

Office of Naval Research Award N00014-02-1-0757

R/V KILO MOANA SHIP OPERATIONS AND TECHNICAL SUPPORT SERVICES

Brian Taylor, PI

University of Hawaii

Final Technical Report

September 8, 2010

**Summary**

Award N00014-02-1-0757 supported the initial operation of Research Vessel (RV) Kilo Moana, a Navy-owned research vessel operated by University of Hawaii under Charter Party agreement with ONR. RV Kilo Moana was built and outfitted for research with an award from ONR (N00014-98-1-0629) to University of Hawaii, and the current award followed for initial operations. Kilo Moana operates as part of the University-National Oceanographic Laboratory System (UNOLS) fleet, with time available to academic researchers funded by NSF, ONR, NOAA and other federal and state agencies. The funds received by UH under this award totaled \$4,862,438, and included an initial award on 05/17/02 plus 19 amendments (some no-cost), the final of which was received 10/09/08. In addition to funds to operate the Kilo Moana and to support shipboard technical personnel, funds were also provided under this award for RV Kilo Moana upgrades and maintenance, and a small amount of support was provided for use of other University-owned/operated research vessels (R/V Ka'Imikai-O-Kanaloa and R/V Klaus Wyrcki). A summary of individual award, amounts, dates and purpose follows. The award expired on 06/30/10, following no-cost extensions to finalize all contracted efforts and payments. A separate award for continued RV Kilo Moana operations began with the 2009 operating year (N00014-09-1-0530, Alexander Shor, PI).

**Award Synopsis**

***Initial award***, Ship Operations: 05/17/02, \$374,000

Operation of Kilo Moana for ONR-sponsored research.

***P00001***, ONR Administration: 08/23/02, \$7,575  
Conference and student travel support.

***P00002***, No-Cost Modification (corrected PI)

***P00003***, ONR Administration: 10/28/02, \$7,623  
Conference and student travel support.

***P00004***, Ship Operations: 09/03/03, \$259,754  
Operation of Kilo Moana for ONR-sponsored research.

***P00005***, No-Cost Modification (added government property)

***P00006***, Ship Operations: 12/02/04, \$222,000  
Operation of R/V Ka'Imikai-O-Kanaloa (UH-owned research vessel) for ONR-sponsored research.

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**REPORT DOCUMENTATION PAGE**

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**P00007**, Ship Operations: 03/16/05, \$76,860  
Operation of Kilo Moana for ONR-sponsored research.

**P00008**, Ship Operations: 03/23/05, \$450,000  
Operation of Kilo Moana for ONR-sponsored research.

**P00009**, Ship Operations: 07/17/06, \$255,906  
Operation of Kilo Moana for ONR-sponsored research.

**P00010**, ONR Administration: \$15,734  
Conference and student travel support.

**P00011**, Ship Upgrades and Maintenance: 12/01/06, \$1,000,000  
Upgrade of vessel capabilities, including acquisition and installation of new CTD-handling system (integrated winch/crane), plus upgrade of command/control system, evaluation of power management system and replacement of weather doors.

**P00012**, No-Cost Modification

**P00013**, No-Cost Modification

**P00014**, Ship Operations: 09/12/07, \$587,920  
Operation of R/V Ka'Imikai-O-Kanaloa (UH-owned research vessel) for ONR-sponsored research.

**P00015**, Ship Operations, \$1,341,600

Operation of Kilo Moana and R/V Ka'Imikai-O-Kanaloa (UH-owned research vessel) for ONR-sponsored research.

**P00016**, Ship Operations: 05/13/08, \$10,000  
Operation of R/V Klaus Wyrtki (UH-owned research boat) for ONR-sponsored research.

**P00017**, Ship Operations: 09/05/08, \$15,000  
Operation of R/V Klaus Wyrtki (UH-owned research boat) for ONR-sponsored research.

**P00018**, Ship Operations: 09/10/08, \$99,000  
Funds to overhaul Kilo Moana's #4 Main Engine.

**P00019**, Ship Operations: 10/09/08, \$139,466  
For a study of the Kilo Moana's computer automation system and its integrated operation with the power management and dynamic positioning systems on the vessel. The purpose of the study is to review problems we have had with the system since before the ship was completed six years ago, provide recommended solutions for those problems, and prepare a plan for such replacement.

**Total award: \$4,862,438.**

## Discussion

Award N00014-02-1-0757 provided operational support for ONR-funded projects on R/V Kilo Moana for six years (CY2003-2008). It was the initial award for such support following construction. Operating as a UNOLS vessel, schedules are established annually through the UNOLS Ship Scheduling Committee (SSC) in consultation with NSF and ONR program managers. Because of this, the precise mix of work for individual funding agencies varies from one year to the next on each of the 20+ ships in the fleet in an effort to meet specific project requirements and to efficiently schedule transits and meet cruise logistical or regulatory requirements. Rates for use of UNOLS vessels are proposed by the operating institutions, following which they are reviewed by federal agency representatives, led by the Ship Operations Program in the Division of Ocean Sciences at the National Science Foundation. Provisional rates are approved and charged to agencies or researchers by the operators at the beginning of each calendar year, and any adjustment of rates related to significant deviations in cost are adjusted at year

end, all under auditory authority of NSF. Rates charged to federal agencies for use of the vessel in any calendar year are the same, and no lower rate is charged any other user, including the State of Hawaii. Separate rates are charged for vessel operations ("ship day rate") and shipboard technical support ("tech day rate"). Both rates are required for every vessel operating day, which is defined by UNOLS (includes all days at sea in operations or transit mode, plus port days away from home port).

Over the six years covered by the present award, Kilo Moana's ONR-funded usage varied from zero to 38 days annually. Total Navy-funded operating days were 17 of 251 in 2003, 0 of 309 in 2004, 17 of 236 in 2005, 15 of 203 in 2006, 0 of 266 in 2007, and 38 of 248 in 2008, a total of 87 operating days in six years out of 1513 total operating days. Most days were supported by the National Science Foundation, with State of Hawaii using the second-most time, much of which was part of the cost-match support to which the University is committed through our Charter Party agreement with ONR.

In addition to the use of Kilo Moana, two of our other vessels were operated on behalf of Navy projects with ONR support from this grant. Our research vessel Ka'imikai-O-Kanaloa was used to support the ARGENT-4 program in 2007 for 24 operating days, and our small boat, R/V Klaus Wyrтки, was used for 145 hours during March and June 2008 to support Navy research projects near Oahu. Rates for both vessels are set by University of Hawaii and reviewed by cognizant federal agencies; procedures for establishing, charging and reviewing KOK rates are similar to those for UNOLS vessels. Wyrтки rates are based on hours of use, and include costs for the captain, fuel and dockage fees.

In addition to operational support under the current award, we also received funds to address some issues related to vessel design and construction. One problem, unique to the SWATH hull, is the combination of a high deck and restrictions on weight distribution that complicates deploying instruments over the side of the vessel. The original design for CTD and related instrument deployment included separate winch and crane systems working in tandem, but it provided poor visibility for the winch operator, thus necessitating up to five persons in a standard CTD deployment, a process that takes only two individuals on most research vessels. We had a number of complaints about this design beginning the first year of operations. The solution supported by ONR to UH involved development and installation of an articulated crane integrated with a winch and smart control system. A smaller version was also funded separately for deployment on University of Delaware's new vessel R/V Sharp. The UH system was supported as part of a supplemental award for upgrade and maintenance in 2005, and it was designed by Caley Ocean Systems, Ltd, a British company. The design and construction, however, was delayed by a variety of problems, chiefly weight concerns and regulatory issues. Delayed delivery under the present award was the primary reason that the grant duration was extended to 2010, since the system was ultimately installed on the ship during a shipyard period in Portland, Oregon, beginning in December 2009. Though we continue to evaluate and modify the system, it is now accepted and on the vessel, and we no longer rely on the former winch/crane combination, which have been removed and disposed (with ONR approval).

The other principal item supported under this grant that relates to upgrade of Kilo Moana is a study of the Kilo Moana's control system. The control system study addresses an important concern regarding the vessel design, specifically that it relies on proprietary software and now-outdated computer

operating system and hardware, increasing reliability concerns as the system ages, and making UH dependent on a single small business to address certain problems with the vessel's computer control. The study prepared under this award provided a report that outlined a plan to improve the reliability and support for the system. It formed the basis of a proposal that allowed us to move forward with NSF ARRA funds to address ventilation problems in some parts of the vessel that were reducing reliability of some electronics. It also provides an outline for future replacement of the existing control system with a commercially-available package that would eliminate reliance on a single vendor. The report from this project was submitted to ONR Code 321RF (Robert Schnoor, PD), and we will move forward with upgrades based on discussions with the Program Director regarding priorities and availability of funds.

Finally, support was provided in the grant for several maintenance items, specifically including the replacement of several weather doors and an engine overhaul, and with some funds reprogrammed (with specific prior permission) for shipyard costs associated with installation of the new Caley load handling system and other efforts during the December 2009 – January 2010 shipyard period.