815. Construction of the lead ship will begin in FY09 with delivery in FY12. The second ship would be delivered in FY15.

Year (FY)	Funding	Source
2008	$7M	RDT&E PE 0603564N
2009	$35M	S&T
2010	$35M	S&T
2011	$30M	S&T
2012	$35M	S&T
2013	$35M	S&T
2014	$30M	S&T

Table 1
Potential outyear planning budget for two Ocean Class ships (first delivered in 2012 and second delivered in 2015). Ship incremental costs reflect maximum rough order of magnitude estimates, and are expected to be refined during the design phase.

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CONFERENCE REPORT ON H.R. 1815, NATIONAL DEFENSE AUTHORIZATION ACT FOR FISCAL YEAR 2006 -- (House of Representatives - December 18, 2005)

"Renewal of University National Oceanographic Laboratory System fleet

"The House bill contained a provision (sec. 226) that would require the Secretary of the Navy to develop a plan for a program to construct ships for the University National Oceanographic Laboratory System (UNOLS) fleet.

"The Senate amendment contained no similar provision.

"The House recedes.

"The conferees are concerned with the Navy's plans to fund the construction of academic research vessels in the basic research account in fiscal year 2007. While the Ocean-class research vessel provides the Navy with a robust understanding of its battlespace, diversion of fundamental science funds to design and construct such ships would adversely affect the goals of the innovative research account and is an inappropriate use for scarce Navy basic research funds. The conferees direct the Navy to fund design work for future ships in PE 63564N, the Ship Preliminary Design and Feasibility Studies program.

"Released with the fiscal year 2006 budget request, the fiscal year 2007 budget projection included $25.0 million for UNOLS ship construction. The conferees direct the Navy to request ship construction funds in the Shipbuilding and Conversion, Navy (SCN) account. The committee expects that the Navy will continue to use the SCN account to provide for the recapitalization of Ocean-class research vessels in the future-years defense program.

"Finally, the conferees direct the Navy to update its plan for renewal of the UNOLS fleet to reflect current fiscal realities, schedules, missions, and research priorities. The updated plan should be submitted to the congressional defense committees no later than 6 months after the date of enactment of this Act."

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