

REGIONAL CLASS RESEARCH VESSELS

\$105,000,000

The FY 2018 Request for the Regional Class Research Vessel (RCRV) project is \$105.0 million. This represents the second year in a three-year funding profile, with an estimated total project cost of \$255.50 million.

**Appropriated and Requested MREFC Funds for the
Regional Class Research Vessel Project¹**
(Dollars in Millions)

	FY 2017	FY 2018	FY 2019	Total
FY 2016 Actual	Estimate	Request	Estimate	Project Cost
-	\$106.00	\$105.00	\$44.50	\$255.50

¹ This table does not reflect final action on FY 2017 appropriations, which were enacted too late to be incorporated in this document. P.L. 115-31 provided funding for an additional RCRV which impacts funding requirements for FY 2017, FY 2019, FY 2020, and the total project cost. There is no impact on the FY 2018 Budget Request.

The RCRV project will fund construction of two ships to meet anticipated ocean science requirements for the U.S East Coast, West Coast, and Gulf of Mexico. The 2015 National Academies of Science report, *Sea Change: 2015-2025 Decadal Survey of Ocean Sciences*⁷, described eight high-priority science questions, all of which will be supported by RCRV in U.S. coastal waters:

1. What are the rates, mechanisms, impacts, and geographic variability of sea level change?
2. How are the coastal and estuarine ocean and their ecosystems influenced by the global hydrologic cycle, land use, and upwelling from the deep ocean?
3. How have ocean biogeochemical and physical processes contributed to today’s climate and its variability, and how will this system change over the next century?
4. What is the role of biodiversity in the resilience of marine ecosystems and how will it be affected by natural and anthropogenic changes?
5. How different will marine food webs be at mid-century? In the next 100 years?
6. What are the processes that control the formation and evolution of ocean basins?
7. How can risk be better characterized and the ability to forecast geohazards like mega-earthquakes, tsunamis, undersea landslides, and volcanic eruptions be improved?
8. What is the geophysical, chemical, and biological character of the seafloor environment and how does it affect global elemental cycles and understanding of the origin and evolution of life?

Baseline History

The RCRV project is a major component in the plan for modernizing the U.S. Academic Research Fleet (ARF).⁸ In 2001, a report from the Federal Oceanographic Facilities Committee documented the need for up to three Regional Class vessels. In 2004, NSF and the Naval Sea Systems Command (NAVSEA) entered into an interagency agreement that resulted in two candidate designs for Regional Class ships. In 2007, the Federal Oceanographic Fleet Status Report identified the need for up to three NSF-built Regional Class vessels to meet future science demand. In 2009, another National Academies of Science report, *Science at Sea*, described the desirable characteristics of a modern Regional Class vessel. These characteristics and other science community factors were considered by the review panel when the preferred NAVSEA design was later down-selected. In 2012, NSF issued a solicitation for the refreshed design and potential

⁷ The National Academies of Science. *Sea Change: 2015-2025 Decadal Survey of Ocean Sciences*, 2015. www.nap.edu/read/21655/chapter/1

⁸ National Ocean Council. *Federal Oceanographic Fleet Status Report*, 2013. https://obamawhitehouse.archives.gov/sites/default/files/federal_oceanographic_fleet_status_report.pdf

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construction of RCRVs. Oregon State University (OSU) was selected and received the award in 2013. Input from external review panels, the University-National Oceanographic Laboratory System (UNOLS), and the NAS *Sea Change* report were received during the period 2013 to 2015 which informed the final decision to pursue construction of two RCRVs. In 2015 the National Science Board authorized inclusion of funds to initiate construction of two RCRVs in future budget requests at the NSF Director’s discretion. The Final Design Review was conducted in December 2016 and the panel recommended to NSF that the project be advanced to the construction stage.

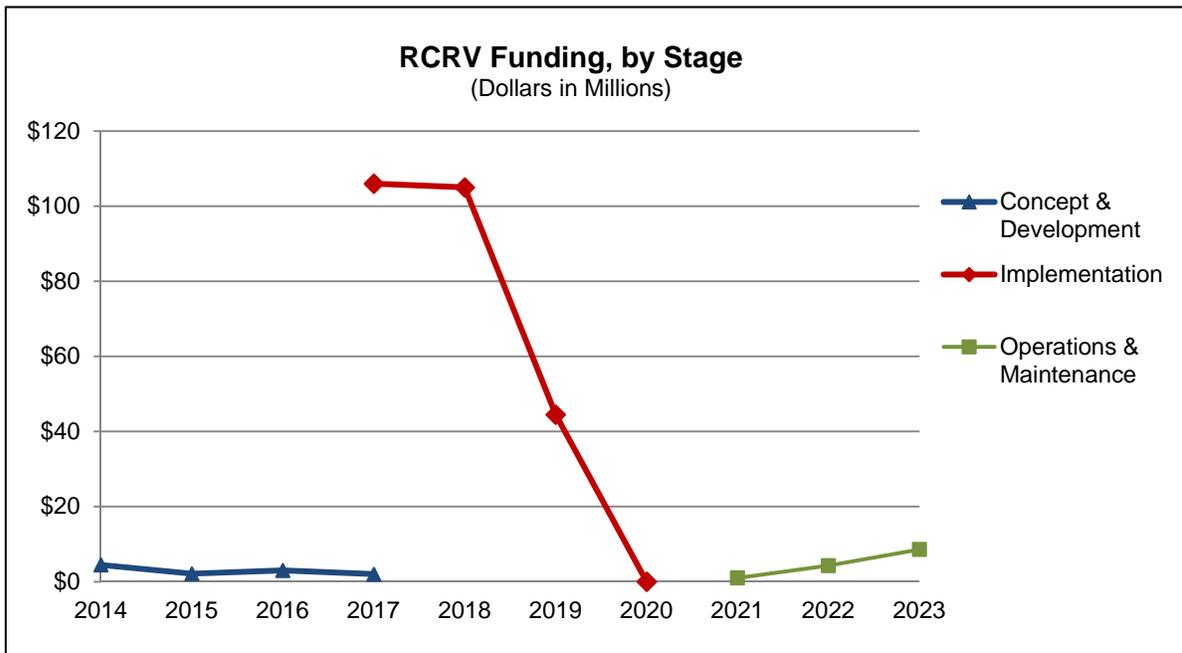
Total Funding Requirements for RCRV¹

(Dollars in Millions)

	Prior Years ²	FY 2016 Actual	FY 2017 Estimate	FY 2018 Request	ESTIMATES				
					FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
R&RA:									
Concept & Development	\$6.62	\$3.09	\$2.00	-	-	-	-	-	-
Operations & Maintenance	-	-	-	-	-	-	1.00	4.30	8.60
Subtotal, R&RA	\$6.62	\$3.09	\$2.00	-	-	-	\$1.00	\$4.30	\$8.60
MREFC:									
Implementation	-	-	106.00	105.00	44.50	-	-	-	-
Subtotal, MREFC	-	-	\$106.00	\$105.00	\$44.50	-	-	-	-
TOTAL REQUIREMENTS	\$6.62	\$3.09	\$108.00	\$105.00	\$44.50	-	\$1.00	\$4.30	\$8.60

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² Concept & Development funding and Implementation funding are cumulative of all prior years.



Management and Oversight

- **NSF Structure:** The RCRV project is overseen by the Division of Ocean Sciences (OCE) as part of the Ship Acquisition and Upgrade Program. OCE provides overall interdisciplinary science community guidance and oversight, while the administrative location of the RCRV project in the Integrative Programs Section promotes science facilities support expertise and coordination. Within NSF, RCRV project oversight is managed by a dedicated program officer with support from a secondary program officer who has experience with other OCE facilities. Cross-foundation coordination is provided by an integrated project team (IPT). The IPT includes staff from the Office of Budget, Finance, and Award Management (BFA), the Large Facility Office (BFA/LFO), the Division of Acquisition and Cooperative Support (BFA/DACS), the Division of Institution and Award Support (BFA/DIAS), the Office of the Director (OD), the Office of the General Council (OGC), the Office of the Assistant Director for Geosciences (OAD/GEO), and the Office of Legislative and Public Affairs (OLPA).
- **External Structure:** The RCRV project is funded through a cooperative agreement with Oregon State University (OSU) to manage the design refresh (Conceptual, Preliminary, and Final Designs), construction, testing and trials, and eventual operation of the first RCRV for the scientific community. The principal investigator (PI) for the award is the project manager (PM), who reports directly to the OSU Dean of the College of Earth, Ocean and Atmospheric Sciences. The PM interacts directly with NSF and manages the RCRV administrative staff. The project scientist (PS) is a co-Principal Investigator (PI) on the award. The PM manages the core RCRV team including the risk manager, earned value management and schedule specialist, contracting officer, and OSU shipyard representative (SR). The SR in turn manages the naval architect and engineering contract and oversees the OSU shipyard staff, and marine science technical advisors. The RCRV Science Oversight Committee (SOC) with regional representation, multidisciplinary expertise, and independent science representatives conducting research in mission areas supported by stakeholder federal agencies (e.g., NSF, Office of Naval Research (ONR), and the National Oceanic and Atmospheric Administration (NOAA)) will be active through all project phases. The SOC provides guidance to the OSU RCRV project team through the PM and/or the NSF program officer.

Reviews

- **Proposal Review:** In 2012, NSF issued Solicitation 12-558, Construction of Regional Class Research Vessels, to select a lead institution for construction of up to three RCRVs, with the option to operate one of the ships. An NSF external review panel was convened to evaluate three proposals, and Oregon State University (OSU) was selected.
- **Interim Design Review (IDR):** Although an Interim Design Review (IDR) was not required by NSF, OSU hosted an IDR on July 23-25, 2013, in Corvallis, OR. NSF program staff assessed the OSU project team performance and concluded the IDR followed closely the NSF requirements, and used the R/V *Sikuliaq* example, as appropriate, to craft the RCRV Project Execution Plan (PEP). Both the design and the PEP were well-developed at this pre-Conceptual Design Review phase; particularly the organizational structure, work breakdown structure (WBS), risk management, and configuration and contingency management.
- **Conceptual Design Review (CDR):** CDR was conducted December 3-5, 2013, at NSF Headquarters in Arlington, VA. The NSF program staff concurred with the panel's conclusion that the Project Execution Plan and Technical Design Package met, and in some cases exceeded, the requirements of the Conceptual Design Phase.
- **Preliminary Design Review (PDR):** PDR was conducted August 5-7, 2014, at NSF Headquarters. The panel found that the Project Execution Plan and the technical design package were both well-developed for the PDR phase and recommended that the project proceed to the Final Design Phase.
- **Post-PDR Reconciliation:** Following PDR, in response to the panel recommendations and NSF program staff direction, OSU incorporated modifications to the design and revised their estimated program costs and schedule accordingly. The NSB was presented with the post-PDR Project baseline as the basis for

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their authorization to request funding for two RCRVs in future budget requests.

- Acquisition Strategy Review: A review of all aspects of the shipyard selection process was held in February 2016, at NSF. NSF directed OSU to make minor revisions to the Request for Proposals (RFP) based on the review.
- Interim Design Review (IDR): A second IDR was held in May 2016. Although not required, the value of the previous IDR for improvement to the technical package and the Project Execution Plan was sufficient that another IDR to prepare for FDR was warranted. The review was hosted by the RCRV Project Team in Corvallis, OR, and attended by NSF program staff as well as the RCRV SOC. The SOC provided minor technical improvements to the RCRV, which were incorporated into the RFP package.
- Final Design Review (FDR): The FDR was held in December 2016 to ensure that anticipated project costs remained realistic and that no unforeseen events had arisen prior to the start of construction during FY 2017. Several members of the PDR panel also participated in the FDR. Like CDR and PDR, FDR was conducted in compliance with NSF's Large Facilities Manual. The FDR Panel recommended to NSF that the project be advanced to the Construction Stage.

Project Status

As stated above, OSU was selected as the lead institution. A cooperative agreement (CA) was awarded to encompass the entire project, including tests and trials. The project was divided into four distinct phases; each to be funded through separate cooperative support agreements (CSA), with award of each phase contingent upon successful completion of the prior phase. These phases are:

- Phase I: Project Refresh (Years one to three)
- Phase II: Shipyard Selection (Year four)
- Phase III: Construction (Years five to nine)
- Phase IV: Transition to Operations (Years eight to ten)

The project will complete Phase II in CY 2017, during which bids for construction of RCRVs are being solicited and evaluated from U.S. shipyards. Total funding to OSU for RCRV through FY 2017 is expected to be \$11.39 million in R&RA funds and \$106.0 million in MREFC funds.

Cost and Schedule

The projected length of the project is 10 fiscal years, including a six-month schedule contingency. Funding for the construction of two ships over three fiscal years would support a shipyard contract structure that stipulates an initial ship, plus the option for a second ship. This approach preserves funding flexibility while maximizing shipyard efficiency by potentially having both ships under construction concurrently, but at different stages.

One significant enhancement to the management of contingency is holding a portion of budget contingency (up to 100 percent) and only allocating to the program, for obligation to the project, based on demonstrated need. This oversight mechanism will generally result in some MREFC carry over each year, however, future obligation is anticipated to manage project risks.

Risks

Bid Risk: OSU provided a bottom-up cost estimate for two vessel construction using various escalation rates. No additional "buffers" or "reserve" are added to the bottom-up estimates. Hull construction uncertainty is addressed by the risk register, and associated contingency per NSF policy on contingency estimating and use. There is a risk that shipyards may respond to the RFP with bids that exceed the estimation. The base estimates from OSU were validated by expert panel review as well as through comparison with an independent cost estimate commissioned by NSF.

Technical: The desired low ship self-noise levels may not be initially achieved. Contingency funds are included if a secondary noise mitigation strategy is required to meet the ship specifications. Sonar sensors, science load handling systems, and other vessel sub-systems may also not perform as required. Contingency funds are included to ensure performance capabilities are met, given that many warranties are not likely to be performance-based or be otherwise limited contractually with the shipyard. The ship may be unable to meet the low exhaust gas emissions requirements for the budgeted amount, in which case contingency funds are included to meet emergent regulatory requirements on stack emissions. A selected shipyard may fail during the construction phase, in which case contingency is included to facilitate transfer to another shipyard. A science prioritized, time-phased de-scoping plan is in place (per NSF policy) to minimize the impact to science capabilities in the case contingency funds are insufficient to cover realized risks.

Future Operations Costs

Annual ship operations costs are well understood after several decades of experience with vessels of all types in the U.S. Academic Research Fleet (ARF). OSU understands how to estimate future costs given their experience operating vessels similar to RCRV, such as R/V *Wecoma* and R/V *Oceanus*. OSU included an estimate for the first year of operations beginning in 2021 using reasonable assumptions for escalations through 2020. They also assumed a robust but reasonable operating schedule of 200 days per year. OSU estimates RCRV will cost \$6.10 million to operate in its first year, resulting in a rate of \$30,441 per day, including technician support. This is comparable to the operation of current similar vessels after applying the appropriate cost escalation factors. NSF supports approximately 70 percent of the utilization of the U.S. Academic Research Fleet, which suggests RCRV is likely to cost NSF approximately \$4.30 million in FY 2022, which is the first year the lead ship transitions into full operations in the ARF. NSF intends to issue a solicitation for an operator of the second RCRV after construction funds are appropriated and will make an award after a competition is held. The second ship would transition to full operations in the ARF in FY 2023.



Artist's rendition of the RCRV as constructed. *Credit: The Glosten Associates Inc.*

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