Regional Class Research Vessels

Innovations in Research Vessel Design

RCRV Project Update
November 18, 2014
INMARTECH
Global Class Ships
- Marcus G. Langseth
- Sikuliaq

Ocean/Intermediate Class Ships
- Kilo Moana
- Neil Armstrong
- Sally Ride

Regional Class Ships
- RCRV2
- RCRV1
- RCRV3

Fleet Renewal is part of long-term UNOLS community planning.
New Portraits in the UNOLS Fleet

R/V Sikuliaq

Global Class

R/V Neil Armstrong

Ocean Class

RCRVs will facilitate **coastal research and education**, serving many stakeholders. Design and project management benefiting from lessons these builds.
RCRV Project Status and Timeline

- 4 phase, 10-yr project
  - Phase I = Design Refresh
  - Phase II = Shipyard Selection
  - Phase III = Construction
  - Phase IV = Transition to Ops

- Up-to-3 ship class acquisition
  - Leads to overlap of Phases III and IV

- Currently at start of Phase IC
- PDR approved by NSF
Top Level Design Requirements

• Twin azimuthing drives and dynamic positioning
• A retractable centerboard to support integrated acoustic systems
• Large aft deck for operational flexibility and side-by-side 20' laboratory vans
• High bandwidth satellite telecommunications
• Acoustic quietness
• Energy efficient features
• ADA referenced accessible stateroom and labs
• Endurance - 21 days
• Mission Payload 50 long tons
Other Design Drivers determined during refresh

- ABS Ice Class: C0
- ABS DP Class: DPS-1
- Voluntary Enviro Certified: Green Marine & IAPH Environmental Ship Index (air emissions and other standards)
- Sea-keeping: U-tube anti-roll system
Noteworthy RCRV Innovations (evolutions…)

• Vessel Advancements
  – Power Generation (Siemens’ Blue Drive Plus C)
  – Schottel Push Pull Z-Drive
  – Hull Design (optimized modified bulbous bow)

• Science Support Advancements
  – Stern Frame and LARS
  – Centerboard design
  – Incorporation of Deck Skidding
  – Telepresence Concept
Inboard Profile

LOA 193 ft
Beam- 41 ft
Draft- 12.5 ft
Berths- 31 (16 science complement, 2 techs, 13 crew)
General Arrangement

Main Deck

Main Lab  510 ft²
Wet Lab   350 ft²
Computer Lab  175 ft²

Main Deck (aft of house)  2,020 ft²
Main Working Deck (including side deck)  2,230 ft²
Side Deck Length  70 ft
Space on the port side for two vans (mated to superstructure)  70 ft
General Arrangement

01 Level

Telepresence Center  245 ft²
Winch Deck Area      550 ft²

Science Berths       8 Double Staterooms on O1
                     (includes accessible stateroom on Main Deck)

Marine Technician    1 Double Stateroom
Hull Form

- Modified Bulbous Bow
- Lightweight Construction Materials
- Minimized ballast and No fixed ballast
  - Increases fuel efficiency by up to 6% at cruise speed
  - Reduces weight, lowering power requirements

<table>
<thead>
<tr>
<th>Hull Coefficients</th>
<th>Value</th>
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<tr>
<td>Prismatic</td>
<td>0.622</td>
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<tr>
<td>Maximum Section</td>
<td>0.931</td>
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<tr>
<td>Block</td>
<td>0.579</td>
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<tr>
<td>Waterplane</td>
<td>0.803</td>
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</table>

Length of Waterline: 178' - 0"
Breadth, Molded: 41' - 0"
Depth, Molded: 19' - 0"
Design Draft: 12' - 6"
Propulsion System / Power Generation

Integrated diesel electric propulsion with three variable speed DC generators, water-cooled AC electric motors and azimuthing propulsors

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Total Load kW</th>
<th># Gens On-Line</th>
<th>% Gen Load</th>
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<td>Transit Summer</td>
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<td>Transit Winter</td>
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<td>Heavy DP</td>
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<td>In Port</td>
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<tr>
<td>Emergency</td>
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<td>97%</td>
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Variable Speed DC Power Generation

• Increase Fuel Efficiency
  • Variable Speed Power Generation
  • Power electronics produce 60Hz power
  • Optimal operating point
  • Increased fuel economy (g/kWh), especially at light loads
  • 5%-15% fuel savings
Sea Keeping

Located in hull frames 36 – 39. (Duct width is same as tank width)

Operability
Max Roll Displacement 3° RMS
Max Pitch Displacement 2° RMS
Max Lateral Acceleration 0.05g
Max Vertical Acceleration 0.15g
Propeller

• Using Schottel STP Twin Propeller
  – Push/Pull, ducted, single shaft
  – Lower RPM (reduces cavitation, increases efficiency)
  – Reduced individual propeller size but greater surface area (increases efficiency and bollard pull)

• 4 Propellers are individually “wake adapted” for maximum efficiency.
  – Fits well with RCRV hull form
Flow Through Sensors

- Surface Salinity
- Surface Temperature
- Light Transmission
- Dissolved Oxygen
- pH/Oxidation Reduction Potential
- Chlorophyll
- Phycoerythrin or Rhodamine
- Phycocyanin
- Colored Dissolved Organic Matter
- Turbidity- Red, Blue and Green Scattering
- Nitrate
- Total CO₂ and pCO₂
- Irradiance

*Other Research Vessels provide only ancillary data such as Temperature and Salinity, few include transmittance and chlorophyll but rarely is this data provided in real time or QC’ed.
Linking Scientists to Quality Real Time Data

Flow Through & Met Sensors

Continuous Data Collection Platform

Data Handler & Acquisition System

Quality Control

Real Time Data

Operational Input

Monitoring

Outreach

Remote Sensing

Validation
Deck Skidder Systems - For CTD
RCRV Centerboard Concept

- Centerboard provides a platform for: Evolving suites of sonars; Placing sonars below the bubble layer; Service/changeout of transducers without drydocking.

- Incorporates removable 2-foot bottom section and interchangeable face plates to accommodate a variety of current and future sonars

- Centerboard will carry compact multibeam and ADCPs
  - These require tight repeatability in roll/pitch/yaw
    OR
  - Separate, Centerboard-mounted, Position/Attitude/Time System

- RCRV will incorporate both

- Currently Under Development

One possible arrangement of sonars on Centerboard “Foot”
Discovery’s and Sikuliaq’s Centerboards
New R/V Sikuliaq Stern A-Frame Design

UNOLS “Standard Bolting Flange”

Removable / Swappable Wings

Built to UNOLS “App B” Standards (DLT=120kip)

Rotating Trunnion Style Cross Beam
Conclusions

• RCRV: Regional Class Research Vessels to meet national coastal ocean priorities within the 21st Century
• Much input from the science community has led to several innovations in the next generation RCRV science support systems.
• Close monitoring of the maritime industry has led to the incorporation of several next generation technologies used to improve efficiency and performance.