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Division of Ocean Sciences
Integrative Programs Section

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TO: Dr. Clare Reimers,
Chair, UNOLS Fleet Improvement Committee

FROM: Bauke Houtman
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C/c: Dr. Veron Asper, UNOLS Council Chair
Jon Alberts, UNOLS Office Executive Secretary

SUBJECT: RCRV Request for Input

As part of the charge to the RCRV down-select committee, NSF requested the panel to identify any potential "Future Areas of Inquiry" that NSF should investigate before moving the Glosten design forward under the new NSF phased approach. In general, these Areas of Inquiry were:

1. Total available power
2. Usable aft deck space with two vans aboard
3. Dynamic positioning capability
4. Detrimental effect on transducer performance from the bulbous bow
5. Incorporation of "Green Technologies"

A copy of the "Future Areas of Inquiry" section of the panel report is attached for the Committee's information.

NSF concurs that these items are of concern and require further evaluation to ensure the RCRV is capable of meeting future science needs. The Integrative Programs Section requests that the Fleet Improvement Committee provide NSF with recommendations on the following specific questions:

1. **Aft Deck:**
    i. With the two vans on deck, is the remaining aft deck suitable to support both current science operations through the A-frame and future science operations such as ROV and AUV deployments?
    ii. With either one van or no vans on deck, is the aft deck suitable to support coastal ocean observatory deployments and recoveries?

iii. Could the usable aft deck space be increased by shortening the deck house (i.e. moving structure forward) without compromising other important aspects of the design? Under this scenario the length overall would not increase.
iv. Alternatively, should the aft deck length be increased? Under this scenario the length overall would increase, but only aft of the deck house as with the extension of the *SIKULIAQ*. The length of the forward deck house would not change.
v. If adding to the aft deck, what is the recommended number of frames to be added (24" increments)?

2. **Z-drives and DP:** The Global AGORS are the Academic Fleet's first exposure to Z-drives. Industry use of Z-drives has greatly expanded and their designs have improved significantly since the early 1990's. The R/V *HUGH R. SHARP* is fitted with Z-drives and R/V *SIKULIAQ* will also have them installed. New science missions such as deployment of ocean observatory components and the use for ROV's will require very capable DP systems.
   i. Considering both cost (installation and maintenance) and capability, as well as the experiences of the *SHARP* over the past several years, should the use of Z-drives be re-evaluated as an "option" for the RCRV?

3. **Bow Thruster (Power, DP, and Noise):** Bow thrusters are essential for DP capability and useful for maneuvering in close quarters including docking. Historically, many vessels in the academic fleet have been fitted with bow thrusters that are underpowered and/or noisy during DP operations. The *SHARP* is fitted with a tunnel thruster while the *SIKULIAQ* will be fitted with an azimuthing, low cavitation bow thruster that has been used on the NOAA FSV's, the R/V *RON BROWN* and other *Global Class* research vessels. Like the *SIKULIAQ*, the Glosten design for RCRV calls for a 467 kW (626 HP) Tees White Gill, 360 degree azimuthing bow thruster optimized for acoustic performance (i.e. low cavitation).
   i. What has been *SHARP*'s principal use of the bow thruster? Maneuvering, docking, DP offshore?
   ii. Has the *SHARP*'s bow thruster proven effective with regard to size (HP) and performance (delivered thrust)?
   iii. How does the HP and delivered thrust on the *SHARP* compare to the proposed azimuthing bow thruster for the RCRV? Is there confidence that the proposed bow thruster on RCRV will meet operational requirements?
   iv. Has the *SHARP*'s bow thruster proven satisfactory with regard to habitability/noise during DP operations or docking?
   v. Has the proposed White Gill azimuthing thruster been effective on other vessels with regard to habitability/noise during DP operations and docking?

4. **Power:** The main propulsion system was designed to keep operating costs low and with an average cruising speed of 10 knots. However, the Panel was concerned that the total power may have been reduced to the point where the vessel's ability to operate effectively and safely in higher sea states was compromised.

    i. Without regard to operating cost, is a design cruising speed of 10 knots adequate given environmental conditions (currents, etc.) in the coastal zone? Maximum design speed of the Glosten design based on model testing is 11.8 knots in calm water.
    ii. How does predicted fuel consumption (1289 gal/day at 10 knots), speed, and available horse power (for main propulsion) compare with the *SHARP*, *CAPE HATTERAS*, and (say) *ENDEAVOR*?
    iii. Has offshore performance been acceptable for these vessels?
    iv. Based on the results, does FIC have confidence that total HP on the RCRV is adequate to ensure operability?

5. **Van Mating:** The *SHARP* has a unique design to mate vans to the ship's superstructure using top hatches and inflatable seals that can accommodate <u>any</u> van without having a specific mating surface on the van itself.
    i. Has the crew of the *SHARP* found this mating arrangement effective?
    ii. Are there any changes that the ship's crew would recommend based on several years of operation?
    iii. Would FIC endorse incorporation of this specific design into the RCRV?

6. **Bulbous Bow:** Bulbous bows have caused significant bubble sweep down problems on recent research vessel designs such as the UK's R/V *JAMES COOK*. When pitching in a seaway, the bulbous bow sheds significant bubble "clouds" which degrade sonar performance. In general, modern bulbous bows decrease required horse power from 15-25% depending on the design. Model testing for the RCRV's "optimized hull" predicts a reduction of 22% in required horse power which represents a significant decrease in the size of the propulsion motors and lowering of fuel consumption. The bulbous bow on the RCRV is integral to the hull as opposed to an appendage added to a standard bow form. Removal of the bulbous bow cannot be accomplished without completely redesigning the lines with potential negative impacts on trim and stability. Bubble sweep down is currently modeled only in calm conditions (CFD and other) where transducer performance is generally good to begin with. Accurate analysis of bubble sweep down in sea states indicative of offshore conditions is not currently available.
    i. Given the risks to transducer performance compared to potential cost savings, should the bulbous bow be eliminated?
    ii. Could the risks associated with a bulbous bow be reduced if a retractable centerboard were incorporated? (See Question 7 below)

7. **Retractable Centerboard:** The R/V *SHARP* is fitted with a bulbous bow and a retractable transducer centerboard. This vessel does not have a hull-mounted multibeam and all science transducers are currently located in the centerboard. *SIKULIAQ* will have both a centerboard and a hull-mounted multibeam along with other sonars. A bulbous bow was not considered on *SIKULIAQ* because of the ice capable hull form.
    i. For the vessel's suite of transducers, has transducer performance been acceptable to scientists using the *SHARP*?
    ii. To what extent has the crew of the *SHARP* used the centerboard's ability to change out transducers while alongside? Has the concept worked well operationally?

iii. Based on the concerns with the bulbous bow above, should a retractable centerboard be reconsidered for the RCRV? If so, for which acquisition systems? FIC should keep in mind that there will be impacts on internal space and arrangement.
iv. Given the vessel's potential operating area, should the list of hull-mounted sonar systems be revisited for the RCRV? If so, what adjustments to the sonar suite are recommended?

8. **Underwater Radiated Noise (URN) Criteria:** URN treatments and vibration damping can add significantly to the initial vessel cost depending on the standard being used. However, the secondary advantages with regard to habitability, improved working conditions, and transducer performance are well known. ICES 209 was developed specifically for fisheries vessels, but several potential standards for general-purpose research vessels have emerged in recent years, including the *SIKULIAQ*, the *Ocean Class* AGOR's, and the UK's *DISCOVERY* Replacement. Discussion papers and a comparative URN curve for these projects are attached.
   i. Have the maintenance costs or other operational issues for the URN treatments aboard *SHARP* been significant or problematic in any way?
   ii. Should the project continue to strive to meet ICES at a reduced speed similar to the *SHARP*?
   iii. Do the recent URN trials for the *SHARP* (attached) support the idea that a different standard than ICES is more achievable and appropriate, such as the limits being used for the ARRV?
   iv. Alternatively, would FIC endorse the use of the URN limits currently being used for the *Ocean Class* AGOR's or the *DISCOVERY* Replacement?

9. **Incinerator:** There is no regulatory requirement for vessels to have an incinerator under MARPOL. Having an incinerator is an operational choice in lieu of storing waste aboard followed by proper disposal ashore.
   i. Given the trend in "green" vessel design and emerging coastal state clean air regulations, should a vessel operated primarily in the coastal zone be fitted with an incinerator?
   ii. Should the alternate provisions for handling waste be considered during the Phase I Project Refresh?
   iii. Would FIC prefer space currently used for the incinerator be used for other ship or science purposes? If so, what?

10. **CTD Operations:** The current Glosten design for RCRV has CTD operations conducted over the starboard side between frames 22-25.
   i. Does FIC endorse the ability to route the CTD cable over the stern A-frame?
   ii. If so, if it were feasible and cost effective, should the stern A-frame be capable of the same "hands-free" deployment and recovery capability for science packages as the side handling device?
   iii. Similarly, should the main deck crane be capable of the same "hands-free" deployment and recovery capability when using portable deck winches and/or the ship's fixed winches? This capability is under consideration for *SIKULIAQ*'s main deck cranes.

iv. What specific improvements from the *SHARP* and *KILO MOANA* systems should be incorporated into *the Load Handling System (LHS) Functional Requirements* (and the resulting construction specifications) for over-the-side handling systems with similar hands-free capabilities? For example, are the docking head designs and materials acceptable to all science users?

11. **Incubators:** Incubator space is problematic (and controversial) in every research vessel design.
    i. Should dedicated incubator space be eliminated and the vessel operator allowed todeal with it on an as-needed basis?
    ii. How would this space be better utilized for other science purposes?
    iii. How does the *SHARP* deal with incubators and incubator plumbing? Is this an acceptable model?

12. **Berthing:** The Panel felt that the acceptable berthing arrangements were unclear in the design documentation.
    i. Given the size of the vessel, is it acceptable to have the lounge also used as the ADA stateroom?
    ii. Should the lounge be used to expand general berthing capability? If so, how many bunks should it have?
    iii. Has the convertible lounge concept on *SHARP* been acceptable to both science and the operator?
    iv. If the vans are properly mated to the house, USCG inspected, and fitted with their own heads/showers, is the use of a berthing van acceptable to science?

    FIC should consider elimination of the hospital described below.

13. **Scientific Storage Space:** The Panel had concerns about the available science storage space, both temperature controlled and uncontrolled.
    i. Given the size of the vessel and its projected operating area, is the available built-in science storage space reasonable and adequate?
    ii. Assuming no allowable increase in the size of the deck house but with potential increases in aft deck space, is there any existing space that should be re-allocated to science storage? If so, what space?
    iii. If the aft deck space is increased such that there was still usable space with two vans on deck, would portable vans meet the requirements for science storage (both temperature controlled and uncontrolled)?

NSF would greatly appreciate the FIC reviewing these areas and providing us with inputs. Your recommendations will be taken under consideration, and where appropriate, will be incorporated as requirements in the RCRV Phase I Project Refresh solicitation documents.

NSF intends to have the academic institution selected to design, construct and operate the RCRV take the following actions on the other Areas of Inquiry raised by the Panel:

1. Eliminate the hospital and convert it to a usable science berth. This requirement pertains to inspected vessels and, given the operating area and significant impact on usable science space, is not considered necessary for the RCRV.

2. Require the institution to include the effect of deck equipment and science handling systems in URN and airborne noise estimates.
3. Require the institution to fully evaluate all available and emergent "green ship" technologies currently available.
4. Evaluate the access between the computer lab and the aft deck.
5. Better define and specify the science handling system requirements based on developments aboard the *SHARP, KILO MOANA, SIKULIAQ*, and *Ocean Class* vessels. NSF will require that a Load Handling System Integrator be employed similar to the *SIKULIAQ* Project.
6. Better define and specify the science electronic and acquisition system requirements, including meteorological sensors and scientific communication systems.
7. Eliminate the "D0" ice strengthening requirement.
8. Require a more rigorous model testing program that incorporates realistic sea states, wave action, vessel motions, lateral stability and trackline keeping; particularly if Z-drives are considered as an option.
9. Evaluate incorporation of DP-2 requirements in lieu of the DP-1 requirements currently specified.

NSF considers the RCRV Statement of Requirements (SOR) developed under the NAVSEA process to be a historical document. NSF does not intend to request the UNOLS community revisit the SOR since the Glosten design will be the foundation for the Phase I Project Refresh. Only the appropriate FIC recommendations, the Glosten drawing package, the draft specifications, and certain other deliverables developed under the initial NAVEA process will be moved forward as the basis for the solicitation for "*Design, Construction, and Operation of the RCRV*." It will be the responsibility of the selected institution to refine the design as part of the new Phase I, Project Refresh. To ensure UNOLS Community input in the new process, NSF intends to require the institution to establish a Science Oversight Committee for the entire project, similar to the ARRV Oversight Committee supporting the R/V *SIKULIAQ*.

NSF is closely monitoring development of the NAVSEA *Ocean Class* Project to ensure the RCRV moves forward in concert with overall Fleet composition requirements, as well as federal agency budget constraints.

NSF greatly appreciates the continued involvement of the UNOLS community in the RCRV Project and requests FIC provide responses to the specific questions listed above by October 1, 2010.

Enclosures:

RCRV Down-Select Panel Report; "Future Areas of Inquiry" Section
Glosten/Nichols RCRV Executive Summary
Glosten RCRV General Arrangements
Draft Specification Sections (Abbreviated)
NCE Noise Report (Abbreviated)
Model Testing Report (Abbreviated)

Underwater Radiated Noise Limits:

1. R/V *SIKULIAQ White Paper to the AOC – August 2009*
2. *DISCOVERY* Replacement
3. URN Comparison Curves

R/V *SHARP* URN Report, October 2009