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From: University-National Oceanographic Laboratory System (UNOLS)
To: Commandant (CG-751), U.S. Coast Guard
Copy: National Science Foundation (Office of Polar Programs)
Office of Naval Research (Code 32)
Arctic Research Commission

The University National Oceanographic Laboratory System (UNOLS) chartered the Arctic Marine Research Capabilities Committee (AMRCC) in June 2024 with support from the National Science Foundation, the Office of Naval Research, and the Arctic Research Commission. The AMRCC's purpose is to review and refresh anticipated science missions and affiliated science mission requirements for future Federal icebreakers operating in the Arctic Ocean and other northern polar regions, including any commercially available icebreaker acquired by the Federal government and future "medium" or "heavy" federally flagged and owned icebreakers.

The AMRCC is composed of experienced Arctic scientists that represent the range of different oceanographic science disciplines, different career stages of working in Arctic science (i.e., senior, mid-level, and early career), marine technician / science support, and USCG operational experience. All members of the Committee are very familiar with Arctic science operations successfully supported by USCGC *Healy*.

The Committee is working on a final report with recommendations for scientific capabilities that would be ideally designed for implementation in the enlarged USCG icebreaker fleet. However, the Committee recognizes that the USCG is more immediately preparing to commission USCGC *Storis* in August and is identifying the modifications required to prepare the ship to be fully in service as a USCG cutter. In the legislation authorizing the purchase of the ship, it was stipulated that any icebreaker acquired or procured have scientific research capabilities comparable to those of USCGC *Healy*. This is consistent with the Coast Guard's seven statutory duties (14 USC 102) that include the responsibility to "engage in oceanographic research of the high seas and in waters subject to the jurisdiction of the United States." The AMRCC has identified core enabling capabilities (Table 1) that they recommend the USCG consider as they prepare *Storis* for cutter service.

The identified capabilities are grouped into categories based on function or category and are: Highest Priority Infrastructure, Overboard Handling, Meteorological and Underway Observing, Laboratory and Staging, and Science Network and Data. Each grouping includes two or more specific capabilities. Those that can be accommodated using modular or portable assets are identified. The scope of modifications anticipated to achieve each capability and the type of science research that would be enabled also are noted. It is worth noting that the AMRCC recognizes that while its members are experienced ship-based scientists and technicians, they are not marine architects or engineers and cannot definitively identify the scope of any specific desired modification. The supporting systems required for each enabling capability also have been identified to the best of our ability. The integration of these science

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capabilities and how they contribute to US national interests, including national security needs across the whole Coast Guard icebreaker fleet will be further elaborated in the upcoming Committee report.

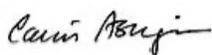
In these interim recommendations specific to USCGC *Storis*, the AMRCC has identified capabilities that are most important to implement early to be able to conduct science from the ship in the near future. Included with the identified capabilities are the Committee's recommendation on short-term to long-term phasing of each capability. Many of the short-term phasing capabilities require only minor modifications and can be accomplished using modular equipment. Note that the phasing identified here is not an evaluation of the value of the different types of science measurements but rather a recognition that some capabilities can more easily be achieved because they require only minor changes or because they can be modular.

Two substantial high-priority infrastructure recommendations are for hull-mounted transducers and for berthing and hotel services for scientists/science technicians. Any work to install hull-mounted transducers would require a dry-docking period as well as hull modifications. Whether hull-mounted acoustic instrumentation will be able to collect high-quality data from *Storis* is unknown, given the ship's hull configuration and the likelihood of bubble generation that interferes with such instrumentation. This instrumentation is highly desired, however, both by the USCG and the science community and the AMRCC recommends that the USCG research the feasibility of a successful installation.

Support of some science capabilities may require substantial modifications to the ship infrastructure, such as plumbing for ambient seawater, cable runs for hull-mounted acoustic sensors, and deck strength to accommodate over-boarding equipment or science vans, that will require vessel stability, deck strength, weight, space, and volume analyses. For example, the Committee recommends that *Storis* carry hull-mounted sensors such as a multibeam echosounder for bathymetric mapping. Identifying and constructing the cable runs for such sensors might most efficiently be accomplished during other, cutter-readiness ship modifications and could save time and expense later. Likewise, the piping for a science seawater system could be installed alongside other, non-science modifications. Other recommendations require specific adjustments that might not coincide with other non-science modifications. All over-boarding capabilities require lower rails than presently exist on the ship, particularly on the stern where a science A-frame for deploying instrumentation could be installed. Installation of a meteorological mast on the bow may be impractical because of the current flight deck configuration.

The AMRCC hopes that these recommendations are useful and stands ready to answer any questions elaborating on them. Please contact the AMRCC Chair Carin Ashjian (cashjian@whoi.edu) or the UNOLS Executive Secretary, Doug Russell (doug@unols.org) to start the conversation.

Best regards,



Carin Ashjian, Ph.D.
Chair, AMRCC



Bruce Appelgate, Ph.D.
UNOLS Chair

Encl: Table 1 – AMRCC Science Mission Capabilities Recommendations for USCGC *Storis*

Table 1 - AMRCC Science Mission Capabilities Recommendations for USCGC Storis

| | Enabling Capability | Modification | | | Supporting Systems | National Security Needs | Science Enabled |
|--|--|--------------|----------------------------------|-----------------------|--|-------------------------|-----------------|
| | | Phasing | Scope | Portability | | | |
| Highest Priority Infrastructure | Hull Mounted Transducers | Short | Extensive | No | Conduits for cables and space above water line for transceivers, anti-freeze flooded tanks, ice windows. Also motion sensor, GNSS system, surface water sound speed sensor, XBT system | A | b |
| | Berthing and Hotel Services - Minimum 25-26, Goal 35 including Science Techs | Short - Long | Minimum - Maximum* | No | Appropriate for needs | A | a |
| Overboard Handling | Dynamic Positioning | Short | Existing | No | | A | c |
| | High Capacity (15-ton minimum, 30 ton preferred) Stern A-frame | Medium | Major | No | Deck strength, electrical and hydraulic. Removable low stern rails to permit overboarding. | A | c |
| | Installation of Modular Equipment (e.g., Winches, launch/recovery systems, compressors) | Medium | Minor | No | 2-foot on center tie down reinforced deck, appropriate high voltage/amperage power for equipment, high-volume seawater cooling | A | c |
| | Side or Portable Launch and Recovery System | Short | Major | Yes | Deck strength, electrical and hydraulic. Low or removable ship rails / bulwarks. | A | c |
| | Oceanographic Winches (Replacing existing winches) | Medium | Extensive | No | Electrical and hydraulic power, cable runs, sheaves and overboarding systems (crane, A-Frame), control system | A | c |
| Meteorological and Underway Observing | Flow through Uncontaminated Science Seawater System to which Instruments can be added | Short | Minor | No | Navigation, data infrastructure | A, B | d |
| | Platforms for Meteorological Sensors | Short | Minor | Yes | 10-m above mean water line at bow (ideally forward-tilting); climbable; ability to mount auxiliary equipment; access to power, freshwater source on bow to enable use of hose for cleaning, science network | A, C | e |
| Laboratory and Staging | Permanent Interior Lab Space | Short | Extensive | No | Flexible chemical/flammable resistant work surfaces, network connections, clean power, comms, network, fume hoods, UPS, compressed air, sinks, deionized water, hazmat lockers, space/power for freezers (-80 °C and -20 °C)/refrigerators/portable incubators | A | a |
| | Modular Specialized Laboratories | Short | Minor | Yes | 1-foot on center deck bolt pattern in lab spaces, power/water/HVAC/comms/on-deck plumbing that doesn't freeze for modular labs. | A | a |
| | Modular Specialized Science Equipment (e.g., Compressors) | Short | Minor | Yes | Tie down reinforced deck, appropriate high voltage/amperage power for equipment, high-volume seawater cooling | A | f |
| | Heated, Weather Protected Staging Area with Deck Access for other Science Equipment (e.g., AUV, ROV, Electronic equipment) | Short | Minor | Yes | Freshwater, drains, electricity, 2-foot on center deck bolt pattern, compressed air, wide door deck access | A | g |
| | Heated, Weather Protected Staging Area for CTD | Short | major | No | Freshwater, drains, electricity, 2-foot on center deck bolt pattern, compressed air, wide door deck access | A | h |
| | Scientific Cargo Hold | Short | Interior-Major; Portable - Minor | Yes | Tie down for portable solutions | A | a |
| Science Network and Data | Independent Science Network & Data Storage System | Short | Minor | No | Navigation, SATCOMS, UPS, airgapped unclassified network | A, D | a |
| | High Bandwidth Satellite Comms System, Internet, Telepresence | Short | Minor | Yes | Power, undisturbed field of view for science antennas, | A | a |
| | Access to Ice Radar (X-band) Data Feed (archived is OK) | Medium | Minor | NA | Navigation, networked data storage (see Healy system) | A, E | a, i |
| | Situational Awareness System (e.g., Shipwide GIS System, Ice Products, Bathymetry, Remote Sensing) Accessible to both Operators and Scientists | Short | Minor | Yes | Simultaneous access to data and imagery products for operators and scientists, including navigation data, science network connectivity and computer for bridge | A | a |
| | CCTV Systems to Monitor Decks, Winches, etc. | Short | Minor | Yes but not desirable | Networking and/or dedicated cable runs to relay data, power | A | j |

Table 1 - AMRCC Science Mission Capabilities Recommendations for USCGC *Storis*

* Scope depends on number of science berths

Key to National Security Needs

A: Enabling capability that is critical to all observations

B: Pollutants, contaminants, HABs, surface sound speed

C: Supports observations for situational awareness, critical to atmospheric/ice observing science capabilities, including those that could be directly assimilated into forecast models for sea ice prediction and weather, or improve those capabilities.

D: Critical to all listed science capabilities, feeds into forecast models including sea ice prediction and weather, enables participation of non-USCG personnel on deployments

E: Situational awareness, enables sea ice drift analysis

Key to Enabled Science

a. All science

b. Multibeam and sub-bottom bathymetry, water column velocity and bioacoustic measurements

c. Seafloor sampling, water column sampling, mooring and/or asset deployments/recoveries

d. Pollutants, contaminants, HABs, surface sound speed, nutrients, microbial composition

e. Atmospheric observations, weather and real-time state analysis, heat fluxes, air-sea exchange

f. Seismics, future large instrumentation

g. ROV/AUV/UAS based observations, large volume pumping, storage of equipment that cannot freeze

h. CTD measurements, water column sampling, other rosette-based instrumentation

i. Cruise track and sampling planning, sea ice observations